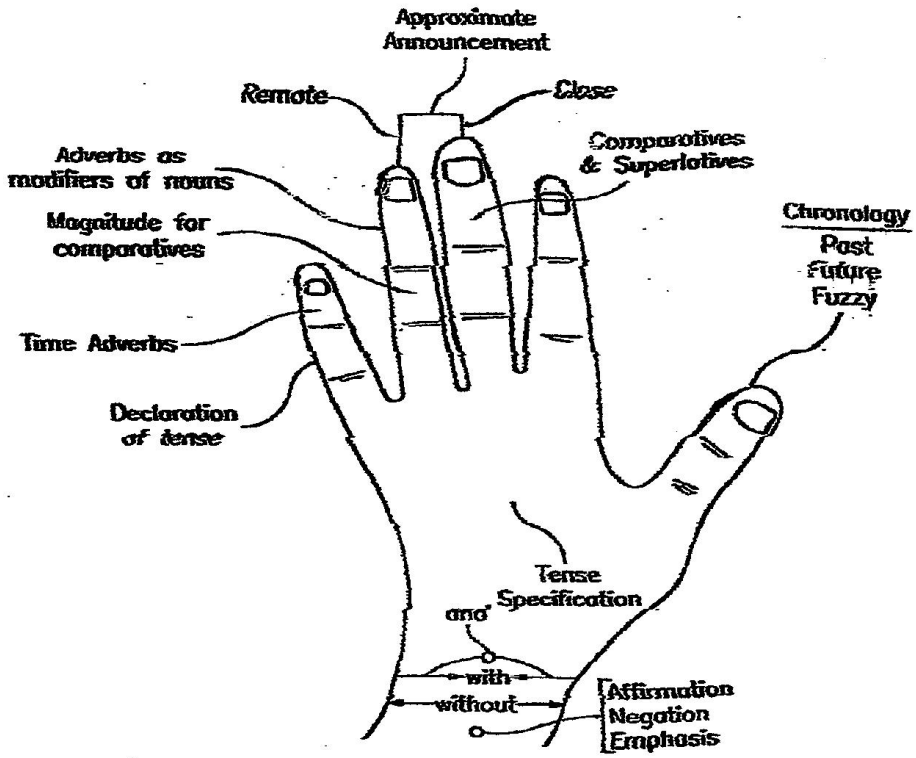
Sotto voce, "E pur si muove"
[Nevertheless it does move]
(Galileo Galilei 1564-1642)

"Do every day at least one good deed for others"
(My mother)

Touch Language

Communication and Descriptive Dynamic Scenes Transmitted By Touch



Raanan Liebermann

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Introduction

Deaf persons utilize Sign Language that enables them to communicate among themselves and with some auxiliaries also with hearing persons. Sign Language does not solve all perceivable audio situations. Deaf persons cannot hear thunder, the wind, sounds of streaming rivers, sounds of animals or sounds produced in our society like cars, trains, or music. There are partial solutions to enable deaf persons such perception of sound by either providing a description of it or by enabling perception through another sense of the five human senses (hearing, seeing, smell, touch, and taste). Such solutions involve for example light signals (sense of seeing) in alarms, vibrations (sense of feel/touch) for alerts, but above all, they see with their eyes and have an immediate unfettered access via a human sense to their environment as a compensating auxiliary element.

Deaf individuals are able to utilize their sense of seeing as the compensating auxiliary for perceived connectivity to their environment. Blind persons use the opposite for such connectivity. That is, their sense of hearing, which maintains perception of what happens in their environment. Thus, audio description of sights enables a substitution on some level for their lack of seeing. The blind can also augment, to a degree, their lack of seeing by partially utilizing the sense of touch as is done when reading Braille, letting their fingertips perceive the combination of raised dots that comprise appropriate letters. Other sensory utilizations have been introduced, such as the Tac-Tile sounds in the works of Russ Palmer, Paul Chamberlain and David Mitchell or holistic and interactive communication methods by Riitta Lahtinen.

Thus, we notice that a person with dysfunctional sense can compensate, to a degree, lack of a certain sense by enhanced use of another sense. In the case of blind persons we notice that another sense, the sense of touch, is partially used in reading Braille. The blind can also “feel” their way around by touching elements in their immediate environment, such as walls, doors, or door handles. The blind can also utilize a combination of a somewhat extended sense of touch combined with the sense of hearing when they utilize a cane to navigate.

However, persons who are both deaf and blind (deafblind) are in a different category of perception. The lack of two major senses, hearing and seeing, appears to leave at most only three other senses. The sense of touch, smell and taste. When the senses of taste and smell are intact, a deafblind person can enjoy almost to the fullest the satisfaction of food or a meal, and even to the fullest when garnishing is not a factor. The major contributor to such enjoyment being the sense of taste, augmented by the sense of smell, and finally the sense of touch provided not by the hands but rather by the inner parts of the mouth, namely tongue, palate and even teeth. However, utilization of these senses does not enable a deafblind person to perceive the environment at large and are suitable only for very limited auxiliaries. The invention of the eCane and its auxiliary devices (Liebermann 2003) enables the deafblind to communicate with others, locate desired places or objects and navigate to them if desired. The Security Emergency Vehicle Alert Companion (SEVAC) in one embodiment can enable deafblind to feel confident in the home environment so that they know if a break-in occurred in another room in the house, or the vibrating fire alarm with direction can alert them to fire occurring on another floor in a building.

However, all such auxiliary devices fall short in enabling the deafblind to enjoy other amenities in our society such as listening to a radio or enjoying a television show. Television perception for the deafblind is an invention (Liebermann 2008) that utilizes two other senses of the five known to us, the senses of smell and touch. There is no need to create any interface to the sense of smell, as even the deafblind utilize their sense of smell much the same as their seeing and hearing counterparts do. However, when it comes to the sense of touch, an additional tool is required in translating touch components of dynamically changing and even static scenes. Touch Language is therefore proposed as such a communication medium that could be useful for the blind and in particular for the deafblind. Furthermore, the proposed Touch Language has great utility for communication, allowing for the transmission and reception of pragmatics in an intuitive and condensed manner and thereby substituting the need for dependency on word articulation as is done in Braille.

Sign Language used by deaf, utilizes motions of the fingers, hands and arms. However, additional components are supplied through facial features and body language to relate such elements as magnitude, emphasis, or bewilderment that spoken language provides through intonations and changes in form of utterance. Taking our cue from Sign Language, we realize that such visual auxiliaries are inappropriate for deafblind persons. Specifically when a deafblind person may want to partake in a TV or video enjoyment or other amenities. Therefore, it is proposed to extend the analogy of additional visual communication components of Sign Language to provision of appropriate elements via touch. However, in contrast to Sign Language, the task in utilizing touch is much more difficult due to territorial confinement for signal delivery and due to its complexity. Touch parameters need to be defined under additional constraints relating to their descriptive modes, where no previous visual clues exist and where intuitive perception guides our consideration, rather than some accepted methodology. Though, sounding somewhat ambitious, and with the caution discussed below, we will refer to it as Touch Language.

Sign Language as utilized by deaf individuals, was developed and has been evolving in an intuitive form due to existing needs. As such it has a distinct anthropological aspect. An experiment that was done some years ago, grouped deaf children who did not know Sign Language and kept them isolated from hearing children or adults. Within a relatively short time, the deaf children developed their own form of communication that was basically a Sign Language of sorts. Interestingly enough it had many of the existing elements of currently practiced Sign Language.

The children in the experiment had a base from where to start. Namely, they had three basic (and minimal) conditions satisfied.

- They were free to devote time to develop their communication form, as their basic needs of food and shelter were taken care off.
- They were among like individuals (i.e., children) with the same basic lack of hearing abilities.
- They could see each other and thereby their motions for communication.

The deafblind on the other hand, have at least two of the above basic conditions missing. Thus, it is the responsibility of an advanced and humanistic society to close the gap of the two missing conditions, or provide a somewhat "artificial" mode of communication.

To a certain degree, such provision has been rendered through the teaching of palm fingerspelling and the exercise of such new skills in interpersonal communication. However, it still leaves a lot to be desired and falls short of a communication medium that could open up more access to our social amenities, as well as getting rid of the almost complete dependency on others for basic necessities and amenities taken for granted by persons who do not have such dysfunctional senses. Touch Language is advanced here as a step in that direction. The idea of touch as a language is not new (Enakoski, R., and Routsalo, P.). We build on the accepted base of such surmise and introduce below the needed component for Touch Language.

Persons who interface with autistic individuals know that deep pressure helps such individuals to be connected and specifically connected to the external world. Therefore, Touch Language needs to contain deep pressure elements that are as important to the autistic person as they are to the deafblind people. It is important when remembering that deafblind people are not privy to the audio and visual connectivity elements, to the external world. That goes both to personal connectivity as well as inanimate objects. Thus, Touch Language has built in elements of deep touch achieved via strong vibrations, pressure points and pecking sensation defined here as nibbles. The invocation of these elements is not artificial, such as being evoked every so often by a program routine, but rather is integrative. Namely, Touch Language is built on a basic corner stone that provide the deep touch connectivity throughout its usage without the need for their artificial introduction.

We provide an example of Touch Language to illustrate its utility. The components and elements used in the example will become apparent only later on, when they are properly introduced in the book. Thus, the example has no didactic value and is merely provided in the interest of acquainting the reader with the operative value of Touch Language. The example given below is that of an electronic TV or video presentation for deafblind persons based on Touch Language.

Example - The Electronic TV and Video for the Blind and Deafblind (eTV)

Functional equivalent of visuals on TV or video are made available for the blind and deafblind via an apparatus and method. The apparatus is a set of electromechanical gloves that translate the dynamic visual content on the TV or computer screen to [a set of] vibrations and impacts on the palm, fingers and back of the hands. The signals of the electromechanical gloves, perceived by the blind and deafblind, are built on scientifically proven basis of communicating such excitations to the brain. The signals and excitations are a subset of Touch Language, a powerful communication tool created for such and other communication purposes. Both subsets will be discussed later on in the book.

The palm of the dominant hand serves as a functional equivalent TV or computer screen onto which dynamic motions from the TV or computer screen are "projected", while simultaneously conveying through impacts and vibrations to other parts of the hands and fingers, essential information completing the perception of actions on the screen. The information imparted

through impacts and vibrations is done by pragmatics, where topics transmitted enable full comprehension of the following the actions on the screen.

Imparting fine grain detail is an integral part of the process and the transliterated functional equivalent visuals with their actions and content occur in an instant, all ripe with fine grain detail.

For example, the back of the four fingers of the dominant hand (i.e., without the thumb) represent people, the fingers' location bespeaks of gender, and impacts on selective parts of the fingers provide information about character and age brackets. Impact on the back of a finger identifies the action initiator, while impact on the face of it identifies the action subject or recipient. Thus, a scene whereby a nice old lady is chasing a young mischievous young boy would be transmitted as follows:

The back (denoting action taken or initiation) of fifth finger (nice lady) receives three impacts (denoting older age); the hand vibrates or receives impacts with the Morse code of the single verb "chase"; the face (denoting recipient or target of the action) of the second finger (denoting not nice male) receives a single impact (denoting young age), while a contour of the chase is drawn on the palm of the hand. It only takes about a second to perform and contains the complete story illustrated on the TV or any video screen. The written description is lengthy, the execution is instant and the comprehension is immediate.

At present time, the deafblind can communicate only by fingerspelling in the cup of the hand or read Braille (books or computer Braille readers). Thus, they live in total isolation of sensory excitation and severe deprivation of social contact. The electronic TV and video that is based on Touch Language, could enable them access to the media and facilitate for them the ability to partake in life events.

Touch Language has five components: Morse code, PalmScreen, impact nibbles, vibrations and the optional Braille dialogue segment. As will be seen later, we will strive to minimize the latter (Braille Dialogue Segment) and operate Touch Language devout of any Braille components.

The book is structured on an evolutional tract leading the reader through the building blocks of Touch Language, rather than the assumption of an already developed language with the didactical divisions to segments.

The decision to use Morse code rather than Braille was a result of an experiment conducted at Focus Groups, a division of Signtel, Inc. The company hired well over 100 deaf and hard of hearing employees, some of which were blind. They were all employed as assistant developers for the products developed in the company. They were divided into focus groups and analyzed and developed their responses to a variety of issues related to their culture and the products under development. In the experiment mentioned, they were first taught Braille and then Morse code. Subsequently, they were asked to produce their names, first in Braille and then in Morse. They were then asked, which of the two (Braille or Morse) was easier. Morse won hands down. Thus, the Morse code was adopted as the preferred form of communication.

Accepting Touch Language.
Innovations and new technologies have many times to overcome resistance to their acceptance. The public usually welcomes and embraces such innovations not realizing the effort and sometimes even uphill battles to bring the innovations from concept to market and usage. Acceptance at the various stages is crucial as it begets support and support begets action, resulting in the introduction of the innovation to the users. Thereupon comes the cycle of acceptance by users, whether immediate or delayed and leads to public demand for the successful products. The more innovative, groundbreaking or revolutionary the products are, the more resistance they could face. Touch Language may be in that category of innovations. To illustrate how resistance is overcome by tenacious innovators, we cite below excerpts from a commemoration address given by President George W. Bush in 2004, honoring the Wright Brothers who invented the airplane that lead to the commercial and passenger aviation industry.

In his address, President Bush told the audience that: The United States Patent Office "concluded the plans were inadequate and the machine could never function as intended".

"The New York Times once confidently explained, why all attempts at flight were doomed from the start."

"To build a flying machine', declared one editorial, 'would require the combined and continuous efforts of mathematicians and mechanicians from one million to ten million years.' As it turned out, the feat was performed eight weeks after the editorial was written."

President Bush continued to say: "There is something in the American character that always looks for a better way, and is unimpressed when others say it cannot be done. Those traits still define our nation. We still rely on men and women who overcome the odds and take the big chance -- with no advantage but their own ingenuity and the opportunities of a free country."

Another example relates to the author of Touch Language, who together with two engineers from Los Alamos Laboratory, Michael Wolf and John Crowley built in the early 1980s a laptop computer operating both DEC, as well as IBM operating systems. When they looked for venture capital money to market the laptop computer they were told "A laptop computer? Who in the world will ever need a laptop computer"!

The acceptance of Touch Language could encounter some type of resistance. It is a new and intricate concept, it is revolutionary and will require a learning curve like any new language. Teachers of Touch Language will encounter the arduous and repetitive tasks so common in teaching new languages, yet magnified several folds; but so did Mrs. Sullivan who taught Helen Keller, and the rest is history.

The potential cost of hindered acceptance of Touch Language, would not be measured by money lost, nor by time spent, but rather by the number of deafblind persons who could have used the Touch Language, as a tool and an aperture to the hearing and seeing amenities of life, available to the hearing and seeing community.

It is up to us, who care for the deafblind, to be courageous and dedicated, so that we could enable generations of deafblind persons to benefit from partaking in a more active communicative and

perceptive role and enjoyment of life amenities available to the hearing and seeing persons in our society. Touch Language makes it possible.

Touch Language Preliminaries

Sign Language is a visual language. To a degree, even regular textual language is visual, since readers perceive the complete word visually as part of the cognitive process. Furthermore, most of the languages practiced by hearing persons, are such that sound cues of the words become an integral part of cognition. Indeed, most of these languages are phonetic languages (Liebermann 2000). Thus, for most of us, we utilize both phonetics, as well as visual cues in exercising our reading skills as part of our total language skills.

Therefore, persons who can utilize their hearing and seeing senses, have complete basic communication instruments. Deaf persons substitute or augment the hearing sense with visual auxiliary by viewing Sign Language that is functionally equivalent to hearing spoken words. The end result is the cognition, irrespective of the route taken to achieve it. It is a well-known fact, that on the micro level of our anatomy, i.e., the nervous system, one can observe the same functional result irrespective of the route taken to achieve it. Namely, if we pinch a particular nerve in the body, or we apply acid to it, or we pass current through it, ultimately, the same result is observed. That is, a current is produced in the nerve. Therefore, taking the cue from the micro-level and exercising it at the macro level of language cognition, we contend that producing the same cognitive result, irrespective of the route taken is an appropriate step in evolution.

Blind person are deprived of the visual cues in reading text, but can substitute lack of visual sense by the sense of touch, yet maintaining the phonetic cues as part of the cognitive process. The situation is however quite different, when it comes to persons who are both blind and deaf. The question before us, is whether the sense of touch can operate on two separate levels, providing on one level, the reading comprehension utilizing Braille, and on the other level the substitution for the visual resulting from the sense of seeing. Basically, what we ask, is whether the sense of touch can double up in two separate forms, to enable both reading by touch (Braille) and visual substitution by touch. Namely, can our sense of touch be effectively utilized to provide visual cognition in a route that is functionally equivalent to visual perception? It should be stressed, that we do not discuss an alternative route to the impact of a picture on the human retina, but rather a functional equivalent process rendering a similar but not congruent cognitive result.

We therefore propose, to utilize a body part, rich with sensory abilities close to the skin that can accomplish such a task. We already know, how fingertips are effective in their sense of touch when reading Braille, and that fingers are used for fingerspelling words in the cupped hand of deafblind persons, as a form of communication. Therefore, it would stand to reason to utilize similar body parts for purpose of communication, both because of their utility as well as familiarity. Thus, the entire length of fingers without the tips involved in reading Braille, is one possibility; the other is the palm of the hand, or combination of both. The more difficult task is the question of what information to provide such chosen receptors. How to transliterate visuals to such information, and finally how to organize it in a cohesive manner into a utility that is

universally taught and exercised in cognitive perception. The proposed Touch Language is our attempt to achieve that goal.

It should be mentioned from the outset, that if it is to be a real Universal language that includes syntax and grammar, then we have a serious task of overcoming the idiosyncrasies of each individual cultural language. Sign Language is called a language and indeed it has its own functionally equivalent syntax and grammar, as is the case in American Sign Language, or ASL. However, that very aspect hinders it from becoming a real universal language. Nonetheless, independent usage of signs, having selected universal meanings, enable a modicum of communication among persons from foreign places (Liebermann 2002) that greatly surpasses the ability of hearing persons to communicate in a language unknown to them, if possible at all. Therefore, we will tread with caution, will boldly assume the name of Touch Language, willing to discard it as a language, and thereby reduce its status, if universality has to be compromised. However, as will be realized later on, the careful choice of parameters will enable us to relax our caution and accept it as a bone fide language, while maintaining its universality under the proposed construct.

Different embodiments utilize different body areas that become the object of perceiving the signals of Touch Language. For example, Scott Stoffel of the engineering department at Temple University, designed a “Palm Braille” that converts computer generated text to Braille that can be read by putting the device against a body part that has sensitivity. Liebermann, in his eCane invention proposed the palm of the hand discussed above and we will maintain that proposal in our current discussion. It should however be kept in mind that some persons have “ticklish” Palms, in which case the back of the hand could be a suitable candidate, though it may require to delegate certain signals to another area. As we will soon discover, Touch Language could reach a higher level of communicative achievement by encompassing more than a single palm or back of hand area.

Type of Information Provided

From the outset, there are two categories of information, since the abstract material is presumed shared more or less equivalently between the deafblind and those who are not. The first category is the static category, such as a still picture impressed on our retina as a picture of a person, house, tree, animal, or object. The second category is the dynamic, pertaining to moving objects, gradual changing status of objects, such as a car moving away or a metamorphosis of a visual item and the abruptly changing status of an object, such as in an explosion.

The translation of the information is through mechanical delivery of sensation to the palm of the hand. Such mechanical delivery, is either by mechanical impression on parts of the palm, through vibrations or pecking of mechanical parts or other means. Such translation could also be achieved by passage of small and safe currents producing a tickling effect on the palm in line with the specific visual equivalent message delivered. The scientific background and mode selection for excitations have been discussed in detail in another manuscript (Liebermann 2000). Central to the touch delivery are the descriptive elements that form the language. We divide the delivery into two segments:

- **The Verbal Component Segment**.
  This segment has dual functions. It provides the verbal components of a show, such as when it pertains to a TV or video broadcast. The second function is a short (i.e., Laconic) description provided in either Morse or Braille that we call "Key Words". Such description, albeit its name, does not necessarily have to be made of single words. Such "Key Words", are either captured by the fingertips of the hand not involved in Palm reception, by the palm itself, or by fingers that are part of the palm reception. Vibration is a viable mode for delivery as well. While the vibrations can be delivered to the designated fingertip, doubling up on the palm utility ought to be considered as well. Namely, The contraption (i.e., electronic gloves) being in contact with the palm could vibrate as a whole to deliver the Key Words in Morse, while various segments of the contraption deliver the mechanical sensations of dynamic attributes to the palm. For example, if the visual is that of a car driving in a particular direction and in a particular speed, the description is only the word "car" delivered in this example as Morse code by vibrations of the whole contraption, where all the rest is relegated to the palm reception, we describe in the section below, such as a sense of a path articulated on the palm. Obviously, there is a method to distinguish between the two segments, making it apparent to which it pertains. In one embodiment, it is the palm receptor that alerts the user to the fact that the word provided is related to the description provided at the palm by a unique mechanical signal dedicated for that purpose only. Such a signal is not needed if the whole contraption vibrates in Morse code as we have discussed.

- **The Dynamic Segment.**
  This segment pertains to the Palm reception of the visuals parameters not provided by the above segment. This segment is where the impact of the language is executed. Referring to the above example with the car, this segment will inform the user about the direction in which the car moves, its speed, directional and speed changes, halting, being involved in accident, rolling over, fire starting or exploding.

We proceed next with the elements and parameters of Touch Language, their definitions, meanings, and utilization. We will revisit the Key Words again later on, when the notion is examined under additional development possibilities.

Touch Language Parameters

We will provide here elements for static description, as well as dynamic parameters, as related to the mechanical transliteration of their meanings. The attributes for the mechanical messages will follow. It should be noted, that there are intended to be various sized of Palm Impression for Touch Language deliveries. The sizes befitting the electronic gloves as the conduit, correspond from rather small palm size, such as in the case of children, to very large sizes corresponding to large Palms of adults.

Approach Philosophy

It is imperative that we avoid the trap of building a language that is populated by abstract symbols, assigning meaning to such symbols and grouping them under the title of language. Rather, our philosophy is to create symbols that imitate functional life situations that will be intuitive to the deafblind. For example, when a deafblind person opens a door he or she does not see the widening angle between the door and the frame, neither is the unfolding view beyond the opening door that we all take for granted, when going through the act. However, the curved motion required in opening a door is felt by the deafblind and with lack of other external excitants, it does register and leaves an impression in the brain. As another example, consider the expansion of dough made with yeast and left to rise, or the expansion of concentric rings or circles in the water, as the waves expand when a stone is dropped into the water. The deafblind cannot see such expansions but can experience the mechanical expansion of a ring inside the palm of the hand delivering the functional equivalence of the visual through the element of dynamic motion of touch sensation. Therefore, the symbol for opening a door will imitate its rotational move, done on the palm of the hand. Furthermore, our philosophy calls for minimizing the total amount of symbols utilized in the language, in order to enable both the rapid learning of it, and more importantly, enhancing the ability for instant recalling of meaning, by contributing to a fluent sensation interpretation by the brain receiving the signals, and thereby rendering it intuitive. The elaborate setting of parameters and their utilization for the attributes should not be mistaken for the final result of the group of mechanical deliveries.

Descriptive Groups

The multitude of parameters needed to accomplish the task may be problematic. The reason lies in the fact that we aim at visual descriptive elements, which do not uniformly conform to alphabetic order by words, sentences, or subjects. Therefore, we take the group approach, where each group contains common building blocks, required to deliver functionally equivalent elements needed to perceive images, such as a static or dynamic scene in real life or on the TV screen or video screen. We establish below the groups and indicate their components. We follow by articulating the needed components and build up the specific elements in each.

THE GROUPS

- **Parameters Group**
    - Static Parameters
    - Dynamic Parameters
    - Attribute Parameters

- **Cross Parameters Group**
    - Relations
    - Activities
    - Characters

- **Protagonists Group**
    - Father/Mother/Grandparents
    - Brother/sister/cousin
    - Boyfriend/Girlfriend
    - Enemy/hater
    - Lover
    - Teacher
    - Employer/Boss
    - Secretary/Receptionist
    - Soldier/commander/Senior Commander
    - Cook/Stewardess/Restaurant owner
    - Policeman/Policewoman/Chief
    - Hardhat employee

- **Process/Operation Group**
    - Start
    - End
    - Commercial
    - Emergency Broadcasting Interruption
    - Reception Problem

- **Lighting Condition Group**
    - Light
    - Dark
    - Flashlight
    - Car lights (Front/Back)
    - Light projectors
    - Lightening is electrical storm
    - fireworks - pyrotechnic display
    - Rockets

- **Descriptive Background and Ambient Group**
    - Trees
    - Traffic on highway
    - A TV or video preparation studio
    - Home (Kitchen/bedrooms/living room/backyard/pool)
    - People dancing
    - Persons dressed
    - Group of people standing/sitting
- **Classes**
    - Gender
    - Appearance
    - Good/Bad
    - Profession(al)
    - Age Group
    - Height

Group Delivery Receptors
We encountered before the PalmScreen and the option of the vibrating Palm cradle or Palm pecking cradle as receptors in a particular embodiment. Other possible embodiments, though not all, are discussed in Appendix E. Some group components would find their delivery to these receptors rather natural, but the multitude of groups and components require additional receptors. Our task then, is to facilitate the process of delivery and reception rather than make it more cumbersome. The solution provided for the embodiment discussed, utilizes the Palm, the back of the hand, the back, face and sides of the fingers, with the topography adhering to rules we provide below.

Static elements
Static elements are defined based on surface elements of small flat units that can be grouped together producing a larger surface element with either the same or different shape (Shape). Shapes do not necessarily need to be constructed from adjacent elements, thus non-contiguous elements can produce different Shapes at any given moment. Provided are the locations of elements, as well as the rules for grouping them into different and larger shapes.

The basic "atomic" mechanical part is the "element". The shape of elements may depend on their embodiment. We will use here an element that is composed of two sub-elements, i.e., the square. The square itself can be described as two identical triangles connected at their respective hypotenuse.

***Definitions*:**

<u>Screen Coordinates</u>

Preliminary Definitions

Up: The upper part of the PalmScreen that correspond to the area of the palm that meets the base of the four fingers.

North: Same as "UP"

Down: The lower part of the Palm that meets the wrist.

South: Same as "Down"

Right: The right hand side of the Palm when it is placed face down, irrespective if the person uses the right hand Palm or left hand Palm. When using the left Palm, "Right" will be the side of the Palm that is next to the thumb.

East: Same as "Right"

Left: The left hand side of the Palm when it is placed face down, irrespective if the person uses the right hand Palm or left hand Palm. When using the right hand Palm, "Left" will be the side of the Palm that is next to the thumb.

West: Same as "Left".

Vertical: Straight direction from South to North.

Horizontal: Straight direction from West to East.

South West: The midpoint area between South and West.

South East: The midpoint area between South and East

North West: The midpoint area between North and West

North East: The midpoint area between North and East

Operational Impact Definitions

Palm Screen: Utilizing the palm of the hand as the functionally equivalent TV screen or video screen for signal (touch) reception. We will refer to it as the Palm Screen.

Nibble: Impact by a mechanical instrument that may be a solid cylindrical rod (needlelike or thicker), with diameter that may be of about 1/16 or 1/8 of an inch. The impacts are on the back of the hand, face of the hand, or, back or side of fingers. The mechanical instrument can impact once or multiple times, slowly or rapidly with high frequency or increasing / diminishing frequency. The Nibble also doubles up in definition as the impact sensation on the human body.

[Note that the cylindrical rod could be a rectangle with a square area or any other geometric form, and the diameter dimension provided above and below are only for illustration purposes and could be of different dimensions altogether.]

Tactilon: Impact by a cylindrical rod with a diameter that may be about 1.5 mm or 2 mm on a sensor utilized as a body Screen, such as the Palm Screen. It can impact once or multiple times, slowly or rapidly with high frequency or increasing or diminishing frequency.

Circle: (Reserved)

Horizonton: A line sensed on the PalmScreen going from East to West or West to East. The Horizonton may be sensed, by impacting its two end points defining its path (Liebermann, 2003). The defining impact could either be simultaneous or by one impact following the other, depending on whether the line is declared or drawn.

Horizontilon: (or Horizontilin): Quarter length Horizonton

Verticon: A line sensed on the PalmScreen, going from South to North or North to South. The impact rules are similar to the Horizonton impact rules.

End Point: The last point reached in a single pass of a path description on the Palm. (This is also a parameter).

Static Parameters

We provide below a few examples of Static Parameters.

Element: The basic (atomic) part. A mechanical device that may be round or square and can protrude or retreat on timing instructions. The basic part can also vibrate on a timing command.

Shape: Any combination of two or more elements, not necessarily adjacent or contiguous.

Motion Shape: A Shape that gives the impression of movement due to its element components creating single or successive impacts at the direction of the evolving shape.

Impact: Contact made with a target, such as the palm, by an element.

Vibrating element: An element induced to cause a sense of vibration at a particular frequency, that may be in a particular direction for a given period of time.

Additional Static Parameters are included in Appendix A

Forming Shapes

It is rather simple to describe verbally a shape, such as a circle, straight line or a curved line. However, in order for Touch Language to be of real utility, rules for definition and formation of shapes are needed so that it can be readily available for translation into automation. We select below a format, as a basis for such rules. The format addresses shapes as based on a conglomeration of points in a coordinate system.

The shapes of objects sensed by a body part, such as the palm may be composed of identical building blocks that are combined at a particular time and stay in cohesion for a specified duration. These “atomic” units will be referred to as Elements. The elements could take any form, as long as they are kept uniformly, during any definition of a shape. It should be mentioned that the definition of shapes means the definition of perceived shapes, i.e., virtual reality of a shape. For example, the shape of a straight diagonal line running from North-West to South-East may not be a real line that creates the impact but rather the two end points, one in the North-West and one in the South- Eahc that may create the sensation of such a line (Asamura 1998), (Liebermann 2000).

The mechanics of signal transmission belongs in an engineering manuscript rather than in our exposition of Touch Language, albeit its immediate relevance to it. However, base definitions that lay the foundation for such possible mechanics are useful and will be covered in an appendix. Thus, we provide a sample definition structure that could be utilized in the construct and delivery of sensations to the PalmScreen. This is by no means a necessary and sufficient definition construct and others may be appropriate or even more suitable. The reader is referred to Appendix K.

Dynamic Parameters

Dynamic elements are provided by attributing action to body parts, such as the palm throughout strength of impact, vibration, or perceived (virtual) movement of elements, whether in linear, curvature, rotational or other motions. Thus, dynamic elements provide for direction, size and speed, to name a few situations.

Moving Objects: Moving objects are transliterated into a Shape made of one or more elements that produce the feeling of movement in a particular direction. The perception is provided when successive shapes come into impact with the body part and then release the impact, whereupon the next shape causes an impact.

***Example*:** An element is perceived to move from left to right, when in reality impacts on the body part are produced by elements that do not otherwise move. Only successive individual elements create through the total sequential impacts, a sensation of motion in the specified direction. The reader is referred to Appendix K for further illustration.

Any person who is versed in the art (mathematics, physics) can write down the equations representing static or dynamic representations, such as from the sample list provided below.

Idiosyncrasies of TV Stations and Video Broadcasting

Various idiosyncrasies related to our watching a TV broadcast or video do not simply translate to functional equivalent "watching" on a PalmScreen. We encounter several situations that are either related to the technology utilized in TV and video or its performance, or relate to cultural elements of utilizing TV broadcasting and video presentation. We will encounter below such situations and provide the building blocks solutions needed for them in Touch Language.

Activity continued beyond the PalmScreen

Another aspect of the dynamic variable is best discussed in context of standard TV sets and video technology. The continuous changing images on the screen occur due to rapid change in still frames that is faster than human eyes can perceive. The standard rate of change is changing frames and running through 30 frames per second. In Touch Language we are confronted with the problem of representing continuous situations. An example is a moving car. Due to the rapid change of 30 frames per second, the car appears to our eyes as if it is moving in a particular direction. It presents no problem therefore, if the car continues to move in a particular direction for a while as the scenery and the path of the car continue to change from second to second, which appears natural to our eyes, due to rapid change of frames, i.e., 30 times per second.

When we describe motion in Touch Language, we utilize actual perception of motion on the PalmScreen or on any other body part chosen for that purpose. However, the traveling sensation caused by mechanical means has a limit, which is the territorial limit of the PalmScreen and unlike a TV screen or computer screen showing a video, we are unable to change the screen image from the outset. Therefore, a different solution is provided. Instead of changes in the PalmScreen, we mandate changes in the path of object creating mechanically the sensation. Thus, we will change the path of the object itself as many times as needed. For example, we consider a motion, such as a car, traveling from South to North on the PalmScreen. When the mechanical object reaches the North of the PalmScreen, it reverts to it initial South position on the PalmScreen to continue, which practically means repeat its movement toward the North. An indicator is needed for the deafblind person, so that the repeated movement will be considered a continuation. Such an indicator is a dynamic parameter providing the needed signal at the point when the mechanical object reverts to its initial position to create the “illusion” of continuance. There are various possibilities for such a signal. It could be a vibration at the end of the motion before it is repeated, it can be a simultaneous impact at the last and new location of repetition, returning from the End point in the PalmScreen in a straight (but Snakelike) line to the South of the PalmScreen for repositioning a repetition, multiple short impacts at the "End" point, just before repositioning, etc. We select the latter one as the signal.

Screen Change Variable

There are other dynamic parameters that relate to the functional equivalent TV or video screen. For example, the rate of 30 frames per second is a fixed rate. If we consider the PalmScreen for example, the rate of functional equivalence of a PalmScreen rate of change is variable and not fixed, as in the case of a video broadcast. The reason for being variable lies in the fact that providing a functional equivalent description of motion on the PalmScreen depends on the speed and duration of the motion. Namely, the longer or faster the motion is, the sooner one will outrun the geographical territory of the PalmScreen, since the territory is constant to the particular user.

That is, if V = Speed,
T = Time (duration of the motion)
L = Length (of the territory length of PalmScreen)

Then: we have the familiar formula of $V * T = L$; while $L = Const.$

Therefore, we define a Screen Change Variable as an appropriate dynamic variable for such purpose. Note, that the definition is for a “Screen” Change Variable and not for a “PalmScreen” change Variable. The reason is, that other body parts can be used instead of the palm, such as the back of the arm, the thigh, etc., such as in the case where a disability prevents the usage of the palm.

Thus, if: S = Screen Change Variable

Then: $S = V*T/L$; where S is a dimensionless number.

Thus the S number provides the number of functional equivalent static frames per second, namely, the number of times we need to activate repositioning of the mechanical signal for repetition. Thus, S = 1 means a single repetition, while S = 4 means four repetitions.

Beginning and Ending of Commercials

It is an acceptable, though not always welcome fact that there are commercial breaks in most TV broadcasting or initial commercials as prelude to a video presentation, such as on You Tube. The deafblind user of the PalmScreen needs to know when a commercial begins and when it ends. It is needed, since vision that immediately tells any other viewer such differential boundaries from the show being watched, is not available to the deafblind. Relegating such task to “verbal” information delivered via the Morse vibrations of the contraption is not effective and can cause confusion. Thus, a suitable alerting signal needs to be produced at the PalmScreen. We selected a large letter “C” (for “commercial”) impacted multiple times (we chose 3 times) in rapid succession on the PalmScreen, to signify the beginning of a commercial. By “large letter C’, we mean the impression of the letter C that is almost as large as the size of the PalmScreen. Likewise we select the same large letter “C” for the end of the commercial, except that here, a Top Right Oblique Line immediately follows the letter “C”. The three impacts we chose, turn now to be six rapid impacts of the letter “C” followed by the Top Right Oblique Line, etc. An alternative commercial ending signal (not selected here) is the mirror image of the letter “C”, rapidly imprinted on the PalmScreen. Usage of the shape reminding the English speaking person of the letter "C", could be retained for other languages as well, since it is basically only a signal and not necessarily tied in to its resemblance to a word in a language.

Multiple Information on TV Screen

TV stations that are dedicated as “News Channels”, such as CNN, MSNBC, or Fox News, provide at the bottom of the screen one or two additional segments of information delivered as text. One of the two can appear as a continuous running strip of information. This represents a requirement choice between the upper TV screen and the indicia written material at the bottom of it. The selection process is challenging when we compare it to the hearing and seeing TV viewers. The reason is that seeing and hearing persons scan the TV screen visually while listening to the verbal exposition provided by the TV. The deafblind are deprived of such scanning procedure and if they are to benefit from a functionally equivalent TV watching, the challenge of rapid assessment of both upper and bottom screen is significant. The deafblind are

not able to utilize the hearing sense to listen to what happens on the upper side of the screen while utilizing their seeing sense to read the information strip at the bottom of the screen. Furthermore, the rapidity required in the process contraindicates utility for the deafblind. Finally, the running strip of printed news at the bottom of the screen is stopped during TV commercials. The latter is not as challenging since Touch Language provides announcements of start and finish of commercials. The former can benefit from the fact that running news strips at the bottom of the TV screen, repeat the same content once the strip reached its end. Such information can be stored in the memory of the contraption used by the deafblind partaking in such a TV broadcast. Since the strip content is finite and limited in its volume, it can be made available to the deafblind who do not need to perceive it simultaneously with the exposition on the rest of the screen. This presents an edge over the hearing and seeing persons. Nonetheless, the deafblind can choose to retrieve such information during commercial periods, if they so desire, since they perceive the signaling for the start and end of commercials, provided independently on their PalmScreen by touch.

Foreign Language Translated at Bottom of Screen

Translated foreign language appearing at the bottom of the screen is essential for hearing TV viewers that are not bilingual. Such viewers hear the foreign language that adds "color" to the scene on the screen, while the translation at the bottom enables them to follow the verbal expressions and understand the content. It is immaterial for the deafblind person what language is spoken. Their viewer participation is mostly by touch sensations, while either Key Words or discussion content is relegated to the Morse code perceived through vibrations and pecking (i.e. the nibbles we defined earlier), or Braille that is otherwise provided. Therefore, the only transliterated material reaching the deafblind observing a TV broadcast, is their skin receptors, being exposed to the translated verbal content provided at the bottom of the TV screen.

Background Music Creating Suspense

It is common in watching a suspense movie on TV, to encounter segments that have no words, dialogue or written material, where all that is presented to the viewer appears in some screen activity with a background sound or music. The acoustic is composed and utilized for the creation of a sense of suspense in the viewer. Since the deafblind cannot hear the sounds or music, we need to find a functionally equivalent signal that can achieve a similar effect for the deafblind.

The solution provided is through rapid impacts to the PalmScreen by a small mechanical object. Namely, "up and down impacts", that is short and long sets of impacts to the Palm, either in a particular series, random, or "composed" in a particular manner. Such impacts are delivered to a designated area, such as the PalmScreen or another equivalent "screen" chosen on the body. Further, we have the complex task of enabling the deafblind recipient to be in simultaneous receipt of such signal, while not interfering with the simultaneous proper transliteration of the depicted scene on the screen, i.e., the PalmScreen of the deafblind participant. Finally, we need to consider the specific location on the PalmScreen to where the series of impacts related to any activity are delivered. Whether it is always constant to the same location on the PalmScreen, or varies according to situations. We choose the variable location, and develop below the approach for the related functional equivalent sound effects.

Station ID Number
A station ID number can appear on an upper side of the screen and enables the viewer to know what station is being watched. The number is either constantly up on the screen or can be activated to be there. The deafblind who utilizes a PalmScreen would benefit from keeping to a minimum the amount of information transmitted to the PalmScreen. It is not of particular difficulty to provide the deafblind "viewer" with a station ID number on demand. The more difficult question arises as to how to create within the constraints of minimized output to the PalmScreen, a truly functional equivalent constant listing of a station number on the TV screen. We conclude that such permanent information will be too distracting, due to the fact that its delivery by touch sense has to be by discrete repetitive motions. Thus, station ID number is provided only upon request.

Time Display
Time display is important, for example, in order to judge the time duration to end of the show. The same reasons discussed regarding a Station ID Number prevail here as well. Thus, time display is also provided only upon demand.

Problems in Broadcast reception
When a hearing person encounters problems in TV reception it is recognized as such, even if there are a few seconds of delay due to momentary confusion. Since the hearing person perceives both audio and visual signals, one has the sensory tools for immediate perception of the occurrence. The situation is different in the case of deafblind persons who attend to a TV broadcast. A supplemental signal is required, except that it needs to be preceded by recognizing that a problem exists in reception. The selected signal or code is utilization of the Morse code segment of the PalmScreen, together with coded signaling of the problem as is provided below.

> ***Dark Screen Due to Problem in TV Reception***
> The PalmScreen abruptly stops operating in its standard mode. Instead, the Palm starts a series of long vibrations (5 or more seconds) with short (2 seconds) interruption of a stationary palm without any vibrations.
> ***"Snow" Screen Due to Problem in TV Reception***
> It is immaterial for the deafblind if the TV screen is dark or shows "snow" effect. Therefore, the same signal serves to indicate either one of the disruptive situations, dark screen or "snow" on the screen.
>
> ***Interruption by the Emergency Broadcasting Service***
> As much as the disturbing effect on viewing could be aggravating, when interrupted by testing the Emergency Broadcasting Service during a show, we know what it is and we know it will end shortly. It would be a lot more confusing and irksome to a deafblind individual "watching" a show, and utilizing a PalmScreen. The solution selected relies on the fact that during any such testing, a hearing viewer cannot enjoy the show. Therefore, there is no need to provide the deafblind with more than the hearing is provided with. Thus, our solution is limited to recognize that a test is in progress and notify the deafblind when the test starts and when it ends. The recognition part will be relegated to the Emergency Broadcasting Service that will have to issue a special signal recognizable by

the contraption and delivered simultaneously with its signal to the TV station. Under the American with Disabilities Act of 1990 and the Telecommunications Act of 1996 it is expected (in the US) that such signals should be provided. Thus, the signal selected and proposed here, is cessation of visual impacts on the PalmScreen for the purpose of testing, substituted by multiple impacts of a large letter “T” (for “Test”) on the PalmScreen to mark the beginning of the test, while the vibrating / pecking Morse segments provides the text appearing on the screen, which is part of the special signal for the deafblind sent by the testing agency. (Note the signal for the meaning of “large” in the discussion of Commercials). The end of the test is marked by the large letter “T” followed immediately by a “Top Right Oblique line, and the sequence repeats its impact multiple times on the PalmScreen. Such letters as “C” or “T” provided as auxiliary could be any other letters chosen in other countries so that they are commensurate with their language and /or culture. However, in line with the interest of maintaining the universal aspect of Touch Language, the same reasoning we provided for the keeping of the signal "C" is maintained here for keeping the symbol "T" for universal use of testing.

Understanding the TV Guide Channel on Screen

The TV Guide observable on the TV screen provides may appear in different forms. It could provide a continuation of the presented airing at the time, or a commercial at one part of the screen, whereas the information related to the shows is provided in a dynamically changing or fixed list that either rolls up / down, or is stationary on the TV screen. The problem before us, requires first limiting the exposure of the PalmScreen only to that part of the screen providing the requested information of the TV Guide channel. The commercial information related to other TV presentations, given other part of the screen is designed to capture the hearing and seeing audience. Such audience is capable of multiple simultaneous perceptions, whereas for the deafblind this presents an unrequited overload of information, unrelated to the specific need at hand. The solution is provided below, subsequent to the discussion of the second task. The reason for the delay will become apparent momentarily.

The second task requires the ability to capture the information and delivering it to the PalmScreen. The initial problem rests in the rapid change of the information, if it is not stationary, as it does not allow realistically to follow it, capture it, and deliver it before a line of information related to a channel disappears from the TV screen. Furthermore, such information on the screen, though visual, depends on our reading ability that goes beyond visual perception. The task to provide the channel information to deafblind “viewers” is simplified due to the fact that any hearing person watching TV cannot use the TV Guide channel simultaneously with another channel and the same stands for the deafblind. Thus, we relegate that portion of the TV Guide channel to vibrating/pecking Morse delivery segment of the apparatus, or more efficiently to the Dialogue portion of Touch Language.

Furthermore, due to the latter fact, the commercial part of the TV Guide channel becomes irrelevant to our solution. The reason lies in the fact that providing functional equivalent information about the channels can be prepared and delivered irrespective of synchronizing it with the visual part of the TV screen.

The Remote Control

Utilizing a remote control to maneuver among stations, to increase or decrease volume, or to mute sound is quite useful to the hearing person. However, for the deafblind it would be essential to enable switching stations, yet pose a challenge. It is essential because the hearing can go up or down the channels, with a blink of the eye, discern whether the desired station has been located and then rest the search. It would be much more cumbersome for the deafblind. Therefore, a remote control unit having keys with elevated station numbers in Braille would be quite useful. However, it leaves a major challenge to enable the deafblind to perceive without delay the station attained and the material presented on the screen.

Remote control functions for the deafblind can be divided into three groups.

- Functional equivalent operations of <u>standard</u> remote controls for the hearing
  (Group S)

  - Turning the TV on or off
  - Time display
  - Station ID display
  - Browsing up and down the channels

- Standard remote control functions that are <u>irrelevant</u> for deafblind users
  (Group 0)

  - Increase or decrease sound volume
  - (apparent) Mute function
  - Fast Forwarding

- Functions <u>relevant</u> only to deafblind users utilizing a functional equivalent <u>remote control</u>
  (Group R)

  - Repeat function
  - Bookmark stations
  - Switching between bookmarked stations

The (apparent) Mute Fiction signals temporary halt function to the Key Words transmitted to the electric gloves.

The operations are handled by various cutaneous stimulations that are discussed below under the appropriate receptor, such as Palm, back of fingers and face of fingers.

Definitions

<u>Dynamic Parameters</u>

We provide below some examples of Basic Dynamic Parameters.

Basic Dynamic Parameters

End Point: The last point reached in a single pass of a path description on the Palm.

Screen Change Variable: The Screen Change Variable is (tbd)

Suspense "music": A series of short and long impacts or vibrations on a body designated area, designed to create a sense of suspense in the deafblind "viewer" of a TV show.

Beginning of a Commercial: The letter "C" almost as large as the size of the PalmScreen impacts three times in rapid succession on the PalmScreen.

Ending of a Commercial: The letter "C" almost as large as the size of the PalmScreen followed by a Top Right Oblique Line. The process on the PalmScreen repeats three times in succession.

Test of the Emergency Broadcasting Service: The letter "T" almost as large as the size of the PalmScreen impacts three times in rapid succession on the PalmScreen.

Ending Test of the Emergency Broadcasting Service: The letter "T" almost as large as the size of the PalmScreen followed by a Top Right Oblique Line impact on the PalmScreen. The process on the PalmScreen repeats three times in succession.

Expansion (related via an expanding Ring**):** Impacts of succession of circular rings on the palm, starting from a small Ring and expanding to become larger Rings impacting in succession..

Contraction (related via a contracting Ring**)::** A large Ring collapsing to become a small Ring. Process is opposite to the expanding rings.

Circling Ring: A Ring that rotates like a wheel around its center.

Additional Basic Dynamic Parameters are included in Appendix B.

<u>Combinatory Dynamic Parameters</u>

We provide below some examples of Combinatory Dynamic Parameters.

Crossed Oblique Lines: A Right Base Oblique Line crossed by a Left Base Oblique Line. The crossing is either by simultaneous action (i.e., imparting a large "X" sign on the PalmScreen) or impacts in succession to create the crossing perception.

Additional Combinatory Dynamic Parameters are provided in Appendix C.

Attributes for Mechanical Messages

With the tools of static elements and dynamic parameters defined, we are in the position to attribute them to actual descriptive components of visual scenes.

We will also take a cue from Sign Language, regarding multiple meaning words. That is, some particular signs used in Sign Language denote more than a single spoken language word, such as an English word. The words are related, but there are some fine-tune differences. For example, the same sign in Sign Language, represents both the words big, and large. This economizing in signs is quite prevalent in Sign Language. We will utilize such Sign Language word meanings for multiple meanings, however, we will extend it for other Touch Language elements. In Touch Language, words such as expansion and explosion will be represented with the same Touch Language descriptive. As will be seen below, Touch Language provides us with tools that are unique to its form. For example, explosion carries a stronger impact on the PalmScreen. The reverse is also true. In spoken language we encounter words that have multiple meanings. For example the word "Right" can represent "Right turn", or "To be right", or "This is my right". While it is intuitive for hearing persons to correlate the word with its correct meaning, this is not the case for persons using Sign Language. Thus, each of the above meanings has a different sign utilized in Sign Language. The deafblind are in a double jeopardy situation. Being deaf they cannot hear the multiple meaning word, and being blind they are unable to see, Sign Language (except feeling fingerspelling in their cupped palm) and therefore it is not meaningful for them. However, there is a third situation, which we will discuss below under the Cultural Aspects.

<u>Attributes of Touch Language</u>

We provide below a few examples of the Attributes of Touch Language.

Size (of objects): Strength of impact relates the size. The stronger the impact, the larger is the size. Adding vibration subsequent to the impact before retrieving of the shape means much enhanced size.

Expansion: A circular Shape of small radius that is replaced rapidly with concentric succession of other circular shapes, each of which has a larger radius than its former.

Explosion: Expansion procedure with an impact of the last circular Shape (with the largest radius) and added strong vibration provided at that point.

Implosion: A circular Shape of large radius that is replaced rapidly with succession of other concentric circular shapes, each of which is of a smaller radius than its former and an added weak vibration provided at that point.

Diminishing size with moving away: A dynamic Motion Shape with an imploding semi-circle behind it. It should be noted however, that such diminishing of size by distance is a visual concept that may not have relevance for the blind person.

Rolling Object (e.g. car): Motion Shape in a particular direction repeated a few times at the same location, where each time before repetition a circular Shape Motion appears next to it, and then at growing distance from it.

Opposite Approaching Objects (e.g. cars): (tbd)

Additional Attributes of Touch Language are included in Appendix D.

Group Delivery Receptors
We encountered before the PalmScreen and the option of the vibrating Palm as receptors in a particular embodiment. Some group components would find their delivery to these receptors rather natural, but the multitude of groups and components require additional receptors. Our task then, is to facilitate the process of delivery and reception rather than make it more cumbersome. The solution provided for this task utilizes the back of the hand and back of the fingers, with the topography adhering to rules we provide below.

Back of Fingers as Receptors
We first divide the four fingers (i.e., excluding the thumb) into two groups, A and B.

Groups that Represent Personal Character
- *Group-A*: The Pointer and Middle fingers (i.e., second and third fingers).
- *Group B*: The Ring finger and the Pinky finger (i.e., the fourth and fifth fingers).

    - *Group-A*: Represents bad, evil, or negative personalities, deeds, thoughts, etc.
    - *Group-B*: Represents good, pure, naïve or innocent personalities, deeds, thoughts, etc.

We further divide each of the Groups into two Sub-groups, where a Sub-group contains a single finger. Thus, Group A, as well as Group B, each has two Sub-groups that represent the Gender subgroups. The even number fingers represent males, while the odd number fingers represent females. Namely,

Sub-groups that Represent Gender
- Sub-group A(1): The second (Pointer) finger represents Male gender
- Sub-group A(2): The Middle finger represents Female gender
    - Sub-group B(1): The fourth finger represents Male gender
    - Sub-group B(2): The Fifth finger (Pinky) represents Female gender

Put another way:
- The Pointer finger in Group-A and the Ring finger in Group-B represent the male gender.
- The Second finger in Group-A and the Pinky in Group-B represents the Female gender.

The back-of-the-fingers receive their information by Nibbles, and Sticks, where the number of impacts carries specific information.

- ***Nibble Impacts***:
    - *The Gender finger:*
        - *Single Impact*: Young age
        - *Two Impacts*: Adult
        - *Three Impacts*: Older age

    - *The Personality (i.e., good or bad) finger*:
        - *Single Impact*: Slightly or undecided
        - *Two Impacts*: Moderate to medium
        - *Three Impacts*: Strong to extreme

There is no mistake in doubling up on age and personality as explained below.

As should be noticed, the gender fingers are recipients of information related to both age as well as personality character characterized by Nibbles impacting on them. The ability to distinguish clearly, which type of information is imparted by the Nibbles rests on the location of the impacts on the back of the fingers. Namely, there are two areas for Nibble impacts:

- Area (A) that is on the back of the finger and closer to the wrist [Group (A) Nibbles]. [The degree of the personality]
- Area (B) that is on the back of the finger and closer to the tip of the finger [Group (B) Nibbles]. [The age bracket].

The form in which the Nibbles from each group are utilized appears in the section that discusses the Rules of Association.

<u>Examples of Signal Delivery</u>

- Let us consider a visual on the TV screen, which shows a bad man chasing an innocent young girl. The delivery is as follows:
    - The PalmScreen vibrates (or is impacted) the word “Chase”.
    - The PalmScreen senses a path descriptive of the running young girl followed by the bad man.
    - The back of the Pinky (Group-B finger representing an innocent female) is impacted once (representing young) by a single “Nibble”. The result means an innocent young girl is chased along the path described.
    - The back of the Pointer finger (i.e. male) (Group-A finger representing bad or evil), impacted twice (i.e., an adult) by a single Nibble. The result means an evil adult man is chasing along the path described.

  We could have provided more refined details in the above example, by declaring the young female as moderately or extremely naive, as well as declaring the chasing male to be extremely evil, moderately evil, or even undecided as to what he has in mind - all relating to the locations of the impinging nibble.

  While the description appears lengthy on paper, for the deafblind who trained with Touch Language the process is quick, and with practice even intuitive.

However, such groups of receptors are still insufficient when we consider their multitude and therefore conclude that additional receptors are needed. Thus, we add the face of the fingers and the back of the hand as additional receptors, with the aim of providing additional information, while keeping to the minimum possible, the complexity of perceived touch sensation manageable for a deafblind person.

Face of Fingers as Receptors

The Face of the fingers does not act as a simple addition to the Back of the fingers by extending the number of fingers used. The face of the fingers role is different and thereby easier to utilize. Each one of the fingers utilized from the face of the fingers group is utilized to represent a Group associated with the information provided by the Back of the fingers and the Nibbles. In effect each of the fingers utilized in the face of the hand, provides a selection of a group that is further narrowed down to specifics, with information from the back of the hand and the back of the fingers. We will digress for a moment to specify the utility of the back of the hand before proceeding with the face of the fingers.

Utility of the Back of the Hand

The Back of the Hand is utilized to articulate specific definitions. By itself each of the elements described by the Back of the Hand has no meaning. The meaning comes into effect only when utilized with the fingers acting as sensors. Examples are provided below, after the introduction of the Face of the Pointer (i.e., second) finger, so that they will carry understandable meanings. The Specific utility of the Back of the Hand is achieved with Nibbles. Thus, the number of impacts produced by the Nibbles, articulates the definitions below.

Number Of Impacts	Meaning
1	OF
2	To
3	From
4	Profession / job
5	Disguise

Group Representation Utilizing Face of the Fingers

- **The Pointer (second) Finger:** *The People- persons Group*
- **The Middle (third) Finger:** *Light Dark and Shade Group*
- **The Ring (fourth) Finger:** *The descriptive Group*
- **The Pinky (fifth) Finger:** This (fifth) finger has four major utilities:
    - *Female representation*
    - *The Cross Relationship Group utility*
    - *TV channel query and selection*
    - *Multiple Meanings in Visual Human Signs*

Language Representation

It is a well-known fact that when software engineers create a program for the computer, they utilize a specific programming language. That language, such as Basic, C++, or Java is a set of rules with group of symbols understood by the programmers, utilized as a tool for ease of accomplishing the task and enabling the computer to follow the instructions. Likewise, we also need a descriptive representation that will enable the designers of TV shows and video presentations, transliteration to Touch Language. Namely, a recognized common format. It could also be useful in creating the Touch Language learning modules for the ultimate users, the deafblind. The descriptive representation needs also to reckon with the universality issue by introducing elements that are not associated with any particular language. For example, we will not include the letter "P" to represent the pointer finger, since the word "Pointer", or even its classification as such, is not universal and changes from one culture and language to another . However, using "2" for the finger is universal, as long as we also (universally) know that we represent the second finger rather than say the second word in a sequence. We will also depart from cultural names provided each finger and restrict ourselves to counting the five fingers sequentially, starting from the thumb, which will therefore be classified as finger number one. We also choose the capital letter "L" without any language or cultural meaning. Its selection is based on the fact that it will be easier to classify in our scheme what is the Face ("inner") part and what is the Back ("outer") part of the finger. Likewise, our choice in the case of the palm has the same reasoning. Our choice is the capital letter "G", that will enable unambiguous determination if the Back of the hand is meant or the Palm ("inner") part of the hand. With such reasoning we have selected a representation for Touch Language that is provided below. Further Touch Language representation appears in Appendix F.

>L: Back of Finger
L<: Face of Finger
>G: The Back of the Hand (or for closure it can also be represented as <>G)
G<: The Palm (inner part of the Hand), or G<>.

1>L: Back First Finger (the "thumb" in our representation)
2>L: Back Second ("Pointer") Finger
3>L: Back of Third ("Middle") Finger

L<1: Face of the First ("Thumb") Finger
L<2: Face of the Second ("Pointer") Finger
L<3: Face of the Third ("Middle") Finger

In all those cases we complete the signal into a close signal, so that for example, ">L" appears as "<>L" and include inside the brackets the finger number, such as "<3>L " or "L<2>".

Next, we need to include in the representation a proper Nibble manifestation, as well as specifying the number of impacts delivered to the selected body part. The Selected designator for the **Nibble** in the upper part of the finger is "^" followed by the number of impacts and closed with a right parenthesis. The designator for the nibble in the lower part of the finger is "v" followed by the number of impacts. To designate the middle part of a finger we utilize two horizontal parallel lines between the "^" and "v" signs.

Thus, for example, "<5>L^3)" means an older female person who is good, while "<2>L^2)" represents an adult male who is bad.

To combine Back of a finger with the face of a finger for a particular meaning, we use the addition symbol, plus, i.e., "+".

How it all Works

We noticed before, that the back of the fingers could signify good and evil, as well as gender. However, it can also articulate the gender to be a family member, as well as specifically naming the relationship of the particular person in the family, such as brothers, sisters, uncle who is the brother of the mother or father, a maternal or parental grandmother, etc.

To enable such more refined articulation, without overbearing the amount of information, time for perception and enabling it all to be almost instinctive, whereas it becomes functional equivalent to "seeing", we consider the following. A person seen on the TV screen or video presentation, enables those with functioning sense of sight to know who performs the act projected (i.e., felt) on the PalmScreen. We need to articulate a similar functional equivalent notion for the deafblind. To this end, we utilize the face of the fingers, and in that particular case the face of the second (pointer) finger. It should be remarked that the Nibble is not only used for the back of the fingers, but is also prevalent in its utility to the face of the fingers, as well as the back of the hand, as we will discuss shortly.

<u>The Face of the Second (Pointer) Finger with Nibbles (Peoples' Finger):</u>

The Face of the Pointer finger, as the rest of the Face fingers, works in conjunction with the Back of the fingers. The Face of the Pointer finger can symbolize a number of human identities, such as a family member, a banker, a teacher, a criminal and so on. Thus, the face of the pointer finger narrows our perception to the human entity. However, this is obviously not enough, and we need to narrow down the multitude of options to a specific articulation. We already know that the human entity in question can be painted as good or evil, as male or female and associate an age bracket with it, all based on how we utilize the back of the fingers. In order to specify that human entity into a recognizable identity in the myriad of human possibilities, we utilize the Nibble functions on the face of the Pointer finger. The following Nibble impacts identify the specific identities:

Number Of Impacts	Identity
1	Parents
2	Spouse
3	Child
4	Siblings
1..1	Relation Range (stranger to lover)
2..2	Step relation (e.g., stepmother, stepchild)
3..3	Relation-in-law (e.g., sister in law, father in law)

The number being repeated with two short vibrations in between the first and successive repetition of it, indicated another case of the identity. We chose that configuration as an easier form for understanding the meaning of the reception, rather than creating a lengthy series of nibbles.

Examples of Use

Let us examine through an example, how the back of the hand together with the face of the fingers enable us to perceive the specific images of family relations that appear as visuals on the TV or video presentation screen. Visuals of such relations are quite different from their written appearance in a book. For example, once we see a maternal grandmother on the TV screen, we retain the visual association from then on. It is sufficient for us to see that maternal grandmother in whatever activity performed, to know her association to her daughter, the mother of the children. In written description however, we compensate for the lack of visuals by either remembering her in the context of what is written, or she is referred to by her name, so that we can make the association. However, the controls of reading a book depend on the reader who can slow the reading to the pace needed for making the connections, going back and revisit the relative sentence or section, and so on. The situation is quite different in a TV show or video presentation. The exposure time of the visuals depend on the airing station and the show dynamics and unlike written books, names are not used with the visuals since it is superfluous. Hence, the need for the signals we have designed, which may look elaborate, but should prove to be simple in reality, let alone helpful and necessary for the deafblind to follow in the show. We present below some examples.

Father in Law: (father of the wife) -
Paternal Grandfather: (father of the father) -
Maternal Grandfather: (father of the mother) -
Paternal Grandmother: (mother of the father) -
Maternal Grandmother: (mother of the mother) -
Paternal Uncle: (brother of the father) -
Maternal Uncle: (brother of the mother) -
Paternal Aunt: (sister of the father) -
Maternal Aunt: (sister of the mother) -

Thus, “L<2>^2)” means face of the pointer finger with a double impact, i.e., two Nibbles, or in its meaning a spouse, and when combined (by using the + sign) with “<3>L^3)”, that stands for older good male, it represents together a good older husband. On the other hand, “<2>L^1)” means a bad very young husband, while “<3>L^1)” represents a bad very young wife and “<5>L.^3)” represents an older good wife. Therefore, in the complete combinatory representation, an older good wife (spouse + type of person with gender) is represented by “[L<2>^2) + <5>L^3)]” and means the “good older wife”.

Furthermore, when utilizing the Back of the Hand with a single Nibble to mean “OF” we can represent for example, a good maternal grandfather as:

“[<4>L^3) + L<1>L^3)]<>G^1)[< 2>L^1) + <5>L^1)]”, except however, that we can articulate even to a much finer degree, as we have just demonstrated, by representing a good older father of the good young mother. We note that the representations with character attributes are prejudicial,

however, this is also the case in visual TV or video, where actors are selected to “look” the part they represent, such as good, bad, educated, etc.

Note, that we have added the square brackets in order to signify the relationship between the face and the back finger as a unit in defining the object. Also, the user can forgo the face of the finger “fine grain” description and stay just with the back of the fingers to get the general idea of what is happening on the screen. Namely, if the user for example is not interested that it is the husband who is evil and chases the good mother in law, it is sufficient to follow just the back of the fingers to know that an evil male is chasing a good woman.

There are several more attributes in the human descriptive than what we have provided so far. To this end, we expand the use of the Face of the second (Pointer) finger, or in our new representation, L<2> to numerous other human appearances. Namely, we need to account for plumbers, policemen, judges, attorneys, teachers, drivers, etc. To enable us to do that, we direct Nibbles to impact at the upper (third) part of the face of the second (pointer) finger. We name such Nibble impacts “Upper Nibbles” or “Upper Impacts”. The number of such upper impacts determines the group of professionals, and the list of regular (lower impacts) determines the particular profession in that group. We should note that the professional description is always preceded by impacts on the back of the hand (four in our current representation), announcing that the next set of impacts will be related to the profession of the entity.

We designate the mark “^^^” for the upper Nibble impact, and the number following, the specific group. The “^^^” 0 has already been encountered, where we have not used the upper Nibble at all.

No. Of Upper Nibble Impacts	Profession Type
1	Law & Order / Criminal
2	Blue Collar
3	Education
4	Medical
5	Miscl. / white Collar.

The first group of upper Nibble impacts, “^^^1) with its related (lower) level Nibble impacts “^1)” to “^5)” is given below. (Alternatively, we utilize "^" for the upper nibble and "v" for the lower nibble. The complete list is provided in Appendix G.

Lower Nibble Impacts Related to a Single Upper Nibble

No. Of Lower Nibble Impacts	Profession
1	Detective
2	Policeman
3	Criminal (Robber, thief, etc.)
4	Defense attorney
5	Prosecutor
6	Judge
7	Bailiff

Example:
As an example, consider a criminal "[^^^1) + ^3)"]
Or, consider an adult policeman "[^^^1) + ^2)]".

Important Note: The personality and gender fingers are totally dissociated form the elements provided by the face of the fingers. That is, the face of the pointer finger articulates both males and females, both good and bad. The distinction is made by the back of the fingers that provide the personality, gender and age of the professional, described by the face of the pointer finger.

The Face of the Third (Middle) Finger with Nibbles (Lighting Finger):
The face of the Lighting finger provides information regarding lighting conditions in the ambient environment of the scenes as seen on the TV or video screen. A question that may arise in the minds of those who are not blind, as to the relevancy of lighting condition for a person that cannot see. While blind persons cannot see, they are aware at the very minimum of changes in strong lights. However, that is only incidental to their perception of a daylight scene versus a scene in a dark environment. They deserve to know the details of the scene on TV as it may be integral to the state imparted on the viewer, such as a person walking in the dark and being worried because of one reason or another. Thus, the following lighting states are presented.

No. Of Nibble Impacts	Meaning
1	Bright Daylight
2	Lightening
3	Summer Season
4	Dull Daylight
1..1	Darkness
2..2	Flashlight
3..3	Spot Light (e.g., from a helicopter)

Where the two dots preceding repetition of the Nibble have the same functional meaning as before.

We consider that the source of the lighting condition might have certain importance. Namely, artificial lighting of a designated area at night, turning a place dark by shutting off the lights, or other induced light conditions. A Touch Language parameter for such situation may be determined later.

The Face of the Fourth Finger with Nibbles (Description Finger):
The Face of the Fourth Finger is a rather busy finger, receiving both Upper and Lower Nibble impacts. Since we are already familiar with the notions and functions of Upper and Lower Nibble impacts, we will present below some essentials and relegate the rest of the material to Appendix G.

L<4>: Description

No. Of Upper Nibble Impacts	Description Type
1	Landscape
2	City
3	Buildings [hospitals, offices,
4	Transportation [airplanes, cars, trains, choppers
5	Activities [dancing, walking, running, jumping,
6	Fighting [boxing, karate,

Lower Nibble Impacts Related to a Single Upper Nibble

No. Of Lower Nibble Impacts	Description
1	Trees
2	Bushes
3	Desert
4	Mountains
5	Cliff
6	(Reserved)
7	(Reserved)
8	(Reserved)

For reasons that will shortly become apparent, we will first discuss the functions of the thumb and only subsequent to it, address the utility of the fifth finger.

The Thumb

The First Finger in Touch Language count, the thumb, has different functions than the other four fingers discussed above. The thumb is reserved for control and alerts functions. The control functions are such that any remote control may have, except that for a deafblind person we substitute functions that are not needed altogether, such as increase or decrease volume, or mute the sound. They are "substituted" for other important functions that are important for the deafblind. The most important of them all in perceiving a TV broadcast or video presentation, is the repeat function. It enables the deafblind to have an immediate repeat of the set of articulations so that the essence of the functional equivalent visual makes sense and enables to continue and perceive the TV show or video presentation. Thus, the thumb operates in a reversed Nibble impact. Namely, the impacts delivered by the thumb control the operation of the contraption (e.g., the electronic gloves). The thumb can also be utilized in conjunction with an eCane (Liebermann 2003), or other special devices of utility for the deafblind. In that regard, we discuss next the Control and Alert functions and their relevant Touch Language codes.

The control and alert functions are respectively, activity generated by the thumb and information delivered to the thumb. It is assumed that the deafblind person cannot speak at all. If the person can speak, then certain amenities provided by the list below are not required. Likewise, is the situation with a blind person who is able to hear.

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[*] Use of a finger as a remote control for computer operations was already introduced in the past by the author. c.f. Liebermann, R., "Telephone for the Deaf and Method of Using Same" (1999)

Thumb Control and Alert Function

- **Activity Generated by the Thumb**
    - Call for help Function **(Group A)**
        - Calling an emergency help number ("911" in the US)
        - "Help please" [to whoever is in the vicinity]
        - Calling the guide dog for immediate help
    - Specific Questions Function **(Group B)**
        - Where is the eCane?
        - Where is the guide dog?
        - Who is in the house (now)?
        - Who entered or exited the house just now?
        - Who entered or exited the room right now?
    - Summoning Functions **(Group C)**
        - Asking a person in the house to approach
        - Calling for the seeing guide dog to approach [such function utilizes an electronic auxiliary, containing a speaker and that is either built into the electronic gloves, or is positioned close by to the deafblind person and activated by a signal from the electronic gloves]
- **Information Delivered to the Thumb**
    - Safety Alerts **(Priority Group)**
        - Fire
        - Water rising in the house
        - There is an intruder in the house
    - General Alerts **(Group D)**
        - Someone is at the door
        - The phone / TTY is "ringing"
    - General Information **(Group E)**
        - Persons entering the house
        - Persons exiting the house

The Thumb as a Passive Receptor

The thumb is also a receptor for Nibble impacts much as the back of the fingers. However, whereas the back of the other fingers pertain to gender and character, the back of the thumb in

the passive mode pertains to items rather than persons, while the nibbles do give the measures as in the rest of the back of the fingers.

The control and alert functions need to avail themselves in a simple, unambiguous way and be easy for perception by the deafblind. Thus, the information is provided through the thumb and the cradle on which it rests, or the sleeve into which the thumb is inserted. We will refer to either the cradle or sleeve as the Thumb Cradle.

The Thumb Cradle

The thumb cradle is an auxiliary into which the thumb can either be inserted or placed on. It can move in at least two directions, East or West and South or North. Whether we choose one of these sets, or add complexity and plurality of information, transmitted by including the other additional set of directions, the principle stays the same. For the purpose of presentation, we will assume the East – West set.

The cradle can move to one direction, East or West, and stay there, or return back to its initial "Middle" position. The cradle can also move to one direction and then on return pass the Middle position and end up at the opposite direction. Finally, in the case of the latter movement, the cradle can oscillate in a slow or fast frequency, all that while the thumb rests on the Cradle. Each of the situations described above carry a specific and definite message. The control functions exercised by the thumb, resting on the Cradle, can be exercised from the Middle position, or be exercised while the thumb rests on the Cradle that is moved to one direction or another. The tables below summarize those situations.

Thumb on Cradle in Middle Position **(Priority Group)**

No. Of impacts Delivered by The Thumb	FUNCTION
1	**Start**
2	**Repeat**
3	**Calling Emergency Help ("911"in the US)**
4	**(Reserved)**
5	**Calling for help on the premise**
6	**Calling for the helping dog**
7	**Close or End (any number [7 or more] of impacts)**

Thumb of Cradle in Lateral Positions

The bed or cradle area of the thumb can move laterally sideways to one side or the other, can vibrate sidewise to one side or another, and the vibrations can be low or high frequency. All these elements carry functional information in addition to the impact information delivered to the thumb, as is provided below.

Thumb Movements

Move To Left	Right	No. Of Times Left	No. Of Times Right	Frequency Slow	High Impacts	No. Of Thumb	Information or FUNCTION	Group
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	
0	**1**	**0**	**1**	**0**	**0**	**1**	Where is the eCane?	**(A)**
0	**1**	**0**	**1**	**0**	**0**	**2**	Where is the dog?	**(A)**
0	**1**	**0**	**1**	**0**	**0**	**3**	Who is in the house?	**(A)**
0	**1**	**0**	**1**	**0**	**0**	**4**	Who entered the house?	**(A)**
1	**0**	**1**	**0**	**0**	**0**	**1**	Calling for a person	**(B)**
1	**0**	**1**	**0**	**0**	**0**	**2**	Calling for the dog	**(B)**
0	**1**	**0**	**3**	**0**	**1**	**0**	Fire	**(C)**
1	**1**	**2**	**2**	**1**	**0**	**0**	water rising in house	**(C)**
1	**0**	**4**	**0**	**0**	**1**	**0**	Intruder in the house	**(C)**
0	**1**	**2**	**0**	**1**	**0**	**0**	Someone is at the door	**(D)**
0	**1**	**4**	**0**	**1**	**0**	**0**	Phone/TTY Rings	**(D)**
1	**0**	**3**	**0**	**0**	**1**	**0**	Persons entering house	**(E)**
0	**1**	**0**	**2**	**1**	**0**	**0**	Persons exiting house	**(E)**

1 = Yes; 0 = No

The Face of the Fifth (Pinky) Finger with Nibbles (Cross Relationship Finger):

The fifth (Pinky) finger has three major utilities:

- *Female representation*
- *The Cross Relationship Group utility*
- *TV channel query and selection*

We will describe below types of usages of the fifth finger, including those that do not relate to the face of that finger.

Female representation

We have already encountered before gender representation, when utilizing the third (middle) finger and the fifth (Pinky) finger. The reason for the dual representation is anchored in attributing positive or negative characteristics to each of the fingers. The fifth (Pinky) finger has other functions as well and is utilized for the functional equivalent Remote Control.

The Cross Relationship Group utility

We encountered a private example of cross relationships when we examined the definitions of family members, utilizing the face of the third (pointer) finger. There are of course many other combinations that could provide articulations for many more cases.

TV channel query and selection

The fifth finger (pinky) utilizes its own cradle or sleeve, much the same way that the thumb issues actions and receives alerts by utilizing its own cradle.

Move To Left	Move To Right	No. Of Times Left	No. Of Times Right	Frequency Slow	Frequency High	No. Of Pinky Impacts	Information or FUNCTION	Group
ACTION								
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	
0	**1**	**0**	**2**	**0**	**1**	**0**	“ON” Activation	**(S)**
1	**0**	**2**	**0**	**0**	**1**	**0**	“Off” Activation	**(S)**
1	**1**	**1**	**1**	**0**	**1**	**0**	Time display Request	**(S)**
1	**1**	**2**	**2**	**1**	**0**	**0**	Station ID	**(S)**
0	**1**	**0**	**3**	**1**	**0**	**0**	Browse Stations – UP	**(S)**
1	**0**	**3**	**0**	**1**	**0**	**0**	Browse Stations–Down	**(S)**
1	**0**	**3**	**0**	**0**	**1**	**0**	Repeat Function	**(R)**
1	**0**	**1**	**0**	**0**	**0**	**0**	BM Station	**(R)**
1	**0**	**5**	**0**	**1**	**0**	**0**	Switch to lower BM	**(R)**
0	**1**	**0**	**5**	**1**	**0**	**0**	Switch to upper BM	**(R)**
RECEIVE								
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(Z)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(Z)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(Z)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(Z)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(Z)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(Z)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(Z)**

1 = Yes; 0 = No ; 2 = Twice in that direction (slow or fast), but no oscillation.
BM = Bookmark

Functional Equivalent Sentence Information

The combination of Key Words and Nibble impacts on the back of fingers provide us with functional equivalence of sentence information. Though the description below is given for the English language, it is pertinent universally and is not language specific, or language dependent.

Thus, the Key Words give the verb or adjective (e.g., speed, go, etc.) whereas the Nibbles give the measure (slow, fast, very fast).

For example, consider the two successive words, “car”, “speed”. When the keyword “car” is simultaneously conjoined with a single Nibble on the back of the thumb, it means a sedan, while three such nibbles would mean a heavy trailer. Likewise, the keyword “Speed” would mean slow with a single nibble, fast with two nibbles and very fast with three nibbles. Note that we did not use the word “vehicle”. The reason lies in two factors. First it is longer to spell and the second is that is always preferable to use simpler words in Sign Language and therefore in Touch Language as well.

Touch Language Utility for eCane Usage

Various commands and reception of the eCane (Liebermann 2003), also U.S. Patent (2008), can be utilized by using Touch Language. We provide bellow the essentials of Touch Language in their utility for eCane usage. It can be used for Target - Map, for communications with other parties, whether deafblind or hearing, as well as seek functions that enable the deafblind to navigate their immediate environment. We divide the Touch Language usage for the eCane as follows.

Touch Language Modes for the eCane

- Communication Mode **(Group T)**
    - Activate Text to Speech
    - Connect to a Telephone Relay Service (TRS)

- Reception Mode **(Group K)**
    - Emergency Vehicle Alert (EVA)
    - Directions
    - Identification of Objects

- Seek Mode **(Group H)**
    - Target – map
    - Indoors
        - The home
        - Other than home
    - Outdoors

Entries to the table below are to be determined at a later date (*).

Move To Left	Right	No. Of Times Left	No. Of Times Right	Frequency Slow	High	Middle Finger	Information or Mode Group	
Impacts								
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	
0	**0**	**0**	**0**	**0**	**0**	**0**	Activate TTS	**(T)**
0	**0**	**0**	**0**	**0**	**0**	**0**	Connect to TRS	**(T)**
0	**0**	**0**	**0**	**0**	**0**	**0**	EVA	**(K)**

0	**0**	**0**	**0**	**0**	**0**	**0**	Directions	**(K)**
0	**0**	**0**	**0**	**0**	**0**	**0**	Object Identification	**(K)**
0	**0**	**0**	**0**	**0**	**0**	**0**	Target -map	**(H)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(H)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(H)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(H)**
0	**0**	**0**	**0**	**0**	**0**	**0**	(Reserved)	**(H)**

1 = Yes; 0 = No ; 2 = Twice in that direction (slow or fast), but no oscillation.

(*) The specifics for the eCane in the above table are anticipated to be determined with input from the deafblind community.

Please note that specific entries have not been articulated and await discussion by potential users at large. See below a short description related to User Contribution.

Summary of Fingers with Cradle Movement

Finger	Cradle	Subject Group
First (Thumb)	1	Control Functions
Second (index)	0	N/A
Third (Middle)	0	N/A
Fourth (Ring)	0	N/A
Fifth (Pinky)	1	TV Remote Control (functionally equivalent)

1 = Yes; 0 = No ; N/A = Not Applicable

Group Characteristics Summary of Fingers

Finger	Cradle	Subject Group
First (Thumb)	1	Control Functions
Second (index)	0	Male (Bad)
Third (Middle)	0	Female(Bad)
Fourth (Ring)	0	Male (Good)
Fifth (Pinky)	1	Female (Good)

1 = Yes; 0 = No

Nibble Characteristics

Finger	Back of Face of Finger	Finger	Subject Group
First (Thumb)	1	0	Control Functions
Second (index)	1	0	Degree of being bad
Third (Middle)	1	0	Age Group
Fourth (Ring)	1	0	Degree of being good
Fifth (Pinky)	1	0	Age Group

1 = Yes; 0 = No

Putting It All Together
We are now in position to use the tools and attributes provided hereto. We will first provide the rules of association and follow with case examples. However, before the rules of associations are set below, we will address the universality of Touch Language and its claim for the ambitious classification as a language.

The Universality of Touch Language
The tools provided in this manuscript present universality and the building blocks of its construct lend to its ability of becoming universally used, irrespective of the language practiced at any given place. Therefore, we first list and examine the relevant components enabling visual dynamically changing scenes, begetting the functional equivalent perception of touch.

The components are:

- *Symbols*. The symbols utilized in the Touch Language have no cultural, linguistic or other seeming elements of connection to any particular society and as such are universal in their usage.

- *Visuals*. The visuals, namely the dynamically changing scenes, such as on TV or video presentation, are the same for any culture and irrespective of any language describing the images and their progression in words and sentences.

- *Attributes*. The attributes are based on logical and perceptual assumptions that any human being who perceives them, once trained in their meanings, would sense similar impression. Arguably, various individuals may claim a better or more effective attribute. Thus, the attributes, though presented in written form that is language and culture dependent, are not linked themselves to any language and are therefore independent of any language or culture.

- Rules of Association. The rules of association are likewise, presented in a particular language that is irrespective and unrelated to the attributes themselves and thus are independent of any language or culture.

The ability to use symbols understood in the same fashion by persons of different cultures who use different words and sentences to describe the meaning of the symbols is not new. The Kanji is a form of symbols used both in China and Japan. A Chinese person may use the Mandarin language to verbally describe the Kanji symbols and a Japanese person listening to the spoken language may not know what is said, but will interpret the symbols correctly. Likewise, A Japanese person looking at the Kanji symbols may use Hiragana or Katakana to describe it, which may not be understood by the Chinese person who nonetheless understands the same meaning of the Kanji symbols, as do their Japanese counterpart.

Thus, it appears that Touch Language has the ingredients for a universal language, but more is needed in order to qualify the complete assembly of the ingredients as a language. Notoriously, such important elements of syntax and grammar are conspicuously missing. However, we advance the proposition that they are not missing at all. The ingredients were chosen and each articulated to be language and culture independent, allowing for any culture and language to

utilize them with its local linguistic tools. Therefore, Touch Language adopts such syntax and grammar as used by the particular language utilized by the individual user. Hence, the syntax and grammar may differ among users but the ingredients will stay the same. Thus, we propose that, by incorporating syntax and grammar as variables into Touch Language, it wins the latter claim of language status. The variables will assume the "value" of a particular language at any time. Making syntax and grammar variables, positions them to become functional equivalent language components and contribute to the notion that Touch Language is not only a language but a Universal language as well. However, an important caveat is called for, as follows.

Languages do not stay static. They either evolve in time or become extinct. Evolvement of a language can be viewed as the response provided to stimuli or excitations expressed verbally in a spoken language or otherwise visually, such as in Sign Language. Stimuli or excitations could emanate from needs or missing links in communication among parties, or could emanate from environmental conditions. Such environmental conditions can be witnessed in the plurality of descriptions of the word "snow" in a very cold regions on Earth, vis-à-vis a single word describing it in warm regions. Notwithstanding other learned opinions regarding the reasons for Esperanto becoming an extinct language, we maintain that the lack of proper conditions for evolvement of the language begot its current status. Namely, a language can evolve only when excitations are answered with the elements that keep it responsive. Such excitations-responsiveness cycles are local by their nature and thereby a language aspiring to become universal and bridge the locality aspect is doomed for failure.

Even when we consider globalization and the Internet of our times as creating a cohesive community, still any language evolves in its own local community of users, lacking a universal language commonality. For example, the very basic "@" symbol used globally for access to the Internet, is called (Ruvik Rosenthal 2003) "at symbol" in the US, "Strudel" in Hebrew, "Herring" in Check, "Monkey tail" in South Africa, Germany and Holland, "Elephant trunk" or "Pig tail" in Denmark, "Small snail" in France, "Small duck" in Greece, "Worm" in Hungary, "Small mouse" in Taiwan, "Small cat" or "Pig ear" in Poland or "Ear in" Turkey. Single symbols can migrate from communities and become universally recognized and used, but they do not become integrated into or aspire to be a universal language.

Therefore, Touch Language presented here as a universal language, is only universal to the local community of users that can transcend countries and continents, much like the language evolving among Internet users. It is in such context that it is presented, and it is in that context that we hope it will evolve to encompass and become a utility for deafblind persons, irrespective of the place they live in and the local language spoken there. Attempts at universal language have been noted before. Esperanto as a general language and Gestuno as a universal Sign Language, built from components of individual Sign Languages. Touch Language is built from the outset as an international language where symbols and elements are chosen to be intuitively amenable across languages and cultures, without any idiosyncratic syntax or other rules that could interfere with its Global status.

It should be mentioned, that an attempt to ameliorate Touch Language beyond its usage for the deafblind, as a true universal language, bridging languages and cultures, resulted in a subsequent

work by the Touch Language inventor. This Global Translation Language (GTL), is now complete and currently in the status of Patent Pending.

The Cultural Aspect

Touch Language, is more than a language. It is also a culture, as we discuss next. Touch Language aim is for use by the deafblind, who would be able to enjoy a TV show or video presentation, when utilizing the language. However, the TV broadcast results in visuals of dynamic scenes, which also rely on the culture portrayed. Some of those cultural meanings may be unknown to the deafblind for obvious reason. For example, a wink with the eye carries a meaning both to the person who delivers it as well as the targeted recipient. While we have in Touch Language the attribute for "wink" as it is part of the TV scene and is needed for completion, it may not carry any significance, or meaning to the deafblind being part of the TV audience, unless undergoing first a metamorphosis to verbal expressive local cultural meaning. Other examples relate to meaningful looks provided by facial gestures, such as "don't talk!", "watch what you say!", "did you notice that?", etc. There are also elements of body language, such as moving of the hand to mean "nonsense", Come!", "let's go!", the hand perpendicular to the forehead and facing the ground with a slight moving of the head in a search sign to mean "Where!?", etc. We will exclude in this discussion cultural elements that could be meaningless to a deafblind person, such as a scene of a parade, though they are not uniquely associated with any particular culture and have an element of universality to them. It is insignificant and/ or insufficient for such attributes to be simply taught to the deafblind. Education that relates to the cultural meanings provided by Touch Language, seems an appropriate necessity that will also elevate the deafblind level of participation and integration in their relevant culture and society. Such educational material is beyond the scope of this book and will be left for evolutional steps of the language that are expected to be contributed either by the author or preferably by the public at large. However, we need to focus and deal with the cultural aspect of a situation that is unique to the deafblind, as we do next.

Multiple Meaning in Visual Human Signs

There are various visual signs given by persons, sometimes also culturally-based that are mostly universal. We have encountered before the example of a "wink" with the eye, which is meaningless for the deafblind who cannot see it and even if they could see it, they would not perceive it for its cultural meaning. The unique aspect of these cultural aspects is that some of them carry multiple cultural meanings as well. Not surprisingly, these multiple cultural signs are people-based. Moreover, hearing and seeing persons are the ones utilizing these signs for communicating messages to other such counterpart persons. The challenge before us, demands a transliteration of such multiple meanings in visual human signs into a Touch Language form that will both render a sense to the occurrence, as well as transcend the meaning of the human gesture, that is culturally unknown to the deafblind, albeit its universality for the seeing population. To this end, we propose a Touch Language signal articulating a cultural gesture with meaning that will be delivered to the deafblind simultaneously with the transliteration. Such meaning could be delivered either by touch or by keyword. The signal is of a Nibble form and appears under the proper Nibble category [under the fifth (Pinky) finger]. We list these culturally visual multiple meanings below. We provide a list that is not exhaustive by any means, and is expected to evolve over time.

- **Face of the fingers or Palm behind the Ear.**
    - *Description*: Putting the palm or the face of the fingers behind the ear while possibly also tilting the ear forward.
    - *Meanings*:
        - Cannot hear what you say, speak louder
        - I am waiting for you to say something

- **Moving the eyes to one side or another.**
    - *Description*: Moving the eyes to one side of the eye socket, without moving the head.
    - *Meanings*:
        - A hint saying "look over there"
        - Crossed eye look to the side without being notice

Additional Multiple Meanings in Visual Human Signs are included in Appendix H.

Multiple Perceptions in Interpretation

We have discussed multiple meanings when a word written, spoken and pronounced in the same manner has more than a single meaning, resulting in its being expressed accordingly, by different signing in Sign Language. We have likewise discussed multiple meanings in visual human signs.

Another type of expressive linguistic element that deserves attention, relates to the sense of touch being responsible to both getting acquainted with the element, as well as identifying it later again, which will be discussed next.

We turn our attention to words that are spelled the same, have the same meaning to hearing and even deaf persons, yet when describing such words, human perception by touch or visual sense is quite different. Proceeding to discuss by way of an example we center on the word "bubble". Our discussion does not relate to a bubbly personality, but rather to the word "bubble" that can appear in more than one way:

- Bubbles of air in and on the surface of boiling water
- Bubble of soap appearing for example when washing hands
- Bubble coming to a surface of a lake due to heat generated underneath, such as during a stage of lava eruption.

Notably, one can distinguish among the above cases, by visual element and by size description, none of which is helpful to the deafblind, who cannot first see and later form a perception related to a prior visual. Considering the experience of washing hand with soap by a congenital deafblind person, bubbles do not make a conjecture. The sense of soap laminate on hands, evolving into bubbles is perceived as starting from smooth friction and evolving into light airy foam, while bubbles of air in boiling water have never been seen and certainly not expected to be experienced by touch. Touch Language takes it all into account when providing appropriate articulations for such elements as soap.

Therefore, we introduce the notion of "Multiple Perceptions" related to the same words and meanings, such as in the case of bubbles.

Translating Multiple Perceptions

In the case of Multiple Perceptions, the descriptions related to senses rendered in Touch Language are different for each perceived element. However, the onus to discern them for different perception by sensory excitation, is on the translation medium, whether it is human or artificial, such as in an automated process.

It should be stressed that the discerning decision process is not trivial. It calls for intelligent analysis that takes into consideration both the hearing or seeing perceptions of people, as contrasted with the perceptions of senses by a deafblind person vis-à-vis the environmental "appearance" in their mind, based on all the sensory human tools available to them. We relegate such multiple perceptions constructs to the natural evolution and developmental stage of Touch Language. The vehicle for such evolution is discussed later below.

Relevancy Issues

Another aspect that is unique to the deafblind and deserves attention, is the perception of senses formed based on visuals, whereas there are no counterpart sense excitations expressions to build on. Examples are rainbow with multiple colors, dawn, fireworks, or smoke rings coming from a cigar to name a few. People with proper visual ability who may be color- blind cannot see colors of a rainbow as well, however, the notion of a rainbow is known and they have seen a single color of black and white bow shadow in the sky. The blind person has no such observational perception to what is a rainbow. Thus, the question posed, is whether such elements are relevant for translation purposes to Touch Language. We propose that such elements should not be translated to Touch Language. The reasons for it, go beyond the limited usefulness and take into consideration the importance of limiting the cues provided to the palm. Such considerations ascertain that we do not overburden the Touch Language user and minimize the touch sense vocabulary so that even unsophisticated and uneducated deafblind persons may be able to master the essentials needed for them to enjoy its utility, such as in watching TV, video presentations, or in communication with other people.

Reversed Multiple Perceptions

Another subgroup is that of fine differentiation. For example, consider the following group: [pitch black; dark; twilight; fog]. All four elements in the example set, interfere to one degree or another with clear sight. However, for the blind person all represent "dark" (or normal state of affairs) and the fine differentiation has no meaning. Thus, we realize that there are groups of descriptive elements, where a single description covers all of them, irrespective of the fine differentiations among them. The single description is provided by the interpreter who does not need to exercise a lot of finesse in describing members of such sets.

Touch Language Principles

The language enables blind and deafblind persons to "watch" TV and video presentations, as well as communicate with others. The language utilizes up to 5 major segments as follows:

- Optional Brail delivery to fingertips for Dialogue in the show or presentation.

- Key Word, that is a Laconic description related to the scene on the TV screen, delivered in Morse code to a designated area in the body, either by pecking motions or vibrations. In actuality, the Key Word is a verb that will be essential for multiple languages cross translations.
- Description of motions, such as on the screen, felt in the palm of the deafblind.
- Utilization of back of hand, back of fingers and face of fingers to convey by code provided through pecking on them; such information as gender, age, personalities, profession, etc. Each finger, together with the location and number of pecking delivers a uniquely identifiable code conveying meaning to the user.
- Control functions are provided via similar articulation of hand and finger location employing also movement of various fingers like the thumb and pinky fingers

Second Level Detail

Rules of Association

The Rules of Association provide a set of tools for combining attributes into a dynamic sequence of occurrences and their synchronization with Key Words on one hand and motion, vocal communication and music on the other hand.

Synchronization

Synchronization is required for beneficial usage of Touch Language. Synchronization is required on a number of levels as follows:

- **Synchronizing a group of dynamic scenes with the elements of Touch Language. They encompass:**
    - Determination of the scope of the dynamic scene
        - Is it measured exactly, such as by the number of frames aired in the particular span of determined elapsed seconds; or
        - Is it provided in fashion of, or in actual utilization of, Fuzzy Logic, where the group of Frames varies according to a “fuzzy” group of dynamic visuals that are not determined by an exact measure.
    - The KeyWords
    .
    - The PalmScreen
    - The Nibbles
    - The Dialogue Segments (either with Touch Language or the optional Braille component)
    - User Control Functions
- **Synchronizing Key Words with their counterparts is rather imperative and requires a level of exactness. Those counterparts are:**
        - The Nibbles
        - The PalmScreen

The Rules

- [Scene Group] ~ [KeyWord] + [Dialogue] + [User Controls]

- [KeyWord] ~ [Nibbles] + [PalmScreen]

- [User Controls] ~ [Cradle] + [Frequency] + [Impacts]

- [PalmScreen] ~ [M] / [S] + [I] / [V]

- [M] = M(i,j), that is the Macro cell on the PalmScreen

  [M] Stands for geographic location on the PalmScreen

- [S] The dynamic parameters (based on the static parameters) that form the attributes

  [S] Stands for shape description

- [I] = [Strength Level **:** Time Length **:** Repeat **:** Vibration]
  - Strength Level = [1, 2, 3]
  - Time Length = [in half seconds]
  - Repeat = [0 to 6 times]
  - Vibration = [1 = included; 0 = not included]. When induced, vibrations are taken from the permutated group [A],…,[E]

  [I] Stands for Impact

- [V] = [Strength Level **:** Time Length **:** Repeat **:** Trigger]

  - Strength Level = [1, 2, 3]
  - Time Length = [in half seconds]
  - Repeat = [0 to 6 times]
  - Trigger = [x seconds after [I] or other measure]

  [V] Stands for Vibrations

- Whenever Group (A) and (B) Nibbles are utilized for the back of fingers, the following rules apply:

  - Nibbles of Group (A) always precede impacts from Group (B) Nibbles.
  - Nibbles from Group (B) start only after impacts of Nibbles from Group (A) have ended.

- If impacts from any Nibble Group are missing, the message is that no information is available (regarding either age or personality type of the person.

Translation Mechanism

Scenes on the screen are "narrated" and a sequence of related essential KeyWords and attributes are extracted from the sentences of the narration. The attributes are further reduced to their building blocks of dynamic parameters that are based on the static parameters. This results in the touch sensations, Nibbles in action and Morse vibrations / pecking representing Key Words.

The Touch Language Principle

Algorithm Summary

- A small number of mechanoreceptors excited
  - Pecking on body parts
  - Vibrations
  - Pressure
  - Shear
  - Motion

- A small number of geometric patterns sensed
  - Lines formed by sticks or specifying end points
  - Curvatures and circles specified either by end points or other means
  - Circles formed by specifying short connectivity points

- Combination of geometric patterns in dynamic successions
  - Where they are
  - To where they move
  - Duration of stay in each location

- Dynamic description of TV or video screen on the PalmScreen

- Touch Language accessories
  - Key Words supplements
  - Division of hand and fingers to meanings portrayed
  - Nibbles on fingers articulate messages and meanings
  - Cradle structure
    - For control usage
    - For Alarms
    - For information delivery
  - Thumb as control mechanism
  - Functional equivalence of a remote control
  - Usages for eCane

Key Words - revisited

Key Words are an important segment in Touch Language. The motions and other impact information felt on the PalmScreen mostly do not carry the information regarding the subject "observed" through sense. Namely, we can sense the motion of a car on the PalmScreen and perceive its direction of movements, halting, change of course, etc., but we do not know if that describes a car, truck, a bicycle, a person or the activity of the person, etc. The Key Word provides that information. We have discussed Key Words before and concluded that such information may be provided by vibration or pecking delivered, for example to either the palm not involved in sensing or the PalmScreen itself. Such vibrations/pecking can be delivered in the pattern of a Morse code, whereby the recipient could know from the Morse code spelling which word, or rather Key Word it is.

From a practical point of view, such arrangement taxes the attention span of the user, who needs simultaneously with the interpretation of the sensations on the PalmScreen also to engage in Morse code deciphering. It is especially taxing if the Key Word needs to be repeated several times in the course of a certain scene on the TV or video screen, or if more than one Key Word is required in any particular scene presented. In order to ascertain that in the latter situations the enjoyment of functional equivalent TV and video presentation does not turn into a laborious Morse code deciphering and preoccupying the user, we propose a program for utilizing Key Words symbols that are basically "functional equivalent acronyms".

Functional Equivalent Acronyms

It is quite common to encounter acronyms in Government, military or legal material where in the latter, at the end of a group of words we find in parentheses an abbreviated word or the first letters of these words, that later on are used instead of the complete set of related words. It has also become quite prevalent in mobile texting where for example "u" replaces "you", "4" replaces "for" and "2" replaces "to" when utilizing English. As an example, note the following made up sentence with the use of an acronym: "Touch Language ("TL") utility is a certainty, therefore TL is used in TV broadcasting". We will advance below the same principle for functional equivalent acronyms, describing Key Words.

Usage Particulars

Once a functional equivalent acronym has been defined and established, it is used repeatedly during the sensation provided on the PalmScreen, so that the sensation can be attributed to and correlated with a particular object. For example, if the scene involves an exploding car, then while the PalmScreen provides the proper sensation for explosion, the KeyWord "car" is provided simultaneously. However, when the car is involved in a high- speed chase, the KeyWord "car" needs to be repeated several times. In that situation, the KeyWord is vibrated/nibbled in Morse code once (assuming Morse code to be the selected form for that communication), but after a particular symbol appears at the end of the KeyWord "car", from that point on, it will be the symbol that will be repeated rather than the vibrations/pecking delivering a Morse code. That defined symbol is the functional equivalent acronym used in the scene.

Scene Locality
The locality of a scene is defined differently for blind and seeing persons. It is defined in geographic and action terms for the seeing person. Namely, a moving car, for example, has an attributed locality that changes with the changes of the geographic terrain or environment. For example driven through an inner city versus outside in the country. However, it also has an action scene, where in the same locality we observe a change in the actions attributed to the car. For example, driving slowly versus speeding up, or driven peacefully versus being hijacked, or driven erratically. The scene locality has different definition when utilized for blind participant observers and in that regard becomes a functionally equivalent Locality. Namely, the scene does not relate to a geographic area, nor is it related to action observed on the TV or video screen. Scene Locality for blind persons rests on PalmScreen utility in temporal period of sensed time.

Process Principles
Three principles govern the process

- **Variables**
    - The group of symbols used for the functional equivalent acronyms are in essence variables that can describe any KeyWord available. Being variables, means that they can describe one KeyWord at one occasion and the same variable can describe another KeyWord at another occasion. Namely, such variables are defined at their initial use by immediately following a KeyWord delivered (for example by vibrations/pecking in Morse code). We will shortly show below how to avoid confusion and perceive the proper KeyWord for a particular variable.

- **Group of symbols**
    - The group of symbols chosen is made of a relatively small group of symbols and is given below

    - There are various options for the symbols, however we choose one possibility that will not cause confusion with other Touch sensation on the PalmScreen. Namely, we choose a symbol method that cannot be confused with or distract attention from either descriptive sensation on the PalmScreen, or KeyWords transmitted through Morse code vibrations / pecking. Namely, we choose low (pitch) level frequency that can be equated with the low audio vibrations of a cello or contrabass, or the slow drill of a dentist that is usually much less painful than the high frequency (pitch) drill. Having chosen such vibration as the acronym type, we next define its usage in symbols

        - [A]: Single Long Low Frequency Vibration (i.e., significantly longer than any Morse code "dash" vibration) will be denoted by "**)**". There is a significant delay before it is repeated again, if at all.

        - [B]: "**).(**" – A Long low frequency vibration with a single short delay before it is repeated

        - [C]: "**%**" – A short repeated low frequency vibration

- [D]: "**%.%**" – Two short low frequency vibrations with a significantly much shorter pause between the first and the second
- [E]: tbd

- **Cyclic Permutations.**
  Permutations occur in the group of symbol variables [A], [B], [C], [D], [E]. The reason for the permutations is memory erasure for repositioning of a symbol variable. Namely, once used for a certain description, one needs the brain to enjoy a respite from it, so that its meaning will no longer be associated with the KeyWord it used before. Thus, once [A] was used in a particular scene, as we move to the next scene and [B] becomes the symbol variable, [A] moves to the end of the line and will be used again only after the other symbol variables were used. That is, after the usage of the symbol variable [A], the group of symbols become [B], [C], [D], [E], [A], and after [B] is used too, the permutated group takes the form of [C], [D], [E], [A], [B].

Delimiters
It is important to know when a symbol variable ceases its local functioning and is deposed for a new (next in the permutated line) symbol variable. The easiest and most sensible such delimiter will not add to the amount of material needed to be kept in memory of the user, is simply an empty group member or "No Symbol". Namely, ceasing to use a symbol variable and a new one replacing it can retire it as local variable until its next resurrection with a new attribute. However, there are situations where the current symbol variable is not retired, but rather needs to be used shortly after the introduction of the next in line symbol variable. Having a delimiter is useful in such cases, relegating the symbol variable to a temporary abstinence until being called back to utility, without the need to redefine another symbol variable for the continued function of the attribute utilized under such a symbol variable in the scene locality.

Therefore, we define such a delimiter as follows:

***Negative (Reversed) Delimiter Definition*:** A symbol variable pertaining to a scene locality, with a negative (reversed) delimiter appearing immediately after the symbol variable pronouncement, means that it is held in abeyance for reuse in a short time, without losing its meaning or being obscured by the introduction of the symbol variable next in line. It is defined as:

"**$**": A series (between 3 to 5) of short successive low frequency vibrations.

The Dialogue Segment
Invariably, any TV show contains segments of dialogue between or among participants in scenes. Such dialogues are different from communications that can be "compressed" into a minimal number of Keywords. Therefore, in order to complete the Touch Language capability to render a comprehensive functional equivalent TV perception, we need to provide the mechanism for such dialogue delivery. There are various ways for such delivery, from Braille to Morse code, usage of vibrations or other components of Touch Language.

The Dialogue Information

The dialogue segment can have various embodiments. Our preferred embodiment is usage of Touch Language that enables intuitive immediate and clear delivery of information as will be seen later on. However, since Braille could be a viable solution for people who already know the code, we provide such option as discussed below. We discuss below one such embodiment that enables rapid reading in Braille of dialogue segments appearing during the show. The mechanical apparatus for a Braille component is either a single bar that has its two end points tilted at an angle, or disjoint parts providing same effect. Namely, the tips of the eight fingers (i.e., fingers of both hands without the thumbs) rest on a specialized Braille keyboard that enables to read the captioned dialogue text in Braille, as discussed somewhere else (Liebermann 2003). The tilted edges are at an angle, in order to accommodate the respective fifth finger (pinky) of each hand. The hand that serves for a PalmScreen has other contraptions added to the construct, while the other hand has only a contraption that enables its thumb to receive nibble information required for notification of start and end of process as is given below.

Number of Nibbles	Meaning
1	Start of KeyWord
2	End of KeyWord
3	Start of dialogue
4	Dialogue starts with some other activity in the background, or other location on the PalmScreen
5	End of dialogue

The single or two nibbles are done in rapid manner, while the 3, 4 or 5 nibbles are provided at a slow manner, thereby signaling to the viewer, right from the outset, whether they describe a KeyWord or dialogue.

The Dialogue Reduced State (DRS)

Touch Language primary object is enabling active and real time participation in a TV broadcast or video presentation. However, the versatility of Touch Language enables also utility for communication and transfer of ideas between and among parties. As will be discussed in the material below, we offer the option of a Dialogue segment for text and conversations. However, Touch Language enables to forgo the optional Braille dialogue segment altogether and utilize the rest of the language components to effectively convey the ideas, topic and related material of the dialogue in a rather succinct and short manner. Thus, we strive for an ultimate Dialogue segment that approaches null usage of Braille, or as we refer to it, as the Dialogue Reduced State (DRS). Such aspiration could be achieved by introducing enough Touch Language elements and parameters to render the need for the dialogue segment in any other manner either minimal or obsolete.

Practical Utilization

In DRS we utilize the Morse code for verbs and the rest of the sentence is cast into abbreviated form according to Touch Language rules transmitted to the user.

Conditional Sentences

Unlike American Sign Language (ASL), where conditional sentences are stated in two parts, Touch Language provides it in a single cohesive manner. In these cases (that appear to be the majority), when conditional statements are futuristic Touch Language employs the "tense" element discussed somewhere else in the book.

A combination of DRS and the question or question mark in Touch Language is achieved by coupling the conditional sentence to a person. Touch Language has a special notation when no specific person can be incorporated, such as when the notion of "anyone", "anybody", "someone", "somebody" or just understood from the context. Such notion is articulated by invoking a state of "all persons", achieved by impacting rapidly a single nibble in sequence to all the four of the person-fingers, either starting from the second finger and ending with the fifth finger or starting with the fifth finger and ending with the second finger.

Summary of Functional Equivalent Touch Language

In comparison to a standard language, and as an example, we use here the English language. Thus, Touch Language can be summarized as follows:

- Articles (i.e., a, an, the) are omitted, as is done in Sign Language.
- Adverbs (e.g., slowly, heavily, largely) are not needed, as in Sign Language
- Verbs (e.g., go, jump, drive) appear as KeyWords
- Nouns (e.g., birds, snow, explosion) are relegated to touch sensation
- Adjectives (e.g., slow, heavy, young, old) are transmitted by Nibbles

Touch Language Utility

Touch Language may appear from the outset to be a complex assembly of particulars, requiring efforts to master the language. Furthermore, it raises the question of utility when it is conditioned on such complex learning.

However, it appears much less ominous when any other language is considered in comparison. Spoken and thriving languages, such as the English language demonstrate organized structure of assembled words, governed by rules of syntax and even include rules for cases that do not follow the rules (such as in the simple case of spelling: "'i' before 'e', except after 'c'"). Such a fundamental and not unsophisticated communicative mental apparatus requires years of learning and mastery, yet intuitively most people learn to utilize the basic and important ingredients within a few years of their birth. Furthermore, a comprehensive "industry" of teaching and furthering it, exists for millennia in human society, such as teachers, classrooms in schools and text books, all taken for granted and accepted as useful to spend time and money to attend and learn, whereas in any progressive country it is also mandated by law for children entering the society.

It is in such environment of acceptance and education that Touch Language could fit in as a new member, with the potential of providing deafblind persons a new communicative asset. To this end, we lay the foundation for teaching Touch Language to the deafblind, as well as teachers who may assist in teaching the language, albeit keeping in mind the practical ability of the language and current technology for self learning and education.

Functional Equivalent Sound Effects

Hearing persons enjoy sound effects while watching TV shows, even if such sound effects are only tones that normally would not be categorized as melodic or music, or are subtle in nature. For example, in the now classic movie and TV airing of "Jaws", there is a growing crescendo of tones whenever the shark is approaching, creating a sense of foreboding and heightened "anxiety" level among the viewers. Deaf viewers do not share in such effects, leading to a significant reduction in their enjoyment as compared with their hearing counterparts. Deafblind persons, who would elect to use Touch Language in order to partake in an audio-visual presentation such as a TV show or video presentation, could enhance their level of enjoyment if a functional equivalent form of sound effect could also be provided. So would also deaf persons who watch such shows with close captioning, but where obviously no sound effects can currently be translated into captioning. Touch Language contains the needed ingredients for enabling deafblind viewers to partake in the perception of sound effects as we discuss below. The apparatus utilized to deliver such functional equivalency is described in the manuscript related to Touch TV (Liebermann 2003). The functional equivalent sound effects utilized are produced by vibrations (and to some extent also by nibbles), with breaks in a particular frequency pertinent to the scene, as well as nibbles in a particular quantity and frequency pertinent to the scene.

Vibrations and Frequency

The frequency provided is divided into two distinct forms, and each form is divided again into multiple possibilities, each of which carries additional information, based on the situation at hand. Namely:

Non-suspenseful Situations

- Low frequency vibrations aimed at providing a soothing and tranquil form of functionally equivalent sound effect. Within that scope there is a frequency of providing that low frequency, Namely:
    - Continuous and uninterrupted low vibration
    - Evenly spaced low vibrations with a constant time space between the end of one low vibration and the restart of the same low vibration.
    - Uneven time duration spacing of the low frequency vibrations, whereas the time elapsing as a break between two successive low frequency vibrations is variable and controlled to be long, short, mixture of long and short duration, where no short time spacing needs be similar to another short time spacing and no long time duration spacing needs to be similar to any other long time duration spacing.

Suspenseful and Tense Situations

- High pitch frequency level aimed at providing a general sense of tension
    - Continuous and uninterrupted high vibration
    - Evenly spaced high vibrations with a constant time space between the end of one low vibration and the restart of the same high vibration.
    - Uneven spacing of the high vibrations, whereas the time elapsing as a break between two successive high vibrations is variable and controlled to be long, short, or mixture of long and short, where no short time spacing

needs be similar to another short time spacing and no long time spacing needs to be similar to any long time spacing.

<u>Nibbles and Frequency</u>

Nibbles can be provided to the designated area in two forms. Strong or gentle impact nibbles, and slow, fast or variable time breaks between nibbles.

Non-suspenseful Nibbles

- These nibbles are either of soft or strong impact and could further be:
    - Single or multiple nibbles with fixed time break between two successive nibbles Evenly timed successive nibbles
    - Uneven time breaks between nibbles

Suspenseful and Tense Situations

- These nibbles are either of soft or strong impact and could further be:
    - Single or multiple nibbles with fixed and evenly time breaks between two successive nibbles.
    - Uneven time breaks between nibbles

Vibrations and nibbles can be intermixed in whatever combination that can achieve the desired results. The classification given above regarding suspenseful situations and tranquil situation is provided only for convenience and there is no need to use elements only in the framework they are presented.

Example I:

As a simple example, consider the scene from "Jaws" mentioned before. The functional equivalent sound effect could be composed of:

- A base of constant fixed low vibration; and
- A fast (or increasing speed of) nibbles, that could also grow from soft to strong impacts.

Example II:

Consider the scene from "Mercury Rising" with the autistic child protected from an assassin during a train ride, where a tension moment is indicated by a sound almost paraphrasing nibbles in a particular sequence of "short-short-SHORT-SHORT-SHORT-short-short-SHORT-SHORT-SHORT, … It is rather easy to replicate such tension created by sound through nibbles as prescribed above.

The Other Hand

We have dealt with one hand and will now move to discuss the contribution of the other hand to Touch Language. When we observe Sign Language utilized by deaf persons, it is clear that dynamic usage is made by both hands. Likewise, we will employ both hands in Touch Language for added functionality and clarity. However, unlike Sign Language, Touch Language makes use of fundamental biophysical evidence to differentiate between how each of the two PalmScreens is utilized [Liebermann, 2003]. Therefore, we accept that each person has a dominant hand (DH) and a complimentary hand (CH). Since the majority of the population is right handed, our presentation assumes the right hand to be the dominant hand and has been the center of

discussion to this point. In that sense, the left hand has been assumed to be the complementary hand. We will proceed therefore to discuss the complementary hand (i.e., left hand in the current discussion). As discussed in the Touch TV apparatus manuscript (Liebermann 2003), the apparatus could be the same for both right handed and left handed persons, whereby a flip of a switch enables the device to channel the information to one setting or the other by a relatively simple software procedure.

The left hand with the fingers forms a receptive medium that is similar to the right hand. The Left PalmScreen operates in the same fashion as the Right PalmScreen, though the perceptions are different. When both hands are operational at the same time (though not necessarily simultaneously) a variety of new presentations for perception become available to the "viewer". We will begin with the fingers of the left hand and discuss their meaning to functional equivalent viewing, as well as indicate the various Touch Language rules and idiosyncrasies.

The Left Hand Pinky (fifth finger)

The left hand pinky has dual functions. It is both the grammatical tense as well as the designator of direction as related both to spatial vector, as well as cause and effect or receipt.

Grammatical Tense

The back of the left hand pinky provides the time line for the functional equivalent past tense and future tense. The functional equivalent of the present tense covers also a general static stance without change, and therefore will be also considered to be the “Purgatory” stance. The distinction among the three is provided by nibbles on the back of the left hand Pinky as follows:

No of Impacts	Meaning
0	Past tense
1	Present tense & “Purgatory” Stance
2	Future tense

The tense announcement is always provided at the beginning of a description.

Direction and Cause/Receipt Designation

The face of the left hand Pinky provides us with the origination and direction of effect. The Number of impacts on the face of the Pinky are provided in the rhythm of Morse Code, where elements signifying “initiation” are marked By “A” in Morse Code (i.e., a single impact followed by rapid two impacts) and elements signifying “end point”, or “destination” are marked by “Z” in Morse Code (i.e., two rapid impacts followed by another two rapid impacts and ending by two regular impacts).

Number of Impacts	Meaning
1, then rapid 2	From; Initiator or Originator
2 rapid, 2 rapid, 2	To; Recipient; End point

Example
A woman in the show remembers that when she was a young and bad child, a nice older man gave her an ice cream. This will appear as follows in Touch language:

BEGIN
Left hand backs of Pinky with one nibble impact [Past]
Right hand fourth finger with three nibble impacts [Nice older man]
Left face of pinky with one then 2 rapid nibble impact [From/originator]
[KeyWord]: ice cream

Right hand third finger with one nibble impact [Bad young girl]
Left face of Pinky with two rapid nibbles followed by two rapid nibbles the two regular nibbles [recipient]

Left hand back of Pinky with two impacts [Switch back to present tense, memory is over]
END

In a way, this is somewhat reminiscent of some versions of Sign Language where the sentence could be signed as: ”give I bad girl past ice cream get old man nice past give”. The repetition at end of words provided in the beginning is not a mistake, neither is it the subject of this example.

Object and Person Hand
Under the declared assumption of discussing an apparatus for a right-hand person, we differentiate between the right hand, that is the “Person” hand and the left hand, that is the “Object” hand. Namely, while the Palm Screen of both hands carry the same meaning of articulation, the right hand Palm is where the action primarily takes place and as such no differentiation is observed. However, the fingers of each hand designate specific notion of either “person” or “object”.

The Person Hand
The fingers of the right hand describe gender, age, and personal characteristic, such as a pleasant or bad personality, as well as the strength of such character description. Nibbles impacts are added to the specified fingers, carrying the information pertinent to particular fingers. Namely, nibble impacts on the gender fingers render the age of the party, while nibble impacts on the characteristics fingers render the strength. In the latter case, a nice person can be just nice, very nice or extremely nice, depending on the number of nibble impacts, and likewise for the bad personality.

The Object Hand
The left hand fingers describe aggression as well as its opposite. However, since we are not dealing here with living entities, a single finger will suffice in each case. The description of the pertinent fingers is in line with the right hand designations. Namely,

The Finger	Description
First	Aggression
Second	Neutral; Benign; Intent
Third	Pleasant

The meaning displayed by the left hand fingers is useful. For example, a KeyWord "Car", could describe a car driving peacefully, or a car that is bullet ridden at the time, or aimed at colliding with another car, etc. The degree and level are provided by nibbles. Thus, information provided by the finger describing "aggression" is given below, whereas the KeyWord provides the object identification. The fingers of the left hand also provide information regarding intent or action of either object or person.

Intent & Action

The third (i.e., middle) (Benign) finger provides the notion of intent through the use of a single nibble impact on the back of the finger. Thus, the finger can operate in conjunction with any other finger, both on left hand, as well as right hand. Action, rather than intent is signified by a rapid triple impact on the back of the left middle finger.

When coupled with a first left hand finger, it can further designate whether it has moved from the level of intent to the level of threat. We summarize below the meanings carried by impacts on the left middle finger:

Number of Impacts	Meaning
1	Intent
2	Inadvertent
3	Action

Connotations & Modifiers

The left middle finger is also utilized for other important aspects, which are conveyed via nibbles to the face of that finger. In conjunction with nibble impacts on the back of the left middle finger, we are able to provide modification of the intent or connotation, such as in the example where a bad intent of a person is in actuality also motivated by a psychotic breakdown or a similar onset, where if intended with malice, could be homicidal, or when coupled with messianic 'good doer'. We provide below initial such information.

Number of Impacts	Meaning
1	Sexual connotation
2	Living but not human [e.g., animal], allowing to use the "Person" fingers on the right hand for equivalent articulations, albeit for animals.
3	Modifier [e.g., psychotic breakdown, or past with no present, as in a person who is dead]

The Aggression Group

- Bullet ridden [e.g., person, object like car or house, etc]
- Colliding from the side while driving a vehicle in parallel
- Blocking road intentionally [e.g., by another car]
- Throwing an object [e.g., a Molotov cocktail or similar to/into an object]
- Setting up fire
- Hooking up an explosive device to an object
- Spraying [e.g., mace, window cleaner] on a person [e.g., eyes or face] or on an object.
- Pouring liquid [e.g., acid] on the face of a person], or object [e.g., water into the gas tank of a car
- Throwing a hand grenade
- Collision or bumping either objects, or persons, or objects with persons [which may involve additional fingers from both left and right hands].

Obviously there are many other object members of the above partial list that is given as an illustration of the aggressive group.

Neutral and Matter of Fact Group

The middle (third) finger of the left hand carries information, either by itself, or in conjunction with other fingers from either or both left and right hand. Some examples are provided below:

- Observing activities in a mirror
- Business meeting
- Buying a hot dog
- Taking a bus, cab, train, etc.

The Non-aggressive Group

- Helicopter [e.g., to help injured by removing them]
- Ambulance
- Fire truck
- Ship or boat
- Caressing either an object or a person (or animal)
- Kissing [sexual or non-sexual]
- Soothing [e.g., by calm talk, vibrations, bath, etc.]

Physical Features in Touch Language

The deafblind is the ultimate embodiment of human equalizer. The deafblind cannot hear if the voice of other parties is melodic or shrieking, whether a person is tall or short, good looking or not. Likewise, the deafblind is unaware whether he or she is facing a Caucasian, Afro-American, Oriental, Mexican, etc.

The question before us is, whether to break this utopian ethnicity and other physical features of equality, or whether it serves the purpose of the language and its users to maintain it. However, even before making this decision, we need to ask if it matters at all, since the deafblind has not been aware of the differences before. The answer is actually quite simple. Assuming that the

deafblind are integrated in our society to one degree or another, then they are already aware of it mentally or intellectually. Furthermore, not to provide such information would eliminate certain enjoyable features in a TV airing or video presentation, let alone missing on some entire shows altogether. As an example we mention the TV airing of the movie "Twines" with the large frame well built Arnold Schwarzenegger and the short stubby and excellent actor Tony De Vito. The humorous and essence of this comedy comes from the fact that these two genetically engineered twins are so different from each other. Not including physical features elements in Touch Language will deprive the deafblind from such enjoyable airing, available to the hearing and seeing population. Thus, physical features are deemed useful, being as part of Touch Language and therefore are included to a certain degree as is discussed next. The issue of inclusion of ethnicity as characterized by looks and form of speech is left out at this time based on the discussion below, however it is kept open as an option based on future input from the interested public.

Mechanics of Articulating Physical Features

The mechanics is divided into two parts; Characterization and Magnitude. The characterization is divided into two sub segments, one to announce the physical feature delineations and one to specify the category. The magnitude provides the degree as related to the particular case depicted.

Characterization.

- Announcement. The announcement is provided by impact(s) on the center of the non-dominant palm.
- Specifying Category.

We will briefly discuss potential specific categories and the reasons for keeping some and discarding others.

- Height.
- Body size
- Degree of beauty
- Quality of voice
- Hair on the head
- Glasses

The only categories that will be discarded from the list are the degree of beauty and quality of voice, which we argue as follows.

The quality of voice, whether melodic, shrieking or any intermediate degree is foreign and incomprehensible to the deafblind who never heard sounds. It could be argued that the deafblind should not be deprived of creating an imaginary element called sound, which might be different for other deafblind and would be a private, non-realistic figment of the imagination creating a possible added sense of satisfaction. However, with the basic principle in Touch Language of minimizing nonessential information to avoid overload, this is a theoretical clutter of information not needed for the purpose Touch Language was developed. The degree of beauty is likewise a meaningless element to the deafblind. Unlike other elements to which a deafblind person has

never been exposed and a learning curve could familiarize him or her with the new article, beauty, or melodic elements will remain unattainable abstracts and do not justify inclusion in Touch Language. The category is provided by the appropriate number of nibbles at the center of the non-dominant palm.

Category	Number of Nibbles
Height	1
Body Size	2
Hair	3
Glasses	4

Magnitude.

The magnitude is provided by nibbles with a fixed set code that is the same for all cases, except that it adjusts with regards to specific case. There are two levels on each side of the "standard" that is denoted by three nibbles. The levels are "less" (2 nibbles) and "worse" (1 nibble) on one side of the standard and "more" (4 nibbles) or "plenty" (5 nibbles) on its other side. There is also an allowance for the extreme in both the lesser as well as the excess direction. For example, overweight (4 nibbles) and obese (5 nibbles), where the special case of unordinary very fat and heavy has a special designation of 5 nibbles accentuated by another group of five nibbles given in rapid impacts following a brief pause after the fifth nibble. On the other hand an extremely thin person who is anorexic will receive the single nibble for very thin, followed after a brief pause by rapid five successive nibbles. The material below elucidates and provides the code for the various cases.

Height	Number of Nibbles
[Midget]	1 + [Rapid 5]
Very short	1
Short	2
Average	**3**
Tall	4
Very tall	5
[Unusually tall/giant]	5 + [Rapid 5]

Body Size	Number of Nibbles
[Anorexic]	1 + [Rapid 5]
Extremely thin	1
Thin	2
Average	**3**
Obese	4
Fat	5
Unusually Fat	5 + [Rapid 5]

Hair	Number of Nibbles
[Bald]	1 + [Rapid 5]
Extremely short	1
Short	2
Average	**3**
Long	4

Very long	5
Unusually long	5 + [Rapid 5]

Eyeglasses	Number of Nibbles
[Contact lenses]	1 + [Rapid 5]
Lenses without frame	1
Thin lenses	2
Average lenses	3
Thick Lenses 4	
Very thick lenses	5
[Lenses + external help]	5 + [Rapid 5]

Location Exchange Action and Stereo Sound

The utility provided in Touch Language by using both right and left hand extends to scenes where rapid or sudden activity coupled with change of location is manifested. For example, a person that jumps from one rooftop of a house to another, say during a police chase, a person jumping from the rooftop of one car on a moving train to another rooftop of an adjacent car, or a car jumping a lane on the highway. Since both right hand PalmScreen and left hand PalmScreen operate in identical ways, and only the fingers contain specialized local information, we can utilize it for the purpose discussed.

Location Exchange

Activities utilizing location exchange make use of both Palm Screens as a simulated functional equivalent activity. For example, jumping activity as described above can occur from the major operational PalmScreen (i.e., the right hand one, for right-handed persons) where the activity start and completed *after* the jump on the other PalmScreen. Utility can also be made of sequential jumps by going back and forth between the two Palm Screens.

The location exchange concept of utilizing both Palm Screens can also be useful in conveying split screen situations operating on a TV show.

Stereo Sound

Functional equivalent stereo sound can be obtained by the same method of location exchange, where functional equivalent tones are used as we have already discussed in this book, utilizing vibrations and nibbles.

Localization of Scene Variables

Touch Language has certain peculiarities mandated by its transliterated connotations and visual elements. We have to accommodate scene elements that portray visually unspoken elements that are meaningful to the viewer. For example, you and I can be in the scene running away from somebody, or that person is the target of our pursuit. We could provide for your and my presence in the scene by simply symbolizing an additive particle like “and”. However, the object of our pursuit is also in the scene, yet a simple additive particle to connect between you and me carries a different connotation when applied to the object of our pursuit, since that person is in the scene but not with us and each of us has a different agenda. Thus, we recognize that elements in a scene could be both geographically apart, or conceptually distinguishable, which is important for the person who partakes in the TV or video enjoyment. The approach undertaken below answers the need we just encountered.

A. Geographic Localization

A. Scene Inclusion Variable

A scene inclusion variable provides descriptive elements to a scene as follows:

(a) A party or object that partakes in a like or simultaneous activity in a scene.
(b) A party or object that entered the ongoing scene
(c) A party or object that dropped out of an ongoing scene. This case is divided into two segments:

[C1] When a party or object drops out for good. For example, a person is killed or an object is blown away.

[C2] When a party or object drops out temporarily. For example, a person going behind an object such as a car or a pole and is not seen, or an object such as a gun being concealed behind the back.

We postulate that only elements essential in their relevance to the scene qualify for a scene inclusion variable. Such could be protagonists in a scene, or even environmental landscapes such as heavy rain or hale. However, if the Sun is shining, but there is no transliterated value to the scene, it does not qualify. The Sun does add transliterated value to the scene if its rays shine back in reflection from a piece of metal that carries meaning in the scene.

Value Indicators of the Variables

The Case above	Body part involved	Number of pecks
(a)	Back of non-dominant hand	4
(b)	Back of non-dominant hand	2
(c)	Back of non-dominant hand	1
(C1)	Back of non-dominant hand	1 followed by a line forming West to East at base of hand near wrist
(C2)	Same as in (C1) where the back of the non-dominant hand is utilized, except that either a horizontal line moves up or down, symbolizing where the party or the object disappeared, or a vertical line moving left to right or right to left, symbolizing direction of disappearance.	

B. The In-Wait Mode Variables

These variables are utilized when a static or dynamic scene contains a situation with anticipatory elements. Either, when protagonists or objects are anticipated to reach a geographic scene location or an action in the same geographic scene location.

Examples:

- A ticking bomb with time diminishing
  (1a) At the scene locality
  (1b) At a location away from the current scene locality
- An ambush of adversaries lying in wait;
- Gasoline dripping to floor, that could be ignited into a fireball upon ignition, say by a dropped cigarette. Also a gas line or pipe that could blow up (e.g., a room) when a spark is introduced;
- Police cars blocking a road with officers kneeling behind it or behind open doors with weapons drawn.

<u>Value Indicator for Variables</u>

The indicators are in the form of pecking provided either to the face of the First finger or fifth (Pinky) finger of the non-dominant hand (i.e., left hand for right handed persons). The frequency of pecking is low (e.g., 2 to 3 Seconds apart between two consecutive pecking impacts) and continues uninterruptedly until the event in-wait comes to a resolution when the event occurs. As the situation for which there exists a wait mode becomes closer, the frequency of the pecking impacts increases and just upon happening, the distance between pecking motions is less than one half of a second. Notice, that the same tool that shows accelerated occurrence of anticipated event is also the tool to induce tension in a functional equivalent musical formation, as is shown in another section of this book. We also notice that irrespective of change of scenes, the indicator continues to "blink" the in-wait situation, so that even while we are in a different scene we are constantly reminded about the situation in-wait. Here, the deafblind has an advantage over the seeing and hearing TV or video viewer who needs to keep in memory such visual in-wait scenes that are no longer visually available. He or she may forget about it, while the deafblind has it in active "blinking" memory regardless of the scene that is transliterated for his or her benefit. If a visual "in-wait" situation is shown on the TV or video screen by a split screen or a window-in-window screen, i.e., a second or smaller window, Touch Language foregoes the second window and maintains its own pecking frequencies to transmit such information.

Variable	Indicator
Wait-to-happen situation	*Continuous pecking on face of 1st Finger*
Wait-to-happen – geographically disjointed	*Continuous pecking on face of Pinky Finger*
Disjointed scenes of parallel activity of a Wait-to-happen	*Continuous pecking on face of Pinky Finger*

C. Environmental Scene Variables

Environmental scene elements, as we know them in the seeing population, relate not only to protagonists and objects in the environment. It also covers landscape as well the elements, such as resulting from atmospheric and local weather conditions. In order to minimize the intake burden on the user of Touch Language, we divide environments scene variables into two types.

- **Landscape Only**

  These are shows dedicated to showing landscape such as in a tour for viewers depicting mountains, lagoons, lakes and the like. In this category, one can concentrate on the descriptive elements utilizing few KeyWords and the rest being described on the PalmScreen via appropriate contours.

- **Material Landscape**

  Landscape appearing in a scene as part of a background is only secondary to the plot of the TV's script; otherwise it falls under the category of "Landscape Only". As such, we minimize the amount of information provided to the Touch Language user. Thus, only essential material to the scene is provided, such as rain, hale, wind, storm, lightening, dangerous slope of a mountain, steep hillside of a mountain, etc.

  It should be noted that some categories of material landscape are commingled with other material, such as In-Wait elements. An example is an In-Wait situation of a severe impeding storm or a hurricane, or an approaching tidal wave. Touch Language conveys both landscape only, as well as essential material related to landscape. The face of the Second and Fourth fingers of the non-dominant hand are the landscape descriptive fingers. Pecking on them conveys the elements as they relate to landscape, while the dominant hand provides the usual PalmScreen, KeyWords and other elements related to the description. The table below indicates the various elements pertaining to landscape realization.

State of Landscape Scene	Finger	No. of Pecks	Frequency [1]
	Constant State		
Increase State (e.g., of slope)	2	1	1
Decrease State (e.g., of slope)	2	1	0.5
Variable State – UP	4	3	[2]
Variable State – DOWN	4	5	[2]
Variable State – START	4	1	-
Variable State – END	4	2	-

[1] The Frequency is the number of seconds between adjacent/subsequent Pecks
[2] The frequency increased with height or downward depth

<u>II. Conceptual Localization.</u>

We recognize visually disjointed multiple scenes of common denominator to the plot as belonging to the same TV or video presentation, whether they appear to be of either geographic or conceptual localization. Such could be a case where certain activity is in locality A, where a different activity occurs in locality B, yet both activities relate to the story on TV or the video. In

essence, we encounter here multiple scene scenarios that for the deafblind would be quite confusing, where disconnected scenes may not have any immediate relevance. To this end, we introduce a multiple screen variable.

Multiple-Screen Variable

It is immaterial to the deafblind if the Multiple Screen Variable is a real multiple windows appearing simultaneously on the screen, or a facsimile multiple scenes that appear in succession on the screen, where each pertains to a disjointed situation, connected only by the plot. The reason is, that real multiple windows with different scenes are a visual engagement of human senses. Therefore, it is irrelevant to the deafblind. Thus, we can provide the deafblind with only one perception that counts for both cases. However, what is much more important, is to relate to the deafblind that the two disjointed scenes are related and the connectivity is yet to come. That is, there is no continuity among protagonists, objects and actions in one scene and the protagonists, objects and actions of the other scene. The connectivity is provided conceptually later on. Therefore, our task is to indicate that the scene in progress just changed to another locality, is reverted back to the earlier scene, or that connectivity between the scenes was made.

Scene Variable	Indication
Change of scene A to scene B	Double pecking on back of non-dominant hand at mid-East side of it.
Revert back from scene B to scene A	Double pecking on back of non-dominant hand at mid-West side of it.
Connectivity is made between scene A and B	Double pecking on back of non-dominant hand at BOTH mid-East and mid-West.

Teaching Touch Language to the Deafblind

Acceptance of Touch Language depends on its utility for the deafblind and therefore it is the deafblind whose verdict is the most important for its usability. One needs to teach Touch Language to the deafblind, have a large number of them from all level of education and society use it and average over their opinions and input. Without a selected large group of deafblind participating in a focus group to explore the language it would be a rather lengthy process, and while such exploratory verification could take time, such time is what would be taken away from all potential deafblind users who could benefit from it without delay]. An alternative step in that direction could be provided as discussed below in the section on the vehicle for Touch Language evolution. Thus, Touch Language is incomplete without an educational apparatus to teach the language. Such educational apparatus is significant in the sense that it needs to teach a deafblind to utilize the palm and fingers while those are the very own tools the person uses to capture information, as the deafblind cannot see illustrations or hear explanations instrumental in teaching usage of the language. To this end, a sample of a methodology to teach Touch Language to the deafblind is provided as part of this book.

The Language
The possibilities here are rather limited. One can either use:

- Palm fingerspelling, where the cupped palm is the recipient and fingerspelling is the delivering method; Or
- Braille read from elevated dots on paper or similar substrate, or through a specialized keyboard in computers retrofitted or built for deafblind usage; Or
- Morse code used either through an eCane (Liebermann 2003) or any other suitable delivery system; Or
- Any new method not known at the present time of writing.

The Procedure
The procedure alternates between explanation and hands-on examples of usage, one step at a time, where there is no concurrent or simultaneous explanation and demo due to the limitation imposed on the auditory-visual reception of the deafblind. Therefore, teaching Touch Language to the deafblind is done one language component at a time, with explanation, then hands-on demonstration and practice. When a few new perceptions have been taught, the training exercises are then built on samples extract from all previous taught concepts. To this end, the student of Touch Language is first taught the symbol of "end", so that he/she will know when to switch back to the explanation (language) mode. Appendix J provides examples relevant to the teaching of Touch Language.

Touch Language and Sensory Integration
The concept of Touch Language goes beyond a mere language and beyond the enabling of special effects, such as functional equivalent suspense music. Certain forms of utilization of the sense of touch can be incorporated into Touch Language to enable emotional states achieved normally by words, lyrics, music or combinations of them.
As such, the ability exists to provide the deafblind and others with a simulated effect that borders on individual reality testing. Such ability exists due to the fact, that five of our senses that are universally known are in fact only part of all the total senses available to us in one degree or another. Specifically, there are body / mind adjustment senses that come about as a result of sensory integration as we discuss next.

The Vestibular and Proprioceptive senses
Sensory integration employs two powerful senses. The Balance and movement sense is controlled by the inner ear (the Vestibular sense) yet relies on our sense of sight as well. Trying to raise a foot with open eyes requires very little dexterity, however done with closed eyes convinces us instantly that resisting gravity and maintaining balance is quite more difficult and serves as a testimonial to the sensory integration of the Vestibular and sense of sight. Another adaptive response taken by our body relates to the sense of body position as regulated by our joints and muscles (Proprioceptive sense). Trying for example to find the proper location of a sleeve to put our hand in behind our back without seeing the sleeve's entrance may occasionally prove problematic. Once again, the sensory integration of the Proprioceptive and sight senses are required to guarantee a successful operation without fail.

Another example is a person descending a staircase while observing the stairs on which each foot is landing, where an imperceptible inner calculation enables the person to judge correctly the amount of extension needed before resting each foot on any particular stair. It is sufficient for anyone descending such stairs with closed eyes and encountering an uneven spacing between consecutive stairs (a different height of a stair) to realize the uncertainty of stumbling on such a stair and the importance of the adaptive response related to the position of the body. The latter adaptive response of proper measurement of body (foot) poisoning is another example of sensory integration involving both the Proprioceptive as well as the sense of sight.
The deafblind cannot integrate sight to appropriate adaptive response and usage of a cane is quite prevalent, where the sense of touch is extended through a cane as a somewhat functional equivalent surrogate to seeing.

The Relevance for Touch Language

What is important for Touch Language is the realization that both the Vestibular and Proprioceptive senses in their forming adaptive responses generate an emotional sense of security in a person. While such a sense of security may go unnoticed, the lack of intact Vestibular and Proprioceptive sense leads to lack of gravitational security that begets an emotional sense of anxiety. The producer of a TV show creates for the viewer tense moments, by utilizing a combination of images and sound. Such tools are not appropriate for the deafblind. However, utilizing the human anxiety resulting from the lack of gravity-security can be utilized for a functionally equivalent tense moments in a TV show. Apparatus for the creation of such sensations is discussed somewhere else (Liebermann, 2002) and we will provide below elements that would enable such emotional states. However, we need first to discuss briefly certain elements of control as is done next.

Learned interpretations

Any language known, is learned in stages as people grow from infancy to maturity. Even hearing and seeing that are taken for granted by most people, are part of a learning process where the brain gleans the meaning of the sounds or sights. Hence, it is not surprising that Touch Language requires a learning process of intellectualizing the meanings of the various sensations of touch. However, what may come as surprise, is the related learning that emotionally induced effects of Touch Language are induced and temporary in nature.

Tools of Avoidance

TV or video viewers can divert their eyes from an unpleasant image, a shuddering image or objectionable image. They can mute the sound of the TV or mechanically close their ears to likewise unacceptable sounds. However, the deafblind partaking in a Touch TV interaction, appears to be vulnerable captive recipients of excitations that are designed to produce the same emotional effects. Therefore, it is both called for, befitting and necessary to provide the deafblind with the functional equivalent tools of avoidance. Such tools of avoidance, override the emotional effect commands. Simultaneously with such override mechanism, we introduce the “white sound effect” (the “white effect”), which is a benign signal present only during the duration of the emotional effect and active only upon activation of its avoidance. Such white effect provides the deafblind person with additional controls during his or her interaction with the TV and guarantees that no emotional displeasure is imposed on the individual partaking in the utilization of Touch TV.

The white effect is generated through an unobtrusive constant low-level (not necessarily low frequency) continuous vibration or a set of nibbles applied to the body.

The Non-entertainment Segment

The Touch Language elements provided below, are not only for the purpose of creating suspense and anxiety but could also serve for the purpose of inducing relaxation. Moreover, they could be utilized not only for the purpose of entertainment, e.g., TV or video, but also in educational and therapeutic modes, as is briefly mentioned below.

Autistic individuals respond well to external deep touch that brings about relaxation, which is not surprising to the non-autistic population that can identify with a similar sense derived from body massage. An embodiment of an apparatus that could deliver such results was discussed earlier (Liebermann, 2003). What may present a challenge, is providing the deafblind with the functionally equivalent emotional tools needed to induce a state of hypnosis for medical or psychological purposes. Hypnosis is achieved by the simultaneous introduction of a monotone relating and assuring voice coupled with focused sight attention on an object, produced continuously for a period of time. Such sensory integration is not available to the deafblind person, as both of the required ingredients are not available. Touch Language enables to substitute the ingredients with functionally equivalent sensory integrative ingredients. While in hypnosis we relax one of the ingredients (external sight) once the first level of hypnosis is achieved and enable the patient to substitute it with imagination and inner reflection or memory, we maintain the vocal segment throughout the hypnotic session. The vocal segment also serves as a communication element between patient and hypnotist, physician or therapist. The lack of the vocal segment when addressing a deafblind person presents us with the challenge of losing contact with the deafblind subject, who may drift into a sleep state disconnected from the guiding hypnotist. The author is unaware of any experiments or other hypnotic procedures conducted with any of the deafblind population. Thus, the proposition brought forth in this book to use Touch Language tools for achieving and maintaining a productive level of hypnosis with the deafblind, is only academic at this point, with no available documentary evidence that it might be successful. It is nonetheless brought forth with the hope that additional work will clarify the supposition. In that regard, we propose as tools for hypnosis the sensory integration of vibrations coupled with deep touch as well as the eCane (Liebermann, 2003), where the latter utilizes Morse code either through vibrations or nibbles as the bi-directional communicative channel during the hypnotic state. It should be noted that in such cases, a mechanical movement of the control finger by the deafblind person substitutes the verbal communication by the hypnotized patient.

The Touch Language Elements

The Touch Language elements are of value both to the designer, manufacturer and effect producer of the language, as well as for the direct or indirect user and beneficiary of it, such as the deafblind person. We have decided from the outset to limit the number of emotional grades available and introduce the two diagrammatically opposed emotional elements only with one additional modifier of a lesser degree for each. Thus, we provide below four emotional element states, one combinatorial element to produce simultaneous sensory integrative effect and one control element for avoidance.

Emotional States

State	
Hypnotic State	TBD
Relaxation State	TBD
Worry State	TBD
Anxiety State	TBD
Simultaneous Activation	TBD
Avoidance Control (toggle)	TBD

TBD = To be determined based on future controlled studies with deafblind participants.

We further provide below the base elements of language symbolism for some of the basic elements of Vestibular and Proprioceptive aspects. It goes without saying that an induced sense of lack of gravity will produce a feeling of anxiety, especially if prolonged beyond a brief instant, as much as a lack of balance could produce a state of worry. It needs to be examined, whether such added anxiety element for the deafblind is warranted at all.

Touch Language Symbols of Vestibular & Proprioceptive aspects

State of Lacking of	Adaptive Activity	Symbol
Gravity	Deflated resting platform	tbd
Balance	tbd	tbd

The Back of the Non-dominant Hand Revisited

We have encountered before, the back of the non-dominant hand as a signifier of Event Control. These control signals are applied to the CENTER of the back of the hand. We will now expand the utility of the back of the hand to provide more refined messages that are not provided by syntax only and are mostly determined by facial features, intonation and hand gestures. Needless to say, the deafblind need to become aware of such foregoing elements and the back of the non-dominant hand is selected for such task. In order to eliminate confusion we will maintain the central hand position for Event Control where Pecks / Vibrations determine the control function and will use the four corners of the back of the hand as recipient of Pecks providing the additional information. The only deviation will occur with midpoints we will discuss below as well. We start by allocating geographic meanings to segments on the back of the hand.

Back of the non-dominant hand Geography Assignments

The back of the non-dominant hand is divided into a 2 by 2 matrix that has four squares to it. The upper (closer to the fingers) two squares represent positive elements whereas the lower (closer to the wrist) two squares represent negative elements. The positive and negative are judged by our human social system. The East side of the back of the non-dominant hand (closer to the thumb) represents emotions, whereas the West side (closer to the Pinky) represents the way emotions are expressed, that is they are the emotive elements.

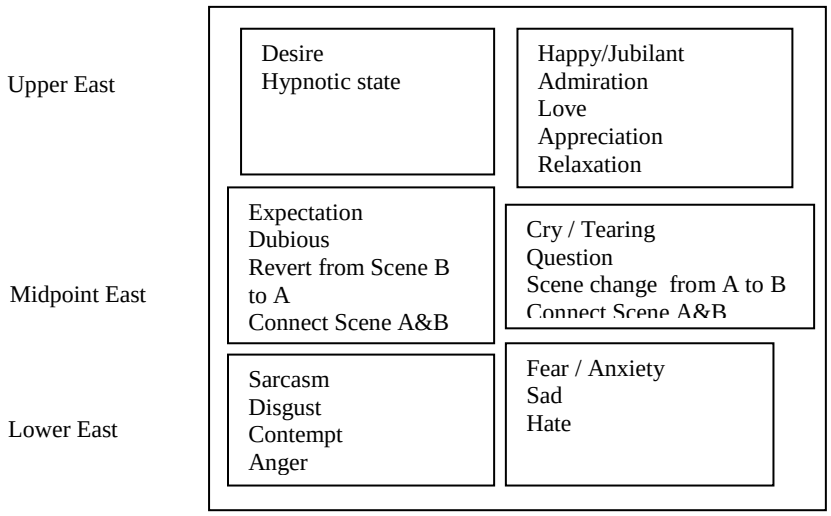
That is:
North East section represents such emotions as “happiness”, “love”, “benevolence”, etc.
South East section represents such emotions as “fear”, “sadness”, “anguish”, etc.
North West section represents such emotive as “desire”, “wish", etc.
South West section represents such emotive as “contempt”, “despise”, “disgust”, etc.

The midpoint area of the non-dominant back of hand harbors states that are either in-between or could signify a positive or negative. Thus the midpoint East side is reserved for such elements as “crying”, that could either be of happiness (i.e., belonging to the upper part) or crying out of sadness (i.e., belonging to the lower part). Likewise, we find on the midpoint of the West side, such elements as “dubious” that could be positive incredulity (i.e., belonging to the upper part) or questionable distrust (that belongs to the lower part). However, from a practical point of application, it may be difficult to discern the midpoint of the East or West side of the back of the hand, when the eyes do not follow the motion. This situation does not arise when pecks are applied to the North of the hand as it is almost on the knuckles and can be discerned. So is the case with the South section, when the pecks are impacting areas close to the wrist. To this end we introduce the midpoint as a three rapid successive impacts that start from the North then the midpoint then the south. If the nibbles call for two or three pecks to the midpoint of the hand side, then the three successive impacts repeat two or three times respectively. When both (West and East) midpoints are impacted simultaneously, the nibbles impact in tandem at the same time on the West and East side, starting from the North and ending at the South of the back of the hand.

Emotive & Emotions on Back of Hand

Emotive/Emotion	Location	No. of Pecks
Happy	North East	2
Love	North East	1
Appreciation	North East	3
Relaxation	North East	4
Sad	South East	2
Cry/tearful	Right Midpoint	1
Question	Right Midpoint	2
Expectation	Left Midpoint	1
Dubious	Left Midpoint	2
Contempt	South West	2
Sarcasm	South West	1
Disgust	South West	3
Despise	South West	4
Fear	South East	2
Hate	South East	3
Hypnotic State	North West	3
Desire	North West	1

Alternatively, if we observe the geographic divisions of the back of the non-dominant hand with its allocated emotions and emotive elements we have the following description:



The Pause and Continue Command

There are certain functions that Touch Language provides the user with an upper hand, as compared to a seeing person watching a TV or video show. For example, when watching a show on an analogue TV, once a frame has passed it is gone and the user cannot see it again unless watching the show again or recording it on such equipment as a VCR or using such an external device as a Tivo. Utilizing Touch TV (Liebermann, 2003), enables a person to bring out of the system buffer material just aired and stored in Touch Language variables for perceiving it anew. A similar capability is provided by the "Pause" command, which we study next.

Pause Command

A deafblind person who enjoys a TV airing, can leave in the middle of an active showing and put his system on "pause", return and continue to enjoy the showing or catch up with it during a commercial. To this end, we introduce a variable of synchronicity that tells the deafblind user if he or she is current with the broadcast, or how far they are from it. The Synchronicity Variable (SV) provides in essence the recent history of a show-in-progress, a show just starting, or that terminated. Such SV is local to a station "watched" at the time and does not pertain to any other station. However, once a user tunes into another station, an SV becomes automatically available and alerts the user to the status of the specific showing on that channel. Furthermore, the SV has an annex in the form of a guide, the Synchronicity Variable Guide (SVG) that follows the show's status report by providing a short description of the show topic. This feature is easily turned off by the "View" command and serves like a station specific TV Guide description. Three comments are in order:

- The SVG can run simultaneously with any current scene, so as not to loose any TV perception with others in the room partaking in the same showing and thus be as close to their temporal perception as possible.
- SVG starts automatically upon release of the "Pause" command and is available for any station upon switching to it, whereas it automatically starts unless shut off by the user.
- A channel visited last or within a show time maintains markers of description provided last, so that upon revisiting the user has the option to continue were he or she left off, rather than perceive the then current SVG.

Pause Command

Active command Body receptor	Passive Command Body receptor	Command/ Receptor	Body Part	# of Pecks	Frequency of Pecks_____
YES	---	Pause	tbd	tbd	tbd
YES	---	Continue	tbd	tbd	tbd
YES	---	Guide	tbd	tbd	tbd
	---	Show Status	tbd	tbd	tbd

Notice that the first three entries in the table are active body command and cease only if the user deactivates their automatic provision if desired at any stage.

Identifying the Speaker

Identifying the speaker visually is obvious, as we can see the speaking person. Identifying the speaking person when the material is textual is not direct and certain auxiliaries are utilized. Such auxiliaries are identifying each speaking person by name or starting a new line for each such speaking person. While deafblind persons can in principle read Braille, relying on new lines is partly visual and could present a problem for the deafblind even when following text. Thus, we are considering the following options for Touch Language.

- *The Dialogue box*. Braille and textual material can be used in the standard form.
- *Morse code*. Morse code should not be used for the purpose under discussion, as it is reserved for verbs utilized in conjunction with the PalmScreen and could be confusing with an added usage.
- *Sign Language Implements*. In Sign Language we position the parties in our mind and refer to each in a visual form. That is visual geography.

Taking our cue from Sign Language, we position speaking parties in functional equivalent visual form by using the hand as a Touch Language apparatus. The mechanism is provided below.

Geographical Placement of Speaking Parties. We utilize the back of the dominant hand, anywhere in the periphery and almost on the counter of the back of the hand (excluding the fingers) as the territory where we place the imaginary parties in the group. The placement is a mapping of locations where the parties are in reality, except that they are pushed to the periphery of the hand. There is no need to announce the presence of any party unless that party speaks or otherwise communicates by Sign Language or Touch Language. Only at that point does their presence become known, and even that only by default reasoning, as we pronounce their communication when relevant. There exist the possibility to announce their presence before any communication, so as to acknowledge such presence. This is done, by a single nibble on "their location" (i.e., on the back of the hand), so it does not come as a surprise when they start to communicate, because the deafblind cannot see them and thereby is unaware of their presence.

Format.

- When a particular party speaks, a line is formed on the back of the dominant hand starting from the imaginary position of that party and continues only slightly in the direction of the party who is spoken to or addressed.
- If no party is addressed in particular, the line stops only briefly, makes a semi-circle (i.e., a "U" turn) and returns half way back to the origination point.
- Invariably, the deafblind (i.e., the recipient of Touch Language) is considered to be in the virtual position of center of the back of the hand.
- If the speaker is positioned opposite the addressed party where the deafblind's virtual position is between the two (i.e., in the line of fire so to speak). A line is formed from the speaking party as usual, except that it proceeds almost to the center of the hand, draws a semi-circle around the imaginary position of the deafblind in the center of the hand and then proceeds a bit in a straight line towards the addressed party.

Finger Sensitivity and Avoiding Reception Mistakes

We next discuss finger sensitivity and an optional way to avoid mistakes in perception. The latter is especially poignant, when a finger is divided into three parts and an impact applied to one part could, when mistaken for another, mean a completely different interpretation.

Touch Language has an optional facility that assists the deafblind recipient in correctly identifying and determining which portion of the finger is being impacted. The singling out facility is based on the principle of elimination. Namely, we first eliminate the other two available options so that when the correct part of the finger is impacted there is no question as to the certainty of it. The elimination procedure operates by impacting rapidly the two finger parts that are not the main target of impact, then there is a briefly pause before the designated impact is delivered. There are however, instances when more than one part needs to be impacted. For example, delineating the fraction ½ requires an impact on the *base* of the back of the middle finger (for the numeral "1") followed by the fraction announcement (of "/") by a single impact on the back of the *top* of the middle finger and finishing with two impacts on the *base* of the third finger (for the numeral "2"). Obviously, it is imperative that we do not err in the interpretation of the areas of impact, let alone being able to distinguish among them. While the latter may be an individually sensitive dependant, we need a uniform mechanism that is devoid of such personal dependency and is available to all. To this end we introduce the mechanism described below through the examples provided.

We denote the back of a finger in the examples below by the capital letter "B", while denoting the face of the finger by "F". The number following the capital letter denotes the part of the finger and could assume only the numbers "1","2" or "3", while the number preceding the capital letters denotes the number of impacts. Thus, "2B3"means two impacts on the back third (or top) of the finger, while "1F2" means a single impact on the face of the second (middle) part of the finger. We also denote by "Rapid", a rapid sequence of impacts with 1/2 of a second or less separating between the impacts and by /t/ a pause that is longer than the time separation in the rapid impact sequence.

Example 1.
1/2 = 1B1 + 1B3 + 2B1

With the singling facility shown in square brackets we have:

1B1 = [1B3 + Rapid 1B2] /t/ 1B1
1B3 = [1B1 + Rapid 1B2] /t/ 1B3
2B1 = [1B3 + Rapid 1B2] /t/ 2B1

Example 2.
2/3 = 2B1 + 1B3 + 3B1

2B1 = [1B3 + Rapid 1B2] /t/ 2B1
1B3 = [1B1 + Rapid 1B2] /t/ 1B3
3B1 = [1B3 + Rapid 1B2] /t/ 3B1

Example 3.
324 = *(*300) + (20) + (4)
= (3B1 + 1F2) + (2B1 + 1F1) + (4B1)

(3B1 + 1F2) = ([1B3 + Rapid 1B2] /t/ 3B1 + [1F3 + Rapid1F1] /t/ 1F2)
(2B1 + 1F1) = ([1B3 + Rapid 1B2] /t/ 2B1 + [1F3 + Rapid1F2] /t/ 1F1)
(4B1) = [1B3 + Rapid 1B2] /t/ 4B1

Example 4.
3401 = (3000) + (400) + (1)
= (3B1 + 1F3) + (4B1 + 1F2) + (1B1)

(3B1 + 1F3) = ([1B3 + Rapid 1B2] /t/ 3B1 + [1F1 +Rapid 1F2] /t/ 1F3)
(4B1 + 1F2) = ([1B3 + Rapid 1B2] /t/ 4B1 + [1F3 + Rapid1F1] /t/ 1F2)
(1B1) = [1B3 + Rapid 1B2] /t/ 1B1

<u>Remarks</u>

- There are two ways to operate the area singling facility: top to bottom or bottom to top direction. To impose an ordering rule, such as top to bottom would be to impose an extraneous rule without any seeming validity. Therefore, no ordering rule exists, except the requirement that the order be kept consistent at all times. Thus, the sequential direction is left to the idiosyncratic choice of the hardware provider of the electronic gloves.

- The electronic gloves used to deliver the impacts and provide vibrations needs to fit properly the hand and fingers of the recipient and most likely

will be custom fitted to each individual, based on the size of fingers and hands. This should not deter the user, since other assistive devices, such as glasses for correcting vision are also made to fit individualy.

Touch Language Utilized in Communication

We have discussed the mechanism of utilizing Touch Language in a receptive mode for dynamic TV and video scenes. Touch language is capable of other utilities and we will discuss next its bi-directional communication aspect.

A deafblind person receives communications either by employing a Braille reader or by fingerspelling utilizing the hand as a receptor. Recently, a third form of communication was introduced with the introduction of the eCane (Liebermann 2003) that enables deafblind the utility of mobile phones, or face-to-face communications. However, all three methods depend on deciphering textual material in one form or another. Touch Language contains the ability to receive real time information in a new and more comprehensive form that is quite natural (i.e., after learning Touch Language). A sentence such as "A nice little old lady chases a naughty boy" could be transmitted in Touch Language by one word, three nibbles on one finger and single nibble on another finger, rather than the laborious fingerspelling of the whole sentence. Such Touch Language expression was already established before and our task now is to examine whether and how a deafblind person can generate Touch Language information with the same ease, so that it could be transmitted to others as well.

The transmission Mechanism

The transmission mechanism does not require the deafblind to learn any new language components, as the same ones used for reception are also used for transmission. The same meanings of fingers and other parts of the hands are operational. The only difference is that the nibbles are operating in a reversed mode. Namely, the deafblind presses keys that operate as nibbles in the reverse so that instead of providing impacts on certain locations of the fingers and in a specified number, it operates as a whole in a reversed mode. The nibble generating key, when pressed sends the information to the recipient. If the recipient is also a deafblind person then there is no need for intermediate transliteration of the meanings implied, since the recipient would also know Touch Language. Notwithstanding the above, there are a few Touch Language elements that need to be acquired for communication purposes that will be outlined next as communication controls.

Communication Controls

When Touch Language is utilized for communication, i.e., both for reception and transmission, we need to differentiate between Morse code generated by the user when providing verbs, and impacts generated by the user that relate to control activities. We will define for ease of presentation the fingers involved and number of impacts as follows:

The thumb of the Non Dominant Hand (NDHT) precedes the number of impacts generated by it. Thus NDHT2 means two impacts by the thumb of the non-dominant hand.

The Controls are:

Start Transmission mode	NDHT2
Morse Code activity for verbs	DHT
Activating Morse code for touch language	NDHT1
Terminating Morse code for touch language	NDHT1
Turn of Transmission mode	NDHT5

We note that the NDHT1 serves as an "On/Off" toggle switch to move between activating and terminating the Morse code. That is, keying it when Morse code is used for Touch Language and turn it off or activate it when it is not active. This switching is necessary in order to distinguish between verbs that are part of Touch Language descriptions and Morse code utilized for other words and sentences generated in the communication. We realize that the thumb of the Dominant hand does the keying for the Morse code, while the thumb of the non-dominant hand provides the controls.

The Functional Equivalent Communication Controls for the eCane

Utilizing Touch Language for communications while operating an eCane is similar, though certain modifications are required, due to the fact that the eCane already has built in mechanism for communication. We distinguish between two such operations, one with a Touch Language Glove (TLG) containing the reception and transmission impact generators and one without such a glove. The Touch Language Glove contains passive mechanical elements under its surface that are in contact with the hand and can impinge on the hand upon command. Likewise, the TLG contains extruding elements that can be utilized to key information in a reversed mode to the impinging of the passive mechanical elements.

Communication between two Deafblind Persons with Touch Language

Face to face communication when one of the parties is deafblind immediately positions the other person in a likewise delivery and reception position, unless such person uses mechanical and electronic auxiliaries such as the Touch Language Glove (TLG). We will next discuss such face-to-face communication, which we call Direct Touch Language Communication (Direct TLC), where each of the parties utilizes Touch Language and we'll observe any similarities and differences in TLG communication.

Mechanism of Direct TLC

- Dynamic activities are provided by party A articulating them on the PalmScreen of party B.
- The fingers of the non-dominant hand (NDH) of part A articulate the dynamic motions onto the PalmScreen of the dominant hand of party B.
    - If one of the parties is right handed and the other party is left handed then either the transmitting party switches between the dominant hand and NDH or mechanically transmits where one of the parties crosses the hands to enable symmetry between overlapping hands.

- The fingers of the NDH of party A provide impact nibbles on the dominant hand of party B.
- The fingers of the dominant-hand of party A provide impact nibbles on the NDH of party B.
- The rules for finger sensitivity and avoiding reception mistakes are adhered to in transmission utilizing the 2nd, 3rd, and 4th fingers to provide the needed mechanism.
- Morse provided to articulate verbs is either replaced by the dominant-hand fingerspelling the verb, or providing Morse code by party A's thumb to party B's thumb. The choice is left to the communicating users.
    - If one of the parties is right handed and the other party is left handed then in the case of Morse code the receiving finger is the fifth finger (pinky) rather then the thumb due to obvious asymmetrical issues.
- Questions end with vibrations, however, the vibration is provided by the fingers of the asking party grasping and slightly vibrating the fingers of the queried party.

Touch Language Grammar

Sentence: There are no sentences in Touch Language. What we have in Touch Language, is the functional equivalence of a grammatical sentence, irrespective of the language in which it appears. The reason lies in the fact that Touch Language is in effect a hybrid of elements from a spoken or signed language and elements of visual perception that are not translated into spoken language, but rather described pictorially on the PalmScreen and topped off conceptually with various combinations of pecks / nibbles on designated body parts (i.e., fingers, back of hands). Finally, a functional equivalent Touch Language sentence comes with its own "special effects" assortment components of timed pecks / nibbles that extend in frequency or spike up in frequency, while modulated at time with low or high pitch vibrations, as well as selective utilization of the non-dominant hand for stereo effects of both geographic and temporal facilities. While the functional equivalent sentence of Touch Language embodies an assembly of multiple components, it is more intuitive in its perception and thus easier to construe and comprehend. We address the components of Touch Language below and recognize that some such single components contain multiple components of non-Touch Language and are by themselves Touch Language particles. We also provide the simple grammatical rules that bind the components into a cohesive "grammatically" correct Touch Language. The rest of the rules and / or modifications will occur in the future as influenced by readers and in particular deafblind persons.

Component: **[Verb]**
Delivery: Morse code delivered to a designated body part
Purpose: To identify the primary action taking place in the scene
Touch Language Component: **[Action Particle]**

Component: **[Direction, Sequence, Position]**
Delivery: Pecks / nibbles impacted on the back of the dominant hand.
Purpose: The sequence and directions are necessary to provide order and sequence of events to uniquely delineate the event taking place
Touch Language Component: **[Event Control Particle]**

Component: **[noun, gender, adjective]**
Delivery: An individual finger selected from the four fingers (i.e., without the thumb) of the dominant hand
Purpose: To articulate the human personality with age and temper qualities
Touch Language Component: **[Protagonist Particle]**

Component: **[Adjective]**
Delivery: Peck / nibble on the descriptive finger
Purpose: To announce, age bracket, size component (e.g., big, small)
Touch Language Component: **[Magnitude Particle]**

Component: **[Connotation]**
Delivery: Peck / nibble of the face of finger of a non-dominant hand
Purpose: To imply connotations
Touch Language Component: **[Connotation Particle]**

Component: **[Sound]**
Delivery: Vibrations and / or pecks of various stationary or dynamically changing frequency of Pecks.
Purpose: Create functional equivalent sound effects, or other tension producing or anticipatory effects.
Touch Language Component: **[Special Effects]**

Component: **[Tense]**
Delivery: Pecks / Nibbles on the back of the non-dominant hand and pinky
Purpose: To differentiate between the present, past and future by indicating if the scene belong to say a past or future occurrence
Touch Language Component: **[Tense Particle]**

Component: **[Imperative]**
Delivery: Via the thumb of the dominant hand
Purpose: Alert the user (Passive Alert) or issued by the user (Active Alert), such as summoning the seeing dog.
Touch Language Component: **[Alert Particle]**

Grammar Binding Rules
Touch Language grammar consists of Touch Language particles adhering to simple building rules that will be provided next. Our goal is to minimize the number of rules and only those required for clarity are introduced.

The Rules
- Minimize as possible the amount of nonessential information to be provided.
- Whenever an Event Particle is associated, an Event Control Particle needs to sort out sequential and protagonist(s) elements.
- An Event Control Particle has a vector function and needs to appear when an Action Particle is manifested.

- There is no rule as to the position where the Event Control Particle is positioned, as it is language dependent [1].
- Special Effects are not a particle and can appear at any place, between particles, before or after particles or in parallel with any particles.
- Special Effects can occur even when no particle is utilized.
- Tense Particles can appear before, after or during any particles occurring.
- Alert Particles can appear at any time as priority.
- On usage of comparative elements, it does not matter if the connotation message is provided before or after the comparative message, as long that it does not interrupt the complete sequence of comparative adverb utilization
- Declaration of tense (past or future) always precedes the description.
- Refinement of tense (i.e., distinguishing among multiple occurrences) occurs immediately after the declaration of tense and precedes the description.

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[1] For example a congenitally deaf person that initially had eyesight and progressively became also blind due to say the Usher Syndrome, could have communicated in the US by American Sign Language prior to becoming deafblind. For such a person the phrase "A bad man chases a nice girl" would have been signed in ASL as "man bad girl nice chase". Another example is the German sentence "The father gave the pacifier to the son" appearing as "dem Sohn der Vater den Schuller gegeben" (word by word with position sensitive kept is: "the son the father the pacifier gave"). Translated Examples from other languages are plentiful. The rules for Touch Language that include sometimes lack of rules, are designed to preserve the global nature of Touch Language as a unified international language for the deafblind.

Additional Remarks

Touch Language is useful also for deaf persons who have full vision, as well as to persons with dyslexia watching TV or a video and possibly to other groups as well.

In American Sign Language (ASL), verbs are not mouthed, however, adjectives and adverbs are mouthed. That means that auxiliaries are needed to express adjectives. The case is different in Touch Language, where the mere choice of a particular finger already implies information regarding adjectives. However, certain groups of adverbs are missing in Touch Language by design. Namely they are omitted from the structure of the language in order to preserve the universality of the language. Let us divide the adverbs into groups and examine some of them to realize where they exist in Touch Language and why they survive as a non-threatening language component to the universality of Touch Language.

Adverbs:

Group A. Adverbs that are modifiers of adjectives belong to this group. For example, the adjective quick is modified to become the adverb quickly by adding the "ly" at the end of the adjective. This is the group that is omitted by design. We forego the adverb and use the adjective instead, even though it is sometimes provided in certain Sign Languages [2]. The reasoning for it, is simply to minimize the overload of information to the user of Touch Language, who can make sense of the meaning with the adjective alone and without its proper (hearing grammatical) replacement by the adverb.

[2] In some cases of Sign Language, the user shows the adverb of groups by showing the sign for "ly" for words so ending.

Group B. Adverbs that are time designators (such as past or future) and are provided by the back of the fifth (pinky) finger of the non-dominant hand.

Group C. Adverbs that are modifiers (descriptors) of nouns belong to this group. For example, the adjective "pretty" describing the noun "flower". Such descriptors are provided by the back of the first and fourth fingers of the non-dominant hand, which automatically also lets us know if the descriptor is positive or negative based on the specific finger selected.

Group D. Adverbs that render quantitative or measure information (such as "very" age bracket, etc.). These descriptors are provided by impacts in Touch Language, where the larger the numbers of impacts means the larger is the quantitative information.

Adverbs of Approximations

In spoken language we encounter approximations without much attention. Words like "nearly", "almost", "closer", "further" are incorporated almost automatically into sentences. Artificial intelligence that tries to imitate our brain functions in decisions making, does indeed take notice of the disparity between the exact and the approximation, to the degree that whereas neural networks are used for exact situations, a totally different system, Fuzzy Logic is utilized for approximation such as "warm", "early" or "later". Touch Language is an artificially induced language that is not intuitive, nor automatic. Hence, we need to provide users of the language, with the tools to relate approximated situations. We turn next our attention to such definitions and articulations.

The Comparative Group

We group words of approximation together with their potential conditional status. Namely, we do not define separately words like "almost" and "remotely", but rather recognize that they are at the opposite sides of a description and lump them into a conditional status where they emerge as solutions to comparative question. Putting it another way, we induce a comparison where the words "almost" or "remotely" are the answers to an imposed unspoken question in the in the above example.

To this end, we introduce the "compare" notion that does not require the user to do any comparisons, but rather makes the user aware of a decision tree selection process where the ensuing actions provide the "answers", i.e., the approximated states.

The back of the third and fourth fingers of the non-dominant hand provide together as a group the role for the "approximate" announcement, and act separately in providing the answer.

Rapid alternate impacts on the comparative fingers (i.e., starting with one, then the other, back to the first and ending with the second) create a sense of unity, yet separateness, and serves to announce the "comparative state". We chose the finger closer to the thumb as the one relating

information of “close” and the finger further from the thumb to relate “remote”. Finally we apply nibbles, to the back of only one of the fingers that implies what our choice is (i.e., close or remote), while fine tuning it by the number of impacts, where more impacts mean either “closer” or “farther”. The mechanism just introduced, enables us to transmit spoken information described by words such as “almost”, “closer” or “farther”, in a simple and logical way that could become intuitive after learning and practice. The structure however, is incomplete without a mechanism to announce the termination of the comparative declaration of the adverbs we discussed. To this end we employ again the very same fingers used as a group to announce the comparative situation to now announce that the process has ended. This is achieved by utilizing a rapid employment to the fingers as before, except that instead of the rapid impacts on them in alternate fashion we provide a sense of a sliding object on one finger, then the other and repeat it in the same fashion done before with the impacts. The table below provides a summary.

TABLE [NDH stands for Non-Dominant-Hand]

Start Comparative used Structure	Sequence Number of	Fingers
Nibbles/Lines		
Start comparative 1 each time Structure	4, 3 (NDH)	4,3,4,3
End comparative 1 each time Structure	4, 3 (NDH)	4,3,4,3
Close, Almost, etc.	3	1 to rapid 6
Remote, Farther, etc.	4	1 to 6 evenly spaced

Comparative and Superlative Words

The English language provides comparative elements between words by the suffix “er” or “est” at the end of the word. Thus, “my tea is ‘hott*er”* (“ than yours”) and “tonight is the ‘cold*est*’ (“of all nights”), compares one element to another in the former (the comparative) or one element to the rest of them in the latter (the superlative). Other languages and cultures may have their own format rules to express comparative and superlative elements, including the idiosyncrasies of exceptions to the rules. For example, the word “good” in the English language that turns into “better” on the comparative level and “best” on the superlative level. Finally, there are words that are distinguished as incomparable, such as “unique” or “perfect”.

Touch Language has a format that is language independent and is understood cross-culturally and cross-languages. Touch Language has four components applicable equally to either comparative or superlative situations. One of the components, the magnitude, intuitively determines the situation at hand. There are no exceptions to the rule, neither are they needed. The incomparable class stands out as the “extreme group” in Touch Language, denoted by the maximal designation of [N3 + Rapid N5].

The Comparative Components

Component (a): Declaratory component that alerts the user to the fact
Component (b): Magnitude applied to provide degree of comparison
Component (c): Identifying the participants in the comparison
Component (d): Pointing to (implied) the owner of the largest magnitude

Component	Finger	Nibbles	Format
Declaratory	2,3, 2, 3	N1, N1, N1, N1	Announcing that next is comparison
Magnitude		Back of 4th	N1, N2, N3, [N3 +Rapid N5]
Identifying		tbd	Elements being compared
Ownership		tbd	First adjective owns the magnitude

Magnitude Levels		Examples
N1	First level	"better", "bigger"
N2	Second Level	"much better", 'significantly bigger"
N3	"Most"	"Best", Biggest"
[N3 + Rapid N5]	Extreme	"unique", "perfect"

N1 = one Nibble; N3 = three Nibbles

Format Order

First element of comparison that owns the magnitude, followed by the magnitude that is followed by the element(s) compared with.

For example, consider the sentence: "the woman has a bigger shoe than the boy's shoe". In Touch Language it will appear as "Woman's shoe, bigger, boy's shoe". However, even before the notion "woman" in this example appears, Touch Language declares that the next coming information is related to comparison. The declaration involves the back of the second and third (middle) fingers of the non-dominant hand, by impacting a single nibble on each one in succession repeated twice. That is, back of second finger then third, then second again and terminating on the back of the third finger. Once the declaration is made, nibbles impacting the back of the fourth finger provide the appropriate magnitude to the comparative or superlative, as is appropriate.

Notice, that the third (middle) finger of the non-dominant hand, together with its adjacent fingers, second and fourth form the total comparative groups. That is, the fourth finger provides comparative information about approximations (e.g., close or remote), while the second finger provides comparative and superlative information. The summary of the comparative and superlative information is provided in the table below.

SUMMARY TABLE

Start Comparative Structure	Fingers used	Sequence	Number of Nibbles / Lines
Start comparative Structure	2, 3 (NDH)	2,3,2,3	1 each time
End comparative Structure	2, 3 (NDH)	2,3,2,3	1 each time
Comparative	2		1 to 2
Superlative	2		3 to [3 + Rapid 5]

NDH stands for Non-Dominant-Hand

The same fingers and series of impacts used to announce comparatives and superlatives, when repeated designate the ending of such usage.

Modifiers

Notwithstanding our presentation regarding comparatives and superlatives, there are instances where we would need to quickly modify a description by lessening its gravity, upgrading its seriousness or neither of these extremes, but make horizontal adjustments. For example, somebody could be naughty but not bad, unmotivated but not lazy, or frugal rather than miser. On the other hand, a person could be complementary rather than flirtatious, or pay attention to detail rather than be pedantic. We want to provide the Touch Language recipient the ability to perceive subtle differences and nuances and therefore introduce several (5 or more) impact nibbles on the back of the non-dominant hand (NDH), immediately subsequent to an articulation of any element we wish to modify. Impact nibbles on the top (north) of the back of the NDH means upgrade the seriousness of the element just introduced, impacts on the bottom (south) of the back of the NDH means decrease the gravity, and impacting cyclically on the East then West, back to East, etc. of the back of the NDH, means neither upgrade nor downgrade but only easing off the notion. The table below shows the cases just described.

Modification	Starting Position	Ending Position
Lazy	Unmotivated	Lazy
Horizontal	Attention to detail	Pedantic
Lower	Bad	Naughty

Commingled Use of same fingers

There are instances where a particular finger is utilized for more than one purpose. The task in front of us, is to distinguish unmistakably between the uses, while guarding that we do not overburden the user with memory requirements. The following example will elucidate the point in the context of the adverbs of approximation.

Consider the words “farther” relating to distance and the word “further” relating to more abstract aspects, even if they denote not only ideas and time but also activities. While admittedly this

example relates to a specific language, English in this case, it is important nonetheless for laying the groundwork for further analyses and evolvement of Touch Language as related to its cross language and culture utility.

RXAMPLE: Farther* and *further

"Farther" will carry a comparative designation and the articulation of magnitude; however, it will also get a locality designation (e.g., by vibrations providing functional equivalence of scene locality as discussed somewhere else in this book). "Further" will also receive a comparative designation with magnitude, except that it will also receive a connotation designation (i.e., nibble on back of non-dominant middle finger). We observe that in the latter case, the middle (third) finger is used for two different messages. The first message provided, is for the comparative condition and the second message for the "connotation" aspect. In reality this should not be confusing at all, as long as the basic rule of order is observed. The rule specifies that it does not matter if the connotation message is provided before or after the comparative message, as long that it does not interrupt the complete sequence of comparative adverb utilization.

Various Grammatical Tense Issues

We revisit grammatical tense below and refine it for multiple event chronology in Touch Language. We have discussed past and future tense in Touch Language. We will now advance to the next level of refinement, where we recognize that in description of either past or future, there is a need for order, where multiple occurrences took or will take place. As we will shortly realize, we need both an order function, as well as a point of reference and there is more than one option for the latter. The present book is written in English and as such, past and future tense will be discussed in that context. However, recognizing that Touch Language is created as an international and cross culture language tool, we will depart from the exposition when developing the construct that would answer the basic premise of Touch Language universality.

Multiple Past and Future Tense Occurrences

English Grammar designates multiple past occurrences by preceding earlier occurred verbs with the word "had". For example, "I had gone to the market and bought fish". The example demonstrates both multiple past activities as well as the order in which they occurred, where buying the fish was subsequent to going to the market. Touch Language has its own past designation by assigning tense to a finger (the back of the non-dominant fifth finger), however, an ordering function is required in order to enable timeline realization of earlier and subsequent. The back of the thumb of the non-dominant hand provides the ordering function. In that regard, when that thumb is not activated for such purpose, then it is a simple past or future situation. However, when a multiple occurrence prevails, the ordering function (i.e., the back of the thumb of the non-dominant hand) becomes operational, assisting in refining the situation. In the latter case its function is always subsequent to the tense function declared by the back of the fifth finger of the non-dominant hand. The table below provides a summary of the ordering and chronology function.

Event Chronology	Hand Involved	Finger	# of Nibbles
Past	NDH	Thumb	N1
Earlier Past	NDH	Thumb	N2
Earlier Than the Earlier Past	NDH	Thumb	N3
Ancient	NDH	Thumb	N3 + [Rapid N5]
Future	NDH	Thumb	N1
Further Future	NDH	Thumb	N2
Further Than Further Future	NDH	Thumb	N3
Extremely Remote Future	NDH	Thumb	N3 + [Rapid N5]

Notice that the chronology function has the same values for both past and future and the case showing which one it is, is determined by the back of the non-dominant fifth finger.

Point of Reference

The point of reference determination is needed in order to determine whether the nibbles proclaim events in ascending order or descending order. Namely, when we consider multiple past occurrences, should a single nibble be the closest event to the present and three nibbles the furthest event from the present, declaring the time arrow pointing and going in the past direction, or should we start with the occurrence way in the past declared by a single nibble and progress to the present with the closest to it declared by three nibbles? Likewise, we need to consider the future direction as well. For the reasons given below, we argue for the time direction to go towards the past and in the future direction to point towards the future as the default case in Touch Language.

Since single nibbles represent simple past or future tense has been described before, it will be consistent to adhere to the procedure and increase the number of nibbles as we progress further into the future or go back into the past. That is the Present being the point of reference by default. Let us look briefly at the reasons for the default situation that is imposed on the deafblind user of Touch Language.

Deafblind individuals who are aware of Grammar and its structure, are more exposed to cultural and other linguistic elements and indeed would come to expect its manifestation also in Touch Language. However, these are the people that possess the sophistication to change the default case as suitable to their own situation if so desired. However, if the deafblind individusl does not read Braille, is less exposed to linguistic and cultural elements, then the default makes it easier to perceive the situation. Finally and most importantly is the fact that in order to preserve the universality of Touch Language, the default case holds.

Verbs in Touch Language

We discussed the communication of verbs in Touch Language, where the verbs are spelled utilizing the Morse code. One of the goals of Touch Language, is to be useful cross languages and cultures tool. Therefore, in order to ascertain that Touch Language is completely transparent to language we introduce the inherent Touch Language structure for verbs.

Deaf persons who use Sign Language do not need to be familiar with the 70,000 words or so one can find in an English dictionary. Instead, they utilize signs that correspond to an approximate subset of some 2,500 to 3,500 words. Such economy in signs is achieved at the cost of relinquishing some fine grain detail and nuances of words, where a particular word can describe several elements. For example, happy, merry, and gay, all share the same sign. Likewise, buy and purchase; obtain and get; walk / go; see / view. Each group shares the same sign.

The reverse, where particular words have multiple meanings does not pose a problem in Sign Language, since the potential for confusion is averted, as every meaning has a different sign associated with it. Namely, a word like "cool" is signed differently for cool temperature and a person considered to be cool. That goes for any words having multiple meaning.

Touch Language accords us further economy in articulating verbs. For example, if a small animal is a protagonist in a description, we will give up the distinction whether such small animal is a "dog", "cat", or "rabbit". The impetus for such cavalier handling of the specifics of such a small animal, results from the assumption that a congenital deafblind person has never seen a dog or a cat and therefore giving up such articulation is not too heavy of a price to pay. Late blind persons who have seen such animals would certainly realize the lost articulation and would be more cognizant of the price paid; yet the result would be the same. Likewise, if an assault instrument is a knife, sword, pistol or rifle is of less importance than the notion of it being an assault instrument. Such and similar economy, drastically reduces the number of verbs needed to be part of the Touch Language bank of verbs. We will shortly make use of that advantage. The potential for confusion is averted since, as we saw earlier in Sign Language every meaning has a different sign.

We will first group necessary articles into Touch Language "types", and then proceed to introduce the rules required to form the realization of the verbs.

Certain signals assist in articulations of the verbs.

- A short vibration signals the beginning of a verb, whereas two successive short vibrations mark the end of a verb description.
- The number of nibbles (i.e., short pecking), provides the order of magnitude for the articulations. Order of magnitude can be assigned to different articulations.
  For example:

    - Propagation
        - Stationary (single nibble)
        - Slow (two successive nibbles)
        - Fast (three successive nibbles)
        - Very fast (five or more rapid nibbles)

- Nature of Protagonist:
    - Live; Still; Growth

- **Elements:**
    - **Earth; Water; Air;**
    - **Natural**
    - **Manufactured**
    - **Material**

- Vertical Locations:
    - Upper; Midsection; Lower
- Positions:
    - Front; Back; Right; Left

- Relational Locations:
    - On; In; Under; next to

- Distance:
    - Close, far; very far away. [nibble controled]
- Time:
    - Now; imminent; some delay; long delay [nibble controlled]

- Temperature:
    - Cold; freezing; warm; hot; scolding

- Basic Dynamics (motions)
    - Inward or outward
    - Individual independent motion
    - Individual motion with respect to:
        - Human;
        - Animal;
        - Growth
        - Object

- Basic Interactivity
    - Hostile; injury inflicting; war; [nibbles dictate strength: Hostile =1; injury inflicting = 2; war = 3]
    - Friendly; loving; amorous [nibble number controls level]

[.] Signifies a single peck (Nibble)
[.] [.] Signifies two rapid pecks
[~] Signifies a single vibration
[~][~] Signifies two rapid vibrations.

Multiples have a similar meaning to the above (e.g. [.][.][.]) means three rapid pecks.

2/12/05 [Verbs are after single vibration and end with the double vibration. One can use the whole rich Touch Language inside the vibrations for the / assistance with description of VERBS. // Location; Quantities//

- [.] Protagonist Group: A+a+1
    - [~] Living
        - Man
        - Animal
            - Interactive
                - Man/man (stands for either gender)
                - Man/animal
                - Animal/animal
    - [~] [~]Still
        - Material
        - Terrestrial (earth; stones; compositions)
        - Made/manufactured
            - Interactive
                - Material/material
                - Material/man
                - Material/animal
    - [~][~][~] Growth
        - X
            - Interactive
                - Growth/growth
                - Growth/man
                - Growth/animal
                - Growth/material

- [..] Interactive Group:
- x

- […] Dynamic Group:
- x

- [.] [.] Abstract Group:
    - Mental
        - Think
        - Realize
        - Scheme
    - Emotional
        - Feel
        - Desire
    - Mix mental/Emotional

- Size
    - Small
    - Medium
    - Large
    - Very large
    - Enormous

Touch Tone telephone has crossing of different 3 x 4 tones, where each combination represents a unique number (the key number hit).

Each represented number from the 3 x 4 is represented by a unique combination of vibrations (horizontal lined numbers) and Nibbles (vertical lines).

Vibrations can be either a single vibration, a rapid two successive vibrations or three vibrations.

Nibbles can be from 1 to 4 pecks.

The total is 12 combinations that we utilize in communicating in Touch Language such groups as "Protagonists", "Interactive," "Dynamic", etc.

NOTE: An alternative is to have the vibrations as Group A, Pecks as Subgroup a.

THEREFORE,
<u>Possibilities</u>:
(1) We have 3 types of X and 4 types of Y to a Total of [ ]
(2) We have 3 [exp 4] to a total of [81 possibilities]

Announcing the verbs can be either of the following options:

START: One vibration on Left Hand
END: Two short vibrations on Left Hand
COMMENT: The vibrations can confused the Vibration / Nibble matrix

OPTION I: Same as above, BUT on the right hand side (RHS), so it does not confuse anything, as it starts with vibrations and nothing on RHS works with Vibrations.

OPTION II:
STRAT: An exact simultaneous Vibration and Nibble on the left hand side (LHS)

Points on back of Left Hand:

2	3	4
	7	
1	6	5

START: Single vibration Left Hand

- **Impact** [Simultaneous Nibble on 3rd + 4th fingers Left Hand]
- **Acquisition** [Simultaneous Nibble on 4th +5th fingers Left Hand]
- **Movement** [Simultaneous Nibble on 2nd + 3rd finger Left Hand]
    - *Direction* [Finger 1 Left Hand]
        - Up [point 3]
        - Down [point 6]
        - Left [point 2]
        - Right [point 4]
        - Ahead [point 7 then point 3]
        - Backwards [point 7 then 6]

    - *Strength* [Finger 2 Left Hand]
        - Soft [point 1]
        - Strong/Hard [point 5]
        - Nil [point 7]
        - Forceful [points 2 + 4]

    - *Velocity* [Finger 3 Left Hand]
        - Stationary [point 7]
        - Slow [point 1]
        - Fast [point 5]
        - Very Fast [points 2 +4]
        - Repeatedly [multiple nibbles point 7]

    - *Functional* [Finger 4 Left Hand]
        - Active [points 7 +2]
        - Passive [points 7 + 5]

    - *Senses* [Finger 5]
        - Smell [point 2]
        - Observe [point 4]
        - Feel [point 5]
        - See/Hear? [point1]

END: Two rapid vibrations Left Hand

NOMECLATURE

Movement:	a
Impact:	b
Acquisition:	c
Definitions	d

Direction:	1
Strength:	2
Velocity:	3
Functional:	4
Senses:	5

Procedure

START: Single vibration Left Hand

General Procedure
Segment A + Segment D + Segment B + Segment C

END: Two rapid vibrations Left Hand

Procedure Announcement

Segment A (Movement) = A single nibble on back of Left Hand 2nd and 3rd fingers Simultaneously
Segment B (acquisition) = A single nibble on back of Left Hand 4th and 5th fingers Simultaneously

Segment C (Impact) = A single nibble on back of Left Hand 2nd and 5th fingers Simultaneously

Segment D (Definitions) = A group four instances provided below

Segment D (Group D [Protagonists])
D(1) [Abstract] = Short successive nibbles on the back of finger 1 and 2
D(2) [Living] = Short successive nibbles on the back of finger 1 and 3
D(3) [Still] = Short successive nibbles on the back of finger 1 and 4
D(4) [Growth] = Short successive nibbles on the back of finger 1 and 5

Sub Segment A [Movement]
Inward; outward

Sub Segment B = A single nibble on the back of the relevant single finger

B(1) [Direction] = Nibble on finger 1
B(2) [Strength] = Nibble on finger 2
B(3) [Velocity] = Nibble on finger 3
B(4) [Functional] = Nibble on finger 4
B(5) [Senses] = Nibble on finger 5

Sub Segment C = Nibbles on specific points on Back Of Left Hand

Specific Sub Segment C Detail is provided by singling out specific points on the back of the left hand. Each of the points has several meanings. However, the meanings are uniquely defined once Segment B particular [i.e., B(i)] is uniquely defined. We will first introduce the locations of points on the back of the left hand and then articulate their appropriate meaning as related to the specific B(i) declaration.

Specific Points On Back of Left Hand:
The numbers below are to be considered as positioned on the back of the left hand where the fingers point to the top of the page. The numbers provide only names for the points in order to distinguish among the locations.

2	3	4
	7	
1	6	5

Specific Sub Segment B(i) detail:

- B(1) [Direction]: up; down; right; left; ahead; backwards; inward; outward
    - Up = Point 2
    - Down = Point 1
    - Right = Point 5
    - Left = Point 1
    - Ahead = Successively Points 7 then Point 3
    - Backwards = Successively Points 7 then Point 6
    - Inward = Successively Point 3 then Point 6
    - Outward = Successively Point 6 then Point 3

- B(2) [Strength]: soft; nil; strong; forceful
    - Soft = Point 1
    - Nil = Point 7
    - Strong = Point 2
    - Forceful = successively twice Point 2

- B(3) [Velocity]: = slow; stationary; fast; very fast; repeatedly
    - Slow = Point 1
    - Stationary = Point 7
    - Fast = Point 2
    - Very fast = successively twice Point 2
    - Repeatedly = successively twice Point 7
- B(4) [Functional]: = passive; nil; active; natural; manufactured
    - Passive = Point 1
    - Nil = Point 7
    - Active = Point 2
    - Natural = Successively Point 5 then Point 1
    - Manufactured = Successively Point 1 then Point 5
- B(5) [Senses]: feel; smell; observe (for hearing and seeing); thoughtful
    - Feel = Point 1
    - Smell = Point 2
    - Observe = Point 4
    - Thoughtful = Point 7

B(2) [Strength]: soft; nil; strong; forceful
B(3) [Velocity]: slow; stationary; fast very fast; repeatedly
B(4) [Functional]: passive; nil; active; natural; manufactured
B(5) [Senses]: smell; feel; observe (for hearing and seeing); thoughtful

Teaching Touch Language

While it may be laborious to teach Touch Language to hearing and seeing persons, the task is no more arduous than teaching any spoken language. In fact, in teaching spoken languages we have to teach both the meaning that touch language does not require, nor the words or their representation, i.e., spelling, not required in Touch Language. Touch language does not require learning spelling of words and is also intuitive to a great degree. Thus, learning touch language by non deafblind persons, could be accomplished in much lesser time than any spoken language that normally takes years to master.

Teaching Touch Language to the deafblind however, poses a problem of communication right from the outset, as the tools that we teach for ease of communications are the very same elements that we ought to teach. Intuitively, one would think of either finger-spelling or Braille as teaching tools. True enough finger-spelling is one on the very short list of communication tools available and albeit the tediousness one could use it to teach Touch Language, step by step and if assisted with pre-prepared tutorial, may even be straightforward. However, we have to bear in mind that exercising while learning is imperative for retaining the new elements taught and commit them to memory, needed for automatic recall. Since Touch Language requires a set of special gloves, teaching with finger spelling has to be done one hand at a time, where the ungloved hand is utilized for finger spelling. To complicate the issue, we have to remember that there are Touch Language elements that make use of both hands and the teacher of Touch Language would need to consider special requirements for these cases.

Braille is so far the premier choice when it comes to fast reading of text that would be quite useful in teaching Touch Language. The fingertips in each glove are kept open and thereby allow simultaneous learning and exercising of new learned material.

Touch Language Structural Concept

An event is transliterated to Touch Language in the order in which it occurs, much like in ASL. However, unlike ASL the topic is not announced first and in fact is not singled out for announcement at all. The reason is that Touch Language is contemplated for use in depiction of dynamic events that could change rapidly, simultaneously occurring of multiple events that could also interlock. Multiple simultaneous windows on TV are also possible, as we already addressed earlier. Imposing a rule for topic first would go against our philosophy of simplicity and universality of the language. Furthermore, verbs in Touch Language are transmitted by Morse code, which gives them a unique standing and singles them out for attention, and could mostly provide a fairly good event idea.

Question and Question Mark in Touch Language

In ASL there is a pause at the end of a question. We cannot afford such a pause in Touch Language with its busy dynamic processing. Neither is the functional equivalent question mark in Touch Language provided by Morse code, but is rather transmitted by other means. This is done for the purpose of simplicity and considering the fact that a query in Morse code requires a total of six impacts (two regular, two rapid and two regular).

In Touch Language we signify a question (appearing in a short dynamic process) by applying a short vibration to the finger involved in the representation, at the end of impact (nibble) application to the finger. For example, consider a scene where an adult male issues a command to an adult female whose path of walking has just been articulated on the PalmScreen, and the adult female starts to run and asks "*why*?". The latter part is articulated in Touch Language by two nibbles on the fifth finger (Pinky) of the dominant hand followed by a short vibration to the fifth finger, followed by the articulation for "why". Note, that the functional equivalent question mark in Touch Language is not provided after the articulation of "why" but rather before it. This order is not relevant to the word "why" and no rule should be inferred as being imposed for it in Touch Language. The short vibration symbolizing the functional equivalent question mark in Touch Language is always <u>coupled to the person</u> who asks it, and is provided at the end of fully identifying such person, i.e., including gender and age bracket. The vibration can be stretched out to be longer if emphasis is required, such as in the case of bewilderment or shock.

Command and the Exclamation Mark in Touch Language

A command in Touch Language is implied by two rapid successive short vibrations attached to the finger symbolizing the party issuing the command, while articulating the recipient party on the back of the non-dominant hand that points out the recipient in line with a technique discussed earlier. The two successive rapid vibrations are applied to the person finger in the dominant hand followed by articulation of the recipient.

Multiples
In both the question mark and the command we signify the written equivalency of such multiples as “????” or “!!!!” carrying their respective meanings by a time elongated vibration for the question and activating a [0 +Rapid 5] nibbles immediately after the vibration in the case of the command.

Appropriated Words
Many languages appropriate words from other languages as a natural process of language evolution, attesting to the reality of population mobility and globalization. Touch Language is a universal language that cuts across cultures and it would appear from the outset that the notion of appropriated words is irrelevant. However, appropriated words sometimes replace local words and as such could be a source of confusion. Therefore, Touch Language provides designation that declares a word, notion or another element to be foreign or appropriated. It is important in particular if the word is a verb that carries a distinct connotation. For example, an English description of a person who drags himself or herself by carrying objects utilize the Yiddish verb “Schlep” utilized as a verb in English. Another example is “rendezvous”, the French word for "appointment" or “meeting”, used in English as a verb, as it appears in the acronym of the French word for "response" in the “RSVP” where the “R” stands for “respondez” or "answer". [namely " Répondez, s'il vous plaît" in French, and "Please answer" in English, where both are abbreviated as "RSVP"].

Singular and Plural Descriptions
All descriptions in Touch Language are singular, except when identified differently as such. Warranted plurality in descriptions could be one of two types, either a specific numerical description, such as “two children” or “three cars”, or non-numeric plurals belonging to the Fuzzy group, such as “many” or “few”. We already know that we can attach a numeric factor to a person-finger or an item and know how to provide information about the numeric factor. The question remaining before us, pertains to the Fuzzy group. As we discuss somewhere else in this book, undetermined person, or persons are designated by providing rapid successive single impact to all the four of the person-fingers. Such articulation of a fuzzy designation provides the recipient with additional information at no additional effort, as it provides also the age group, gender and personality traits. When a total group of persons consists of mixed age group we simply avoid information about the age group, which signals a lack of knowledge or in other words a mixture. When the gender group consists of only males or females we first provide the general group designation of impacting on all the four person-fingers and then proceed to impact in succession the two person-fingers pertaining to the group of interest, i.e., men or women.

Personification
ASL uses agents to personify signs. For example, “buy” plus an agent turns to be “buyer” and ”shoot” plus an agent becomes “shooter”. Personification in Touch Language is achieved by adding the person-element to the verb and distinguishing it from the action signified by the verb, through a single nibble to the face of the person-finger. Thus, Touch Language provides more information than ASL, because the personification also carries information about the gender, age and personality of the subject. However, in order to alert the Touch Language recipient that the Morse code describing the verb is utilized for personification, we start with the personification nibble on the face of the person-finger prior to the Morse code. When Morse code is required

twice in the same description, such as in describing a “driver (“drive” plus person plus personification) driving the car” we economize on the Morse code, use it only once for the “drive” but provide two nibbles to the face of the person-finger.

Reciprocity

Exchanging articles between parties, such as business cards, or exchanging blows in a face-to-face combat requires elucidation in Touch Language. Touch Language provides the verb in Morse code, defines the two parties via the person-fingers and after a short pause adds a reciprocity component by providing a single nibble at the back of the finger of each of the parties involved and repeating it once more, to a total of two non-sequential nibbles per finger. The reciprocity component is provided after the two parties have been identified, including their age bracket. Furthermore, if the exchange is not a singular occurrence, such as in exchanging business cards, but is continuous, such as in exchanging blows between two combatants, then reciprocity components continue to be provided at intervals and could be respective to and in conjunction with the actual blow deliverance by each party. If the parties also roll on the ground during the process, then the PalmScreen conveys such activity. If articulation of the body part receiving the blow is warranted, then the non-dominant hand comes in handy (pun unintended) in providing such information that could also be synchronized with the actual rendering of the action (e.g., a blow in our case). If the recipient avoided the action (e.g., the blow) targeted at him or her, then the “cancel” sign (“X on the PalmScreen) is added rather than using Morse code, which is kept at a minimum.

Spelling in Touch Language

The only spelling we have encountered in Touch Language, relates to verbs that are transmitted to the recipient in Morse code and singles them out for fluency in understanding the dynamic occurrences transmitted. However, there are instances where spelling is warranted and being consistent with our notion of Dialogue Reduced State (DRS), we need to introduce a format that will both satisfy the DRS, as well as maintain the uniqueness of the Morse vibrated verb.

Spelling is important when Touch Language utilizes a person’s name, a name of a country, city or street. To this end we do not involve the Morse vibrated verb mechanism, but rather designate a specific area to be known as the spelling segment for cases as those discussed above and that leaves intact both our notion of Morse vibrated verbs, as well as the DRS.

The designated area, is the face of the thumb in the dominant-hand that is not utilized for any other purpose and will maintain its isolated usage only for spelling by impacts of nibbles that transmit the Morse code of the spelled name, or other carefully chosen articles that may come about with the evolution of touch language.

Inclusion and Connectivity

The word “and” both in text as well as verbally expressed, connects between various segments of communication or descriptions. Spoken languages have either a special word for it, such as “and” in English, or “und” in German. Some languages have a single letter attached to the added part, such as the “ve” (phonetically spelled here) in Hebrew, or the "و" in Arabic (pronounced as "waw"). Sometimes the “and” that is used to connect between elements is also used for inclusion. The word “with” in English is utilized only for inclusion but not for connecting

elements, while the word “and” is used solely for connectivity. So is the case of “avec” in French, “mit” in German or “com” in Portuguese. ASL uses also two different signs for inclusion and connectivity. However, in some spoken languages the verbal or textual addition also doubles up to describe inclusion, such as the Hebrew “ve” or the Arabic "و" mentioned earlier. Touch Language is not a spoken language, nor a visual one and it would appear economical to group the two notions together. However, we will provide two separate elements in Touch Language, one for the connectivity word “and” and one for the inclusion word “with”. However, for reasons that will soon become apparent, we will first present the signs “with” for inclusion and “without” for no-inclusion as is shown next.

***With**:* Two simultaneous movements of starting an elongated impact motion from the opposite edges of the base of the back of the non-dominant hand and meeting at the center.

Without: The reverse motion of “with”, where the impact motion starts from the center of the base of the non-dominant hand and moves symmetrically towards the edges of the hand.

And: To provide the connectivity “and” in Touch Language we combine the Touch Language inclusion articulation “with” and follow it with a single nibble impact at the center of the base of the hand where the two approaching segments just met.

Affirmation Negation and Emphasis

We have positioned the affirmation and negation with the inclusion group due to the locality of information delivery. The designated area is the base of the back of the non-dominant hand, where impact nibbles transmit affirmation, such as the word “yes” or negation, such as the word “no”. Furthermore, we denote emphasis utilizing the same area. Textual material and spoken languages provide for emphasis, such as underlining or bold text in the former and intonation in the latter. The former is visual and the latter is auditory, none of which is relevant to the deafblind. The Touch Language designation for this group is as follows.

Affirmation: A single nibble impact at the center of the base of the non-dominant hand.
Negation: Three nibble impacts at the center of the base of the non-dominant hand.
Emphasis: Five nibble impacts at the center of the base of the non-dominant hand.

Coupled Adverbs and Pronouns

The mixed group of adverbs and pronouns of “when”, “where”, “who”, “what”, “why”, or “how” are not provided as a group, but are rather described within the various relevant functions of Touch Language. Thus, “when” is part of the time element coupled with the question element, “who” is part of the person-finger group coupled with the question element and “where” is part of the location segment coupled with the question element. As we have already discussed, the question element is appropriately coupled by itself and is mechanically transmitted by vibrations. “What”, “why” and “how” are unattached and are not coupled to any specifically discussed element. The specific articulation will be determined at a later time.

Religious and Spiritual Articulation

Large segments of our society have a cognitive or emotional connectivity with either religious or spiritual affirmations, which cross borders, languages and cultures. In line with Touch Language

philosophy we allocate a special articulation for such affirmations, leaving blank the specific elements and allowing for users to embed the specific cases relevant to them. Some examples follow as well.

Due to the individual nature of any affirmation, even if utilized in a group, such as a congregation, we allocate the person-fingers of the dominant hand for such articulation. A rapid series of impact nibbles starting with the face of the second finger of the dominant hand, moving to the third, then fourth and ending with the fifth finger articulates that the ensuing impact nibble specification relates to the affirmation discussed and continue to be articulated until a repetition of the inception declaration announces the ending of it.

There are five elements provided through the face of the second finger, each articulated by a different number of nibbles. Users can assign their own specifics to them according to the examples provided below. The face of the third (middle) finger of the dominant hand being under the declaration of religion or spirituality, is dedicated to the supreme power. In those cases where the belief system of individuals has more than one supreme power as "God", such as the “Father, the Son and the Holy Spirit” one can utilize multiple impact nibbles to designate each of the group mentioned. Namely,

Element	Face of Finger	Number of Nibbles
House of worship	1	1
Spiritual leader	2	2
Place to address followers	2	3
Addressing followers	2	4
Major Holiday	2	5
Supreme Power	2	6

Note: Intuitively, we would equate the supreme power with number one and would lean to assign a single impact nibble to it. However, we take the reverse position and assign the largest number of impact nibbles, not to deflect from the importance but rather enhancing it by giving it the maximal impact nibbles possible, and those who may want to even overdo that, can always use Touch Language designation for the extreme, namely [0+ Rapid 5] at the end of the specified impact nibbles.

Example1: Christian Affirmation

Element	Face of Finger	umber of Nibbles
Church	2	1
Minister	2	2
Pulpit	2	3
Sermon	2	4
Christmas	2	5
God	3	6

Example 2: Islamic Persuasion

Element	Face of Finger	Number of Nibbles
Mosque	2	1
Imam	2	2
The Prophet	3	5
Allah	3	6

Miscellaneous (AND, Yes, No, Parentheses)

AND

We have encountered the addition (plus) sign in the mathematical operations and in first intuitive thinking could consider its utilization for describing non mathematical situation where the connectivity of "and" could be used to minimize the introduction of a new Touch Language variable. However, case such as "a good natured woman AND a good natured child run away from an evil adult male" would become more complex under such hypothetical approach as it would require to first invoke mathematical calculations via a declaration, then utilize the addition sign to be followed by the termination of the mathematical declaration before being able to continue with the description of the event. The net result would have been to add complexity and possible confusion at the receiving end of the deafblind user. Thus, we introduce an independent articulation for the non-mathematical addition by providing a vertical sliding line from the top to the bottom of the face of the fifth, fourth, third and second fingers of the non-dominant hand in the order just presented. We will encounter a third form when we discuss the logical "AND".

Yes NO and Parentheses

Yes and No receive their own independent touch language signs due to the frequency of their appearance and the critical need for an unmistaken articulation in each case. The articulations are provided in the table below.

Parentheses appear both in mathematical operations as well as in text conveying information related to the material presented and enclosing it for keeping it in context, while maintaining a continuity of presentation. Notwithstanding the fact that some learned opinions object to such parentheses altogether, their existence is a fact of reality. We denote the opening (i.e., left) parenthesis by lines going up from bottom to top of the face of the second and then third finger of the non-dominant hand. The closing (i.e., right) parenthesis repeats the same signal where after a brief time delay it is repeated again, however in the reversed direction of top to bottom. We also encounter parentheses in our discussion of logical functions. A summary is provided in the table below.

Element	Line Direction & Fingers
AND	TB5,TB4,TB3,TB2
Yes	TB2, TB3
No	BT2,BT3,BT2,BT3
(	BT2,BT3
)	BT2,BT3/t/ TB2,TB3

Help and User's Guide

When persons who have intact sense of sight learn to utilize text, such as in instruction books, they can revert to any such book, any time they need to update their memory, a reference, or reading again a specific instruction or a routine. Invariably, the initial step is to consult the table of contents or the index to quickly find the desired information. Computer users utilize electronic users' guide and product manuals. Furthermore, it is customary to find "Help" menu that by

clicking through, one can find an appropriate explanation or instructions needed for a particular situation at the needed time. We select a somewhat different approach to assist the deafblind user who needs such information, while exercising Touch Language and center it on the request for help. We forgo explanation or instructions regarding any question and proceed immediately to an example of use.

On-line Instant Help Facility

The "Help" facility is different than what is customary perceived as a "Help" facility in that it is in a reversed direction. Namely, though it is also available, the deafblind user does not ask how to obtain a particular articulation in Touch Language or what would be a certain procedure. Rather, the help facility is automatic and happens upon a request by the user to explain what was just transmitted in Touch Language.

The procedure

There are two different procedural segments in the help facility. The *learning mode,* where the deafblind user wants to find out about a procedure and learn or master it, and the *explanatory mode,* where the user requests to know the meaning of a procedure just delivered to him or her. The former is the *active mode* and the latter is the *passive mode*.

The Active Mode

The user requests help by using the thumb of the dominant hand and follows by delivering a short Morse code to indicate the word describing his or her interest. Thereupon, Touch Language declares an upcoming example; the example is provided and the cycle is closed with the declaration of termination.

The Passive Mode

It is assumed that the user activates this mode while being in reception mode of Touch Language and needs explanation or elaboration on what was just delivered, while needing to ascertain smooth continuity at the end of the explanation and resumption of reception.

The help requested by the user in this category occurs when the user requests help by using the thumb of the dominant hand while being in reception mode of a Touch Language session. The Touch Language system first institutes a "pause" mode in whatever is being received by the user, and collects in a buffer, subsequent continuous flow of material as described somewhere else in this book. A declaration of help facility appears, followed by a very brief Morse explanation of the procedure, followed by a declaration of an example, the example itself is followed again by a brief Morse explanation. The whole procedure is repeated again and only then declaration of termination occurs with resumption of where it was left off to request assistance by the help facility. Namely,

(a) Declaration of help facility
(b) Morse
(c) Declaration of example
(d) Example
(e) Declaration of end of example
(f) Morse
(g) Repeat [(a) through (f)]
(h) Declaration of termination

Declarations in the Help Facility

The declaration of the help facility comes as sequential rapid two impact nibbles on the second, third and fourth back of the fingers of the non-dominant hand.

The declaration of the start of an example within the help facility comes as a single sequential impact nibble on the second, third and fourth back of the fingers of the non-dominant hand followed by sequential two impact nibbles on each of the second, third and fourth fingers of the non-dominant hand.

The declaration of the termination of an example within the help facility comes as a single sequential impact nibble on the second, third and fourth back of the fingers of the non-dominant hand, followed by sequential two impact nibbles on each of the second, third and fourth fingers of the non-dominant hand and finalized by three rapid impacts on the back of the fourth finger. Namely,

Articulation of the Relevant Declarations

Declaration of help facility:	2,2,3,3,4,4
Termination of help facility:	2,2,3,3,4,4
Declaration of an example:	2,3,4/t/Rapid 2(on 2nd), Rapid 2(on 3rd), Rapid 2 (on 4th)
Termination of the example:	2,3,4/t/Rapid 2(on 2nd), Rapid 2(on 3rd), Rapid 2 (on 4th)/t/[+Rapid 3]

Example Table Summary

Activation	**User Or System Activity**
Declaration	2,3,4/t/Rapid 2(on 2nd), Rapid 2(on 3rd), Rapid 2 (on 4th)
Example	Impact nibbles in sequence that user repeats after termination
Word (Morse)	Search the lookup table for
Termination	2,3,4/t/Rapid 2(on 2nd), Rapid 2(on 3rd), Rapid 2 (on 4th)/t/[+Rapid 3]

Note, that the termination of an example is different from any other termination procedure, by adding at the tail end of a repeated declaration, three rapid impact nibbles. The purpose in such a deviation from the standard, is to signal unmistakably an end to an example and being ready for input.

Concluding Remarks

Some concluding remarks before we move on to the specific adjunct areas of the vehicle for Touch Language evolution, Mathematics in Touch Language and the scientific base for the Touch Language.

Languages are developmental in nature and we should have expected Touch Language to go through evolutional steps like any other language. However, due to the communicative limitations among deafblind, inception of the language is called for by external auxiliary means, where modifications, corrections, additions or any and all developmental aspects can also take their natural cues from the deafblind users themselves.

The lists of parameters and attributes provided in the various Appendices and in the body of the book are not exhaustive by any mean. Rather, they are governed by practical reasoning. Namely, our intent is to strive for a Touch Language suitable for all deafblind and with the widest possible range of ages, rather than limit it from the outset to only those deafblind persons who learn fast, possess good memory and can retain successfully all requirements for utilizing Touch Language. Thus, it is quite possible that the parameters and/or attributes provided here might change before initial release for use, or a subset only will be selected for utilization. Therefore, it is of great importance that the community of readers at large, contribute to the proposed material before if becomes finalized.

Furthermore, in order to ascertain the universality of Touch Language, it has been included in a patent application. Namely, we endeavor to minimize sprouting of "dialects" that may create ambiguous interpretations if new or different parameters and attributes are introduced without first ascertaining consistency with the universality elements of the language. Thus, now that the patent had been issued, Touch Language is put in the Public Domain, subject to the condition that all changes and modifications will be sanctioned by a duly selected international body to whom the patent rights will be assigned (see the section on Vehicle for Touch Language Evolution below).

Vehicle for Touch Language Evolution

In order to provide a forum for deafblind individuals, their family, mentors, educators, interested leaders in government involvement, or industry pioneers and other interested parties, the following auxiliary is being planned. As soon as plans are formalized and funding is in place, an independent and dedicated web site will be opened and moderated to create the place, agenda, forums and discussion groups devoted to Touch Language. Such a meeting place will house a committee of appropriate members of the global community at large, who will facilitate exchange of opinions, discussions and final voting on any solidification of elements of Touch Language. A potential web address has already been reserved for such purpose and other possibilities will also be examined.

Number Systems in Touch Language

The number system should also address related fields, such as mathematical functions, geometry, trigonometry, logical functions and Internet access that is important in rendering Touch Language a useful communication tool for deaf, blind and deafblind persons. There are two different types of numbers of all sorts used in Touch Language that are distinguished by their utilization employing the language. Numbers that relate to conversation in a TV airing or description narrated are provided to the user via the Dialogue component of the language segment. Number system related to static and dynamic screen activities need an imminent transliteration to Touch Language and are the subject of the next discussion.

We divide the number system into two separate usage groups. The group of common use and that of less common use. We will first deal with the group mostly used as related to money and time. We will address later on the remaining group. We address as number systems any group that provides individual segmentation or articulation while maintaining the same family identification. For example, the numbers "123" could mean simply the numbers one then two then three, or it could mean a single number of one hundred and twenty three, or it could

represent clock time of 1:23, or monetary value, say of one dollars and twenty three cents, etc. Any particular number used needs to belong to a family or be classified as a member of a number system, so that the user of Touch Language can perceive it in the correct, proper, unambiguous meaning. We employ a dual mechanism for such purpose. One is the mechanism of announcing its inception and end of signal, and the other the signal itself. The signal itself is composed of system identification, such as money, time, and other elements and the articulation of the specific members within that system. The articulation of the specific member accords a major and a minor articulation, whereas it is not mandatory that the minor articulation be present at all times. For example, consider the system identification to be "Time". In this case "hours" would be the major articulation and "minutes" would be the minor articulation. We provide below the declaration and processes.

Geometry

Seeing individuals have an advantage over blind persons when working with geometrical configurations such as triangles, circles, spheres, ellipses, Hyperbolae, etc. Working with geometrical figures in the context of a study, problem solving or other exercises, requires the participant to know various facts, make comparisons, analysis and reach conclusions that need to be expressed in a permanent form such as writing. This is a rather tall task for someone who cannot see the geometrical figure and needs to keep it in active memory during the complete attention span to the problem on hand. Even the creation of a raised geometrical configuration as a facsimile for the benefit of perceiving it by touch is insufficient, since unlike seeing where one can keep the image at sight while thinking about the rest of the data, the image disappears with the removal of the hand(s) that touch it [Helen Keller, 1967]. The procedure articulated below enables a simplification of working with geometrical figures.

The procedure utilizes the PalmScreen as a drawing board for the relevant figures. Whenever, a certain figure requires to be a functionally equivalent "permanent "picture for a duration, the drawing of the figure repeats itself in default intervals (passive) that could be short or long intervals, per the instruction of the blind recipient in a refresh procedure, or be activated at will by such recipient (active) done by the recipient's thumb of the dominant hand. When the procedure requires comparison between two forms, the palm of non-dominant hand (NDH) becomes a "slave palm-screen" (i.e., secondary in stature) to the PalmScreen that is now considered the master "blackboard". The secondary image is drawn on the slave screen and maintained for a duration when called for. Furthermore, we provide procedure and means for people, such as blind persons to actually draw geometric forms in size acceptable to them and locate such forms in a desired location on the functionally equivalent media to paper.

Transmitting and Receiving Operations

The third and fourth fingers, represent different transmission and reception articulations, related to number systems and mathematics, when utilizing the back or the face of the fingers. The second finger represents groups, while the thumb and the fifth finger articulate specific group members from the group indicated by the second finger. The third finger also provides magnitude elements, as well as seasons of the year. Each of the third and fourth fingers are further divided into three sections; a lower section, an upper section; and a top section.

Number Systems in Touch Language

We first define two basic elements of addition and subtraction that have cross usages in many number systems and articulate for them an almost independent standing. The addition or "plus" symbol is a bottom to top line (stick) on the back of the second finger of the non-dominant hand. The subtraction or "minus" symbol is a top to bottom line on the back of the second finger of the non-dominant hand.

Since the addition and subtraction operate cross number systems, there is no specific declaration for them and they retain their meaning, irrespective of the system for which they are utilized.

Declaration of Number system:

The declaration is coupled with the fingers used for the specification. Namely, we utilize the back of the second finger and the back of the fourth finger of the NDH to declare a number system. We involve both fingers in the declaration. 2,4,2,4 declares a monetary system, while 4,2,4,2 declares a time system. The third (middle) finger positioned between the fingers used for the declaration and uninvolved yet becomes the directional identification element for the number system transaction processed. The mechanical operation of the middle finger articulates a line drawn either from the top of the finger to the bottom of the finger (TB) or the reverse motion from the bottom of the finger to the top of the finger (BT). This mechanical motion assumes different meanings in different number systems, while there is a central aspect that prevails in all of them. In the monetary system, the top to bottom line means intake, while the bottom to top line means giving out. Yet in the time system, the top to bottom means AM, while the bottom to top means PM. The dual utilization in the number system extends to the articulations as well. The second finger involved in the declaration also becomes automatically the major articulation finger, while the second utilized finger in the declaration becomes the minor articulation finger. Let us look at the following two examples of monetary and time systems.

System	Declaration	Major/Nibbles	Minor/Nibbles	TB/BT	Meaning
Monetary	2,4,2,4	2/N3	4/N2	TB	Receive $3.02
Monetary	2,4,2,4	2/N3	4/N2	BT	Pay $3.02
Time	4,2,4,2	4/N1	2/N6	TB	1:06 AM
Time	4,2,4,2	4/N1	2/N6	BT	1:06 PM

As can easily be realized from the examples provided in the table above, there is still one element of practicality that needs to be added that has to do with magnitude. Namely, we can provide a few nibbles to a finger associating it with a quantity, but it is not practical, when large amounts need to be articulated, such as 20 minutes or 30 cents. To this end we add another segment for the magnitude level that is provided by the location on the third finger to where the nibbles are applied. Namely, the lower part of the third finger represents single units, whereas the upper part of that finger represents multiple of tens. Implicit in such choice is the realization that one may receive multiple impacts on a particular finger where the nibbles may rotate between two different locations on the finger. The examples below clarify the magnitude aspect, while slightly changing the nomenclature, as is self- explanatory.

System	Declaration	Major/Nib.	Minor/Nib.	TB/BT	Meaning
Monetary	2,4,2,4	2/N3	4/[U3 + L2]	TB	Receive $3.32
Monetary	2,4,2,4	2/[U3 + L1]	4/[U4 + L2]	BT	Pay $31.42
Time	4,2,4,2	4/N1	2/[U4 + L1]	TB	1:41 AM
Time	4,2,4,2	4/N1	2/[U4 + L1]	BT	1:41 PM

U = Upper part of finger; L = Lower part of finger; TB = Top to Bottom; BT = Bottom to top

There is one more element that needs elucidation and that relates to magnitudes of numbers, where hundreds or thousands are involved. These elements will be addressed below as well as fractions as they are all transmitted in Touch Language as well.

We have discussed two number systems, widely used in daily occurrences. Namely, time and money. However, three additional number systems that although not that prevalent, nonetheless appear with regularity and need to be addressed in our number system presentation. To this end, we provide below additional systems together with their Touch Language articulations. The number systems we address below are diurnal elements (e.g., day, month or year), length or distance, area, volume and weight. The Touch Language components retain consistency and start with declaration that employs the second third and fourth fingers in a (twice) repetitive mode of as shown below.

System	Declaration
Monetary	2,4,2,4
Time	4,2,4,2
Diurnal elements	2,3,4,2,3,4
Length/Distance	2,3,4,2,3,4
Area	2,3,4,2,3,4
Dry Volume	2,3,4,2,3,4
Liquid Volume	2,3,4,2,3,4
Weight	2,3,4,2,3,4

Note, that in the two primary systems, the declaration also defines the system, whereas in the secondary group it does not and a different identification format is provided as given below. We resort to nibble impact in identifying specific members of the secondary number system in Touch Language as follows. Throughout the number system in Touch Language we maintain the impacts provided to the back of fingers in the non-dominant hand; however, in the secondary group we also utilize lower and upper parts of the appropriate fingers as can be seen below. The group type is provided by the second finger of the non-dominant hand, while its specific member is provided by the fourth finger. The middle finger is reserved for the magnitude elements of the specific type provided by the fourth finger.

System	Group ID	Member ID
Diurnal elements	second Finger	N1 (note secondary level below)
Second Diurnal	second finger	N2
Season of Year	second finger	N3
Length/Distance	second Finger	N4
Area	second Finger	N5
Dry Volume	second Finger	N6
Liquid Volume	second Finger	N7
Weight	second Finger	N8

Each member of the systems is further identified by five distinct levels of magnitude, as can be seen in the table below.

System	ML1	ML2	ML3	ML4	ML5
Diurnal elements	day	week	month	year	millennium
Secondary Diurnal	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs
Length/Distance	cm/inch	decimeter/foot	meter/yard	km/mile	light year
Area	cm/inch c.	foot sq.	m/yard sq.	km/mile sq.	
Dry Volume	cc	foot c	meter/yard c		
Liquid Volume	cc	pint	liter/quart	gallon	
Weight	gr/oz	kilo/lb.	Ton		

ML = Magnitude Level; km = kilometer; sq. = square; m = meter; g = gram; oz = once
lb = pound; c = cube; cc = cm cube; hrs. = hours.

Note that there are no correlations among members, such as decimeter and foot. They simply categorize an element in a specific cultural situation and in fact are provided here only as an example.

We are now in position to assign Touch Language parameters to the various systems discussed for a unique and hopefully practical and easy identification. The specific members are provided by the fourth finger that operates in conjunction with the second finger that provided the group identification. Thus, when the second finger receives four nibble impacts, meaning it is the length/distance group and the fourth finger receives three impact nibbles, designating meters or yards, we have identified in a unique way for the appropriate parameter. We now have to provide also the magnitude that is done by the third (middle) finger. As long as we are under the declaration of the number system (provided by the impacts on fingers 2,3,4,2,3,4) and have not received the "off" condition (by repeating the declaration call, we know that the utilization of the third (middle) finger is solely for magnitude related to the uniquely defined parameter, as we just demonstrated.

Magnitude

Both the back and face of the third (middle) finger are utilized for magnitude assignment. To this end we employ a principle similar to the power and mantissa in mathematics. Namely, we utilize the face of the finger to declare the power of ten, while utilizing the back of the finger to declare the actual number in the appropriate case. The face of the base of the third finger designates

“ten”, the middle part of the face of the third finger, designates a “hundred” and the top part of the of the middle finger designates a “thousand”. The importance of magnitude assignment goes beyond the standard allocation of a magnitude to length, volume or weight. In Touch Language it is also utilized to better define specific elements. For example, we denote a group of diurnal, specifying a day and then need the magnitude to determine which day it is, such as the numeral “2” for Monday or the numeral”3” for Tuesday. In some languages, such as Hebrew, the days are directly related to numbers, however, when this is not the case, such as in the Latin languages, it would be useful to add the table below.

Day	Number
Sunday	1
Monday	2
Tuesday	3
Wednesday	4
Thursday	5
Friday	6
Saturday	7

The Back of the Third Finger (Magnitude)

The back of the third finger designates numbers in the following way. The base of the finger (i.e., bottom part) represents the actual numbers, while we allocate the other two parts of the back of the third finger as follows.

A single impact on the top of the back of the third finger designates division, while the number of impacts on the middle part of the back of the third finger following immediately the designation of division articulates the quantity of the divisor. For example, a single impact on the top of the third (middle) finger followed by two impacts on the middle part of that (third) finger represents a division by two. If no other information is available to represent otherwise, then we have just been notified about a “half”. Likewise, if the top of the back of the third finger received one impact and the middle of the third finger just below it, received immediately thereafter three impacts, the message is “a third”.

We emphasized above that designating a simple fraction is achieved by a single nibble impact at the top of the back of the third finger of the non-dominant hand. We saw in the examples, how one half and how one third are represented. However, there are times when one needs to express a different type of a fracture, such as two-thirds, three quarters, etc. To this end, we impact on the top of the back part of the third finger, of the non-dominant hand two impact nibbles. The two impact nibbles alerts the recipient that the following number provided by impacts at the base of the third finger is the numerator, while the following number of impacts on the middle part of the back of the third finger represents the denominator as before. Students of numerical systems in Touch Language who might complain about the complexity of working with ratios as described above, should be consoled that their hearing and seeing counterparts are not faring any better and the complexity is inherent in the mathematical operation rather than in the Touch Language itself.

Face of the Third Finger (Magnitude)

We turn our attention next to the face of the third (middle) finger that represents magnitude in our discussion. As we have discussed above, the lower part of the face of the third (middle) finger represents the number ten. A single impact on that part means “ten”. Furthermore, if the single impact follows immediately after by a certain number of impacts on the bottom part of the back of the third finger, it means that the number of impacts need to be multiplied by ten to obtain the number transmitted to the recipient. Thus, three impacts on the lower part of the back of the third finger of the non-dominant hand followed immediately by a single impact on the base of the face of the third finger in that non-dominant hand expresses the number “thirty”. An immediate corollary is the notion that the maximal impacts possible on the bottom of the back of the third finger does not exceed nine. However, if after the expression of “ten” there is reverting back to the base of the back of the third finger it specifies single digits, unless it is followed by impacts on any part of the face of the third finger.

Namely: the rule is as follows

1. Numeral declared first
2. Magnitude of declared numeral follows second
3. No magnitude follows, indicates the single numeral to be a digit between 0 and 9.

Remark: (Provisional rule), The numeral "0" is indicated by a simultaneous nibble on both the back and face of the lower bottom part of the third finger.

The table below demonstrates the operative concept.

Number	LBF/Nx[i]	MBF/Nx	UBF/Nx	LFF/Nx	MFF/Nxv	UFF/Nx
123	N1[1]			N2[2]		
	N2[3]			N1[4]		
	N3[5]					
231	N2[1]			N2[2]		
	N3[3]			N1[4]		
	N3[3]					
230	N2[1]			N2[2]		
	N3[3]			N1[4]		
	N1[5]			N1[5]	i.e simultaneous	

LBF = lower back finger; Nx = x Nibbles; [i] = order of appearance; MBF = middle back finger; UBF = upper back finger; LFF = lower face finger; MFF = middle face finger; UFF = upper face finger.

Alternative Representation

The choice between the two representations will be decided after analyzing comments by readers of the book and feedback from the community of person without the sense of sight.

The middle part of the face of the third finger of the non-dominant hand represents the quantity of “hundred”, while the top part of the face of that finger represents the quantity of “thousand”. The operation in conjunct with the base of the back of the third finger is equivalent to the meaning with the number “ten” except that it is either “hundred” or “thousand” as the case may be. The table below provides some examples.

Number	LBF/Nx[i]	MBF/Nx	UBF/Nx	LFF/Nx	MFF/Nx	UFF/Nx
123	N1[1]				N1[2]	
	N2[3]			N1[4]		
	N3[5]					
231	N2[1]				N1[2]	
	N3[3]			N1[4]		
	N1[5]					
2310	N2[1]					N1[2]
	N2[1]				N1[3]	
	N3[4]			N1[5]		
	N1[5]			N1[5]	(1.e., simultaneously)	

LBF = lower back finger; Nx = x Nibbles; [i] = order of appearance; MBF = middle back finger; UBF = upper back finger; LFF = lower face finger; MFF = middle face finger; UFF = upper face finger.

The reader must have noticed that the above representation does not contain very large numbers, such as millions, billions or trillions. As we discussed at the outset of the number systems, certain information is relegated to the dialogue segment. However, when such large numbers become part of the dynamic scene, we postulate that it is sufficient and warranted not to burden the user with specific articulations of such numbers and instead provide the information that the magnitudes are significantly large. Thus, a single symbol of Touch Language will suffice for it and we employ the signal of adding five rapid nibbles to the largest number specified. Namely, we utilize what will become a familiar notation for such nibbles, [Nx + Rapid 5], where Nx stands for "x" nibbles followed by rapid five nibbles. The [Nx + Rapid 5] signifies extreme of whatever is perceived at the moment.

Fuzzy Magnitude

Lastly, we will delve into the realm of the fuzzy, where non-specific numerical parameters are described in terms of magnitude. Small, large/big, slow, or fast are no longer represented by the middle finger and instead are purposefully moved to be represented by the back of the thumb of the non-dominant hand.

Indicators of time in ASL are quantified, such as in time already expired or time expected, and appear at the beginning of the sentence or close to the subject, yet in some spoken languages they can appear at any part of the sentence. Touch language has two classes for time elements, the class with quantified elements, such as “next hour” (i.e., hour + 1) and the Fuzzy class that is not a physically measurable time, such as “soon”.

Thus, we encounter also fuzzy elements of time, such as “soon”, action oriented, such as “not yet”, or non time related of plural vs. singular (“many”, ”few”), not being able to be specific on the number of persons, such as in “audience”, or even the fuzzy notion of doing something “carelessly” or “conscientiously”. Additional fuzzy articulations will be introduced later on.

As we have seen before, the back of the thumb is used for chronology, or more specifically acts as a time order function, which we encounter in multiple past or future events.

However, in conjunction with the number system, while being still under the declaration of a number system, the back of the thumb of the don-dominant hand is utilized to articulate such fuzzy magnitudes. Thus, when *speed* is articulated, a single impact on the back of the thumb means “slow”, two impacts means “fast” and three impacts means “very fast”. Likewise, in description of *size* a single impact means ”small” two impacts mean “big” and three impacts mean “very big”.

Therefore, we define the notion of size at an East to West movement in a line at the bottom of the fifth finger of the non-dominant hand, i.e., EW. Thus, “size” plus the fuzzy notion of a single nibble on the back of the non-dominant thumb means “small”.

Finally, repetition of the declaration that started the numerical representation signifies the end of such representation and resumption of non-numerical representations.

Fuzzy and Undetermined Articulation

We utilize fuzzy articulation for another aspect that appears at this stage to be unique to Touch Language as is discussed next.

Touch language can transmit fine grain information, such as a person’s gender, age, or character. However, there are cases, where one or more fine grain articulation are not available on the TV screen, yet Touch Language structure may appear at loss to define it. We forego the fine grain articulation in such cases, by signaling a non-committal fine grain articulation. For example, we have a scene of a man chasing a woman, where it is not clear or is unknown who is the good person and who is the bad. To resolve such and similar issues we invoke the Fuzzy articulation to provide a general signal that can be attached to <u>any</u> articulation and thereby declaring it as undetermined, however, <u>without</u> the “number declaration” to signal that it is not magnitude related. The fuzzy signal chosen for undetermined situation is the rapid five impacts on the back of the thumb of the non-dominant hand. This signal can be readily distinguishable from the chronology elements, as well as from assignment of expansiveness,
since the five rapid impacts are <u>not</u> preceded by three impact nibbles that announce a large chronological span. Furthermore, the signal for undetermined articulation (i.e., rapid five impact nibbles) always appears between the two articulations that each could otherwise determine a unique and unambiguous situation. Examples follow.

***Examples*:**

Undetermined Situation	Opening Signal	Fuzzy Signal	C losing Signal	
Good Man or bad man	B2/N1	[Rapid N5]	B4/N1	[*]
Age bracket (adult/old)	B2N2	[Rapid N5]	B2N3	[**]
Man (good/bad + adult/old)	B2	[Rapid N5]	B4	
	B2/N2	[Rapid N5]	B2/N3	[***]

B2 = Back of second finger of the dominant hand; N2 = Two impact nibbles;
B4 = Back of fourth finger of dominant hand; [Rapid N5] = Rapid 5 nibbles on the thumb of non-dominant hand

Notes:

[*] Note that a single impact nibble appears both on the second and fourth finger, signaling it is not the age factor that is undermined.

[**] Note that B2 appears twice, signaling it is not the gender or character that is undetermined but rather the age bracket that appears once as N2 and once as N3.

[***] Note that the succession of twice [Rapid N5] means that first we announce that the character is undetermined and then we announce that the age is undetermined.

We will digress briefly to discuss another element of fuzzy utilization, due to its relationship to elements of chronology and indeterminist states.

Fuzzy and elements of Discourse Analysis

There are elements in languages that are "thrown around" and become embedded in sentences as a form of speech, seemingly without serving any particular need. Elements, such as "so", "well", or "anyway" in English, "nu', "tov", in Hebrew, "alors" in French, or "nu doch" in German. However, studies show that such words or expressions do have a role in the structure of spontaneous communications. They belong to a group of words referred to under discourse analysis and where they act as verbal delimiters, and sometimes as punctuation marks (Borochovsky-Bar Aba). We will utilize fuzzy descriptions for such elements of discourse and will shortly observe that Touch Language is already well equipped for their handling. We will distinguish between two cases,; the loosely and unrelated use of a word as mentioned above and the usage where the elements serve an important delimiter role. Namely, words like "anyway", "well" in English or "tov" in Hebrew have proper utility used otherwise in their appropriate language. Therefore, upon their appearance in touch language we add the "Fuzzy" articulation ([Rapid 5 nibbles] on the back of the non-dominant thumb), to alert recipients to their usage under discourse analysis. It appears from the outset, that such occurrences would emerge under dialogue utility and as such, if they do find their way in the mix of topics and "glue" elements they would be transmitted with the proper fuzzy notion. The second case relates to the discourse as markers. Discourse markers appear in English and other languages as well. We find in English their appearance as "so", "well", or "anyway" as well as "okay , "yeah" or "mm" (Jefferson, 1984). Another example, is the Japanese "ee", and "hai" (Kawamori et al. 1994) or "un"

(Hayashi 1996). As noted by Schiffrin (Schiffrin 1987), the discourse markers convey information about the structure of discourse rather than contributing to the semantic content of the sentence. The introduction of discourse markers, define sequentially dependent elements that bracket units of talk and function, as indicators of the structure of discourse by marking the beginning of a new topic. Thus, it carries an immediate value to Touch Language that is the result of transliterating information provided by their topics. Furthermore, Schiffrin showed how "oh" is used to mark clarifications and to signal to the listener that the speaker is referring back to given information, which now has become relevant. Touch Language has the built-in mechanism of chronology designation, utilizing finger 504 as well as fuzzy designation, utilizing the second finger, each with its own set of rules for that finger. Furthermore, Touch Language can mark certain information with the cyclical markers of vibrations discussed somewhere else in this book. Thus, we draw the attention of the reader to the observation that even when one considers an evolving aspect of languages such as discourse analysis that is a contemporary of research interest, we find that Touch Language is equipped with the tools to partake in the evolution, by mirroring new advancements in knowledge to operate within its own structure.

Seasons of the year

Deafblind persons feel the climatic changes where they are pronounced like everyone else. Seasons of the year, are also referred in communications. Thus, we introduce below the relevant articulation of touch language for the yearly seasons

The four seasons of the year, summer, autumn, winter and spring relate in a round about way to time that in its own link relates to the Number Systems.

Half year, quarter year and so on can be quantified using the year designation together with the designation for fractions. The rest would appear to be just names. However, in order to minimize spelling needs we have specific articulations for the yearly seasons. In Touch Language, we describe the seasons starting from the season of spring that serves to be the pivotal season in our description.

Academic year for schools and colleges starts universally mostly in the fall. The Jewish New-year as based on biblical material starts in the Fall as well. The Chinese year starts sometimes between January 21 and February 21, since it is based on the lunar-solar cycle.

However, in line with our philosophy of the universality construct of Touch Language, we choose to start our season marker by the astronomical fact of equinox which is the time of the year when the Sun crosses the equator, making the day and night of equal length in **all** parts of the Earth, which corresponds to Spring. Due to its mathematical connotation discussed earlier, we proceed to define each season by adding and subtracting from the season of spring. That is, we take the articulation for spring (e.g., three impacts on the second finger of the non-dominant had) and stop there if the reference is to :spring". Otherwise, we proceed to define the season of the year by using either the plus sign (i.e., bottom to top line on the back of the second finger, or the minus sign (i.e., top to bottom line on the back of the second finger). The last step, is either one or two impact nibbles at the back of the bottom of the third finger, to indicate the appropriate numeral. The examples in the table below are self-explanatory.

Season	Back of 2nd Finger	Added number of impact on bottom of 3rd finger
Spring	N3	0
Summer	N3	+1
Autumn	N3	+2 or -2
Winter	N3	-1

N3 = three impact nibble; "+1" = BT on back of second finger, then numeral 1; "-2" = TB on back of second finger, then numeral 2; BT = bottom to top; TB = top to bottom; numeral 1 = one impact on 540.

Notwithstanding the reason for our choice of spring as the starting point, it is arbitrary and can be changed at will by individual users, as long as it is kept consistent throughout the usage of Touch Language by the user.

Mathematics in Touch Language

Although touch language was originally designed for reception of dynamic scenes in a TV broadcast and for communications, it also has an expanded utility of communicating mathematical functions, enabling the deafblind an easy way to partake in educational and professional activities involving mathematics. While the very basic operations of addition, subtraction and even fractions have been addressed, we need to focus our attention on more elaborate and sophisticated operations available in mathematics, to which we turn our attention next.

We utilize the face of the fourth finger of the non-dominant hand for the various mathematical functions and operations. We divide it into three segments where the top and bottom sections are the inverse functions of each other. Namely, if the top of the face of the fourth finger represents addition, the bottom of that finger represents deduction, and if the top represents multiplication, then the bottom represents division, and so on. The middle part of the face of the fourth finger represents alert to the order of magnitude relevant to the function, while the subsequent actual magnitude is provided by the middle finger in the manner already discussed. For example, if the face of the bottom fourth finger of the NDH indicates a mathematical root, it could be a square root, a third or higher power root. We utilize the middle part of the face of the fourth finger in the NDH to alert that a power designation is coming next, then follow up with indicating the numeral of the power by the bottom of the third (middle) finger that provides magnitudes. The only exception is the logarithm of base 10 where no further elucidation is required and the proper numbers of nibbles declare it. A word of comfort to the readers who may perceive it as complicated is in order. We need to remember that in education for the hearing and seeing students, multiplication and division is not introduced in first grade, and when they are introduced, the student is still considerably away in time from the introduction of powers, square roots and complex numbers. That is, we learn in stages with progressive complexity and there is no need for discouragement to the deafblind who can master Touch Language in progressive stages, much as we do in our hearing and seeing schools. The table below provides elucidation of the mathematical functions and operations, where the declaration for its inception is a series of nibbles, starting with the back of the fourth finger, then the third and then the second, repeating the sequence by going back to the fourth finger and ending it on the second finger.

Operation	UPFFF	MPFFF	BPFFF
Declaration	4,3,2,4,3,2		
Addition [*]	N1		
Multiplication	N2		
Power	N3		
Sum (Sigma)	N4		
Integral	N5		
e to the power of	N6		
Subtraction			N1
Division [**]			N2
Root			N3
Differential			N4
Partial Differential			N5
Logarithm			N6
Order of Power/Root (if not square root)		N1	
-Base of logarithm (other than 10)		N4	
Matrix size		N5	

UPFF = upper part face fourth finger; MPFFF = middle part face fourth finger: BPFFF = bottom part face fourth finger; N1 = single nibble; N2 = two nibbles; N3 = 3 nibbles. The 432432 is the declaration for mathematical operations.

Notes:

[*] The user has the option of either, using addition and subtraction under a math declaration, i.e., one impact nibble on the top of the face of the fourth finger for addition and one impact nibble on the bottom of the face of the fourth finder for subtraction, or utilize the "universal" signal of Touch Language, i.e., BT on the second finger for addition (of anything) and TB on the second finger for subtraction. The result will be the same.

[**] The user has the option of either, using division under a math declaration, i.e., two impact nibbles on the bottom of the face of the fourth finger, or use impacts (one for a single numeral in the nominator or twice for multiple digit numeral) on the third finger.

We also need articulations for such mathematical elements as Pi, the designation for a complex number (i), radius, diameter, circumference, function, and matrix. To this end we utilize both the second finger and the fourth finger simultaneously, while the declaration is still the same as for the mathematical operations, namely, 4,3,2,4,3,2 (i.e., fingers fourth, third, second, fourth, third, second, in succession). Both the face of the second finger and face of the fourth finger receive a sliding impact from top to bottom or bottom to top, to signify the case involved, where the number of times such sliding impacts are repeated, in a similar way to nibbles, determine the specific case as shown in the table below.

We have adopted a classification of adding the digit zero (i.e., "0") whenever the face of the finger is involved. Thus, the bottom of the fourth finger is the back of the finger, while the bottom of the fact of the fourth finger is the same location, except that it is on the face of that finger. Thus, while the fingers, such as the second, third and mean both back and front of the finger, we add the "0" designation when we discuss only the front full length of any such finger.

Likewise, we adopt the classification of adding the digit one (i.e., "1") whenever we utilize a line at the bottom of any finger. Thus, a line at the bottom of finger xyz will be referred to as xyz1 and a line at the bottom of finger ABC will be referred to as ABC1.

Function	Second & Fourth Finger
Radius	TB1
Diameter	TB2
Circumference	TB3
Equal (i.e., "=")	TB4
Percent (i.e., "%")	TB5
Function	BT1
Pi	BT2
Complex number (i)	BT3
Factorial (!)	BT4
Matrix	BT5

TB1 = top to bottom once; TB2 = top to bottom twice; TB3 = top to bottom three times; BT1 = bottom to top once; BT2 = bottom to top twice; BT3 = bottom to top three times

There are other mathematical notations that should be addressed under the groups discussed, such as the logical group of "and", "or", "nor", "union" and "intersections". We also need the proper symbols to articulate "larger than", "larger or equal", "smaller than", or "smaller or equal". We will provide below the appropriate articulations for these groups. Finally, there are two groups that we will include below as well. The currency designations group, and the Internet related group. The currency designation group articulates the three major currencies (by economic might), namely, Dollars, Euro, and Yen. The rest are spelled appropriately with the currency spell designation. The Internet designation is limited to those elements that may appear in communication where a web address is provided, and as the Internet evolves in the future so will touch language.

Logical Group	Lines on back of the Fingers of the non-dominant hand
AND	TB[5 4 3 2] (i.e., simultaneously)
OR	BT followed by TB (or reversed) on Back of thumb
NOR	"NOT" plus "OR"
UNION	"AND" plus NDHT[N1] plus NDH (TB[2,3,4,5]) (i.e., "AND"+ NDHT[N1] + TB [second, third, fourth and fifth]
INTERSECTION	"AND" plus NDHT[N1] plus line across NDH back of 4 fingers in succession starting on the 5th finger and ending on 2nd finger (i.e., EW on fifth (i.e., EW 7101, EW 7081, EW 7061, EW 7041 lines)

TB[54 3 2] = Top to bottom lines stating with 5th finger and ending on 2nd finger; NDHT[N1] = A single nibble on the non-dominant hand thumb; NDH[2+3+4+5] = Nibbles in succession starting on 2nd finger and ending on 5th finger. EW 7061 = East to West Line on 7061.

Logical Comparisons	
Equal	is assumed below after the "OR"
Larger than	"Big" plus NHDT[BT]
Smaller than	"Small" plus NHDT[BT+ TB] (i.e., BT +TB on the
thumb of the	non dominant hand)
Larger or Equal	"Big" plus "OR"
Smaller or Equal	"Small" plus "OR"

NHDT[TB] = Top to bottom line on the thumb of the non-dominant hand

Enclosures	
Left Parenthesis	BT[2], BT[3] (i.e., BT on second, then on third)
Right Parenthesis	BT[2], BT[3] /t/ TB[2], TB[3]
Left Curly Parenthesis	BT[2], BT[3] then BT curly line on NDH PalmScreen
Right Curley Parenthesis	BT[2], BT[3] then TB curly line on NDH PalmScreen /t/ TB[2], TB[3]
Left Bracket	BT[2+3], 3,4 i.e. ,BT of both second and third, then N1 on third, followed by N1 on fourth
Right Bracket	BT[2+3], 3,4 /t/ TB[2+3] 3,4

BT[2] = Bottom to top line on 2nd finger; BTS[2,3] = Bottom to top squiggly line on 2nd finger then 3rd finger; BT[2+3] = Bottom to top line done simultaneously on 2nd finger and 3rd finger; 3, 4 = Nibble on 3rd finger followed by a nibble on 4th finger.

Currency Designation	2nd Finger
Dollar	T[1] i.e., BT one time on first finger
Euro	BT[2] i.e., BT two times on first finger
Yen	BT[3] i.e., BT three times on first finger
Designate by Spelling	BT[4] i.e., BT four times on first finger
The Number Sign ('#')	BT[5] i.e., BT five times on first finger

BT[1] = A single Bottom to Top line on the first finger .

Internet and Web	Nibbles on top back of fourth NDH finger
http [or http://]	[N1] on top back of fourth finger
www	[N3]
Hyphen	[N2]
Underscore ("_")	[N1, N2]
At ("@")	[N4]
Forward Slash ("/")	[N1, N4]
Dot (".")	[N5]
Colon (":")	[N8]
Blank	("N7")

N[1] = a single nibble; N[2] = two nibbles; [N1, N2] = single nibble, short time delay and followed by two nibbles.

Note, that we have in the table above the components to build the complete "http://", but leave it for input from the public to decide whether to provide the "http" by itself, or rather the complete combination of http:// as we have done.

As a final note, we introduce the designation for a capital letter. Though its usage could appear in other areas, such as names of persons, countries, etc., we choose to introduce it here due to its possible usage in mathematical notation as well. Thus, we indicate a capital letter by providing a short vibration immediately prior to the impacts providing the Morse code for the particular letter.

Geometric Forms

We present below the needed elements that enable functionality of geometric forms. The various symbolic representations of geometric forms are provided in appendix L. The elements are as follows:

Drawings	Image is drawn on the Palm of the hand
Maintaining drawings	Repeated drawing of same image
Slave image	Implied by its appearance after activation
Symmetrical	A single impact in the center of Palm after drawing is completed
Asymmetrical	Implied by the lack of a symmetrical note
Connected lines	A single impact on concluding line drawing at the point of line ending
Non-connected lines	Implied by the lack of connected line note

***Commands (*by thumb)**

Activate slave image

dominant-hand thumb (DHT) twice-horizontal-right impact, then twice central impacts

Maintain drawing image DH

DHT center impact once then once horizontal right followed by left horizontal once

Maintain drawing image *NDH*

DHT center impact once then once horizontal left followed by right horizontal once

Shorting refresh intervals

DHT horizontal right once then one central impact

Extending refresh interval

DHT horizontal left once then one central impact

Repeated commands by the recipient's thumb for shortening (the default) refresh intervals will keep shortening the interval until user stops requesting a shorter interval. The refresh and interval adjustments, as well as the triggering control commands are produced by the special touch gloves that the recipient has on the hands. Likewise, repeated commands by the recipient's

thumb for extending (the default) intervals, will keep extending the refresh time intervals until user stops requesting a longer interval.

Gloves Usage for Geometric Forms

We have discussed the passive mode of reception of drawings on the palm of the blind and deafblind. To complete the task we need also to address the active mode, where the blind and deafblind are able to do the reciprocal and draw geometric figures. Drawing geometric figure is enabled using the pair of gloves, where one (the dominant hand) is used as a functional equivalent of drawing tool, such as a pencil and the other glove of the non-dominant hand functions as the functional equivalent of the drawing media, such as paper.

The drawing task portrays some differences and peculiarities compared to such tasks performed by persons with the sight sense intact. That is:

- Individuals with the sight sense intact, assign the drawing task to their hand, mostly unaware that their brain is in charge of commanding the hand to perform the drawing. The blind and deafblind individuals, utilizing Touch Language, have to issue a cognitive command and actually command the gloves to engage in a drawing procedure. Such command, done by the thumb of the dominant hand, initiates the process of drawing that will be discussed below.

- At the completion of a drawing process by the drawing person, the system proceeds to actively draw it again, namely transmit the completed product to the PalmScreen as a verification procedure for the intended object.

- A logical reversal in the role of the participating tools, as compared with the logic that the seeing world is accustomed to. Namely, the drawing finger (i.e., the functional equivalent pencil) is in actuality the receptor of the drawing, and the receiving medium (i.e., the functional equivalent paper) is in actuality the transmitter of the drawing.

We will describe the mechanical set up of the gloves, then proceed to discuss the role of each part in achieving the drawing task.
When blind or deafblind persons need to initiate a drawing in Touch Language, they have two general options, the passive mode and the active mode.

The Passive Mode

The deafblind person can access a functionally equivalent pull-down menu and navigate from there the specific interest. Namely, the system provides in series, a list of items that are changed at a pre-determined default time element. The specific drawings in the functionally equivalent pull-down menu appear drawn on the non-dominant (NDH) PalmScreen, one after the other. When any of the drawings appears to be a desired drawing, the blind or deafblind person indicates it by the “yes” command of the dominant-hand thumb. There are a number of steps involved in that procedure:

- **Specifying the correct geometric figure**
  We have briefly discussed above how this specification takes place with the functionally equivalent pull-down menu. The Touch Language system indicates that it understood and undergoes a verification process whereby it draws the geometric figure again on the PalmScreen and waits for an affirmation or negation. If negation (utilizing the thumb of the dominant hand to indicate "no") is not received, the system waits for a pre-determined default time and then assumes that the answer is affirmative and moves on.

  - **Specifying the size**
    Once the geometric figure has been settled, the system needs to know what size it should be. The request for size is provided by drawing the figure again, albeit in the maximal size possible on the PalmScreen of the user. The system waits a predetermined default time and redraws the figure in a smaller size. The system waits again and repeats the process until the user provides the "yes" affirmation. Thereupon the system goes through the verification process by drawing it in the indicated size and unless receiving a negation proceeds to the next step. A negation received at this point causes the system to go through a set of redrawing the geometric figures, however, it is done now in incrementally increasing sizes. The process continues until affirmation, and is considered complete with the final affirmation provided at the end of the verification processes.

  - **Specifying its location on the functionally equivalent paper**, (i.e., the PalmScreen).
    Upon determination of size, the system moves to determine its geographic location on the PalmScreen. The process repeats the negation by lack of affirmation until a proper location is defined. However, there are sub-steps in specifying the location. The PalmScreen initially requests to know if the central location, i.e., in the middle of the PalmScreen is the desired location. This is achieved by drawing the geometric figure twice in succession in the middle of the PalmScreen. If the system encounters a negation (whether direct as indicated by the user or by default due to the lack of affirmation), it then considers the PalmScreen territory as if it is mentally divided into a two by two matrix and proceeds to draw the geometric figure, starting at the Northwest and progressing in a clockwise manner next to the Northeast, followed by the Southeast and finally the Southeast. Its final affirmation is acknowledged by a two successively drawings of the correct size and in the correct location.

The Active Mode

In the active mode, the user draws the figures with the tools provided by the gloves that we have described above. Drawing a geometric figure requires the utility of both hands. The dominant hand is utilized in the drawing motion, whereas the non-dominant hand is utilized as the recipient of the drawing, all within the idiosyncrasies of Touch Language as we shall soon see.

Upon the draw command provided by the thumb of the dominant hand, a stylus is extended from its housing sleeve and goes into operational mode. Likewise all macro cells, go into operational mode whereby their IR transmitter either starts to transmit the infra-red code or is in the position to do so upon the signal provided by its contact parts.

It should be noted that other embodiments are possible for gloves that could function as a functionally equivalent pencil and paper. For example, one could consider piezoelectric cells that emit electricity upon pressure applied to them and where the micro cell could contain piezoelectric material and the stylus would apply pressure to it. Such embodiment will require some pressure by the blind or deafblind individual who has no knowledge if the pressure is sufficient to cause electricity, as no immediate feedback is available. Another embodiment could utilize Palm technology built into the gloves or operated in conjunction with them.

MATHEMATICAL SYMBOLS

The reader may be wondering, why is there a need for such tools in Touch Language, when even without the complexity of the subject, only a relatively small percent of the population with their sense of sight is intact, use mathematical functions of various sorts in their lives. There are psychological, inclusiveness, as well as beneficial aspects for providing these tools, for the deafblind. However, the scope of such discussion will not be covered here and only the tools to enable it for the deafblind is provided in this book.

Likewise, we will not delve here into any of the mathematics related to the subject and only provide the tools needed for those interested to engage in that area of mathematics.

The symbols as Tools

The symbols provided in Touch Language for such purpose, include such symbols used for Summation, the integrals and boundaries. Logarithms, powers, complex number ["i"], and so on. Readers are invited to communicate any symbols not included, for further inclusion.

Graph Providing Information

A graph is a visual auxiliary for persons whose sight is intact, giving a static pictorial image of a "story" that relates what it conveys. Blind person who cannot benefit from such an image shorthand of information can utilize Touch Language symbols to be on par with their seeing counterparts. The graph is provided on the face of the non-dominant-hand by the standard horizontal axis and vertical axis "drawn" in the customary Touch Language tools.

Namely, a horizontal line on the bottom of the NDH, starting at one side by a single nibble, moving to establish the line by a nibble on the opposite side of the palm and moving upwards in a straight line to complete the vertical axis by a nibble at the end point. A short vibration of the palm screen follows, announcing the upcoming graph that is outline in the customary manner as in Touch Language, such as when drawing a circle, triangle or parabola. At the end of such drawing, the PalmScreen receives two short vibrations, indicating the completion of the graph presentation. The dominant hand is involved as well, with the task of providing what is represented by each axis. This task is relegated to the end of the process, after the "drawing" of the coordinates and the graph have been completed. Though it would have been logical to name the coordinates simultaneously with their being drawn on the palm of the non-dominant-hand, it is done only subsequently to it, so as not to burden the brain of the blind person with excess information that pertains to content rather than to the mechanical drawing process.

Therefore, once the two-short vibration on the non-dominant-palm signaled the completion, the dominant hand receives an initial short vibration, indicating the start of the explanation for the horizontal axis, provided in the standard manner of Touch Language, then a two short vibrations follow to indicate completion and moving to the next step of defining the vertical axis. At the

completion of the definition of the vertical axis, a three short vibrations indicate it, as well as the start of the explanation of what the graph is all about. The end of the explanation is marked by three short vibrations on the Palm Screen of the dominant hand. However, taking into account the complexity of following that many signals, Touch Language augment the explanation just given. Namely, immediately after the completion of the explanation, i.e., right after the third vibration, the repetition of the graph image on the non-dominant-hand follows, so as to tie it again to the explanation just provided by the dominant hand. A four-short vibration signal on the palm of the dominant hand announces the end of this operation.

Elements Shown in Graphs

We need to present the essence of a visual depiction, to people who are deprived of the sense of sight. Therefore, a few essentials of the "story" told by a graph would be beneficial to such persons. During the learning procedure of those elements in a graph, the teacher will supply the connecting lines between such points by moving the hand or finger of the student along such connecting lines, impacting it on the brain of the student, which would later be supplied by the brain, when being exposed to such isolated elements, making the needed connections.

Elements shown in a graph are announced by three nibbles on the back of the first finger (thumb) of the non-dominant hand, wherein four such nibbles indicate the end of conveying such description of that group. The single and two rapid nibbles on the first finger is utilized for another group that relates to graph information.

Ascending Linear (line)

Preceded by three nibbles on the back of the first finger (thumb) of the non-dominant hand , there is a single nibble on the back of the second finger, then terminating the group information by four nibbles on the back of the first finger.

Descending Linear (line)

Preceded by three nibbles on the back of the first finger (thumb) of the non-dominant hand , there is a single nibble on the front of the second finger, then terminating the group information by four nibbles on the back of the first finger.

Peak (top apex)

Preceded by three nibbles on the back of the first finger (thumb) of the non-dominant hand , there is a simultaneous single nibble on the back of the second, third and fourth fingers, then terminating the group information by four nibbles on the back of the first finger.

Peak (bottom apex)

Preceded by three nibbles on the back of the first finger (thumb) of the non-dominant hand , there is a simultaneous single nibble on the face of the second, third and fourth fingers, then terminating the group information by four nibbles on the back of the first finger.

Asymptotic (lines)

Invariably, sooner or later one may encounter an asymptotic line in a graph and it would be useful to have a symbol drawing attention to it. For example, if we consider the change in an ascending line, such as in Newton's cooling and heating law, where the initial change is rapid

and shows up in a steep linear line. But it tapers off drastically after a short period, approaches a horizontal line. Namely, depicting an asymptotic line. To this end, we define below the asymptotic symbol for it in Touch Language.

Ascending Asymptotic

A single nibble impacting simultaneously two separate areas on the back of the first finger (thumb), as a group announcement, followed by a single nibble on the back of the first finger (of the non-dominant-hand).

Descending Asymptotic

A single nibble impacting simultaneously two separate areas on the back of the first finger (thumb), as a group announcement, followed by a single nibble on the face of the first finger (of the non-dominant-hand).

Summation

Utilizing the Face of the non dominant hand (FNDH), we start with one nibble at the upper right hand side [FNDHUR 1], then draw a line (real or imaginary) to the opposite side of the left hand side and end up there with a single nibble [FNDHUL 1], followed by an oblique line to the bottom of the NDH, underneath the starting point [FNDHLR 1].

[Note: there is only a single nibble involved that in that case even of designate an imaginary line by pecking once at the start of the line and a second peck where the line end, that one peck symbolizes both the ending point as well as the beginning of the oblique line starting from it].

Integral

Starting the same as the first upper line in the Summation symbol, then after the ending signed by the singular nibble, it reverts by a straight line back to the original starting point, providing there a nibble that indicates both end of the straight line, as well as the beginning of a new oblique line that ends at the bottom left of the face of the non dominant hand with another single nibble.
Namely: [FNDHUR 1], then [FNDHUL 1], then [FNDHUR 1], and finally ending with [FNDHLL 1].

Exponent

To designate the power to which a number or a variable (such as "x") is to be raised, it is first preceded by the exponent declaration, which is denoted in Touch Language by three short successive nibbles on the center of the face of non dominant hand palm. Next comes the signal, whether the exponent is a numeral, a variable or a combination of the two. To signify a number, Touch Language provides a single nibble at the bottom of the non-dominant-hand in line with the fifth (pinky) finger, and if it is a variable, then the single nibble is at the other end of the lower bottom face of the non-dominant hand. If it turns out to be a combination of variable(s) and numeral(s) then the two areas receive simultaneously a single nibble.

Logarithm
The logarithm (log) is defined in Touch Language, only in the terms of its base. Namely log base 10 and log base e. therefore we need first to establish the symbols for the two different bases, that is done next.

Base 10
Base 10 is declared by three nibbles on the face of the non-dominant-hand (NDH), at a location being at the base of the NDH opposite the fifth finger.

Base e
Base e is declared by three nibbles on the face of the non-dominant-hand (NDH), at a location being at the base of the NDH opposite the thumb.

Log base 10
First comes the base 10 declaration, followed by a horizontal line across to the other side of the face of the NDH.

Log base e (Natural log)
First comes the base e declaration, followed by a horizontal line across to the other side of the face of the NDH.

Power
For example the power "2" of the numeral "3" yielding "9", requires that we announce that power indication is coming next, announce the termination of the announcement, and providing the details in between in the standard Touch Language operational symbols and numbers. The symbol for the announcement and termination of information pertaining to it are shown next.

Power Announcement
A single vibration done simultaneously on the first finger (thumb) and fifth finger of the non-dominant-hand.

Termination Announcement of Power
Two short successive vibrations done simultaneously on the first finger (thumb) and fifth finger of the non-dominant-hand.

Function
A mathematical function is announced by a simultaneous single nibble on the back of both the first finger(thumb) and the fifth finger (pinky) of the non-dominant-hand. While for the population with their sight intact, it also contains a variable, such as "x", denoted by "F(x)", Touch Language economizes, by assuming the existence of a variable and denoting it on the dominant hand. Thus, the signal that the function has been fully described, occurred with a double simultaneous nibbles on the first and fifth fingers of the non-dominant hand. However, that comes only after the information was given via the dominant hand.

The variable
All the information related to the variable(s) in the function are provided solely on the dominant hand in the customary Touch Language symbols.

Triangle
A single nibble on the upper center of the face of the non-dominant-hand, followed by a simultaneous single nibble on the face of both the lower designated points of the non-dominant-hand, wherein the designated points are the spots under the first and fifth fingers.

Right-angled Triangle
The announcement of a triangle, followed by a short vibration on the palm of the non-dominant hand, preceding a single nibble at the upper center of the non-dominant-hand that is followed by a single nibble on the face of the non-dominant-hand , first on the center lower part, (opposite the first nibble at the top) and ending with another nibble at the right hand side of the palm, directly opposite the second nibble. The completion is announced by two short vibrations on the palm of the non-dominant-hand.

Obtuse Angled Triangle
The announcement of a triangle, followed by a short vibration on the palm of the non-dominant hand, preceding a single nibble at the bottom center of the non-dominant-hand that is followed by a simultaneous single nibbles on the face of the non-dominant-hand , on two designated spots being the one below the first finger and one below the fifth finger. The completion is announced by two short vibrations on the palm of the non-dominant-hand.

Figurers in Trigonometry
When we come to think about trigonometry and have to postulate symbols for tangent, sinus, and cosine, we have to make a decision, whether to use previously defined symbols, as building blocks for it, in line with our principle of minimizing information provided in Touch Language, or supply new symbols. While from the outset, it bequests rationally to build on top of the existing symbols, we realize that such earlier symbols are provided to persons who are blind or deafblind, and as such their definition required steps of operation, rather than a symbol depicted in a picture or a drawing. To utilize such prior symbols as a base for the new ones needed in trigonometry, would make the definition process longer, more complex and difficult to keep in memory all the steps leading to the final articulation of the symbol. Thus, our principle of minimizing delivered information in Touch Language appears to require an approach that is different than the intuitive one that was initially considered above. To this end we proceed with the independent symbols for trigonometry, that will follow below. Further, we deviate from the need to repeat the construct of any of the concepts, such as the Tangent or Sine, being part of the symbol, assuming that such definition was provided during the teaching of the subject of trigonometry.

The symbols do have a common group symbol, where all start with a single nibble on the first finger (the thumb) of the non-dominant-hand, thereby alerting the User of Touch Language that what is coming next is a trigonometric symbol. Likewise, the symbol announcement ends with two nibbles on that first finger. However, if only a single nibble is provided, the user anticipate

to receive additional numeric information related to the symbol in case, and only at the end of such information delivery will the double nibble conclude the particular information related to the specific trigonometric figure. The group announcement from the outset is important, not only for economy as discussed above, but also for distinguishing the subject matter. For example, for users of the English language who possess the sense of sight, the "tangent" can represent either the trigonometric function, or a line that touches a circle at one common point. Since Touch Language is designed to be a Universal language, such group announcement is mandatory to ascertain its uniqueness from all other possible misunderstanding in any other possible language.

Tangent
Following the declaration by a single nibble on the back of the first (thumb) finger of the non-dominant-hand, there is a single nibble on the back of the second finger indicating the Tangent.

Sinus
Following the declaration by a single nibble on the back of the first (thumb) finger of the non-dominant-hand, there is a single nibble on the back of the third finger indicating the Sinus.

Cosine
Following the declaration by a single nibble on the back of the first (thumb) finger of the non-dominant-hand, there is a single nibble on the back of the third fourth indicating the Cosine.

Cotangent
Following the declaration by a single nibble on the back of the first (thumb) finger of the non-dominant-hand, there is a single nibble on the back of the second finger indicating the Cotangent.

Secant
Following the declaration by a single nibble on the back of the first (thumb) finger of the non-dominant-hand, there is a single nibble on the face of the third finger indicating the Secant.

Cosecant
Following the declaration by a single nibble on the back of the first (thumb) finger of the non-dominant-hand, there is a single nibble on the face of the fourth finger indicating the Cosecant.

The reason for switching to the face part of the fingers is attributed to the fact that the face of each of those three fingers represents the reciprocal of the symbol declaring their notion on the back of the fingers. Namely for the second finger, it is the tangent declared on the back of the second finger and cotangent being its reciprocal (1/tangent) . Likewise, the back of the third finger declares the Sine, and its reciprocal (1/Sine) declares the Secant, while the fourth finger, declaring the cosine on the back of the fourth finger depicts its reciprocal (1/Cosine) Cosecant on the face of that finger.

The Scientific Foundation For Touch Language

In this section we will discuss the psychological and biological Interpretation of cutaneous excitation that give rise and a scientific basis to Touch Language. This section is treated as an adjunct part in the book, since it is not directly related to the presentation and analysis of the language.

Preface

Cats are known to communicate with movement of their tails and the sense of sight is required to perceive the communication. Dogs communicate with both tails and audio signals such as growl, bark or whimper, where the hearing sense is required to complete the cycle of communication. Bumblebees have been discovered to utilize "dance" language for communication. The communication caters for the environment where it is carried out, namely in the beehive. It is based on body movement joint with an angle formed to the Sun. It is anybody's guess whether any of those communications are passing through some cognitive aspect or are automatic and instinctive. On the other hand research has shown that cognitive elements exist among some animals, but the correlation to developmental cognitive language has not been proven. The octopus has eight flexible arms, with tentacles that are used to study objects before taking action. For example, a glass jar with enticing food in it and corked at the top may be studied by the Octopus via its tentacles, then the cork ejected and the food hauled out. The study performed by the tentacles utilizes two senses, taste and touch and the learning and action point towards a cognitive process. We also know that both human infants as well as Chimpanzee infants alike, until their third month learn about objects by putting them in their mouth, utilizing the sense of oral touch. It has already been established that primates can be taught Sign Language and subsequently can communicate with humans who know Sign Language.

Language is a tool for communication and perception, exercised either among persons, or from data to persons. It is a cognitive process, based on stored data, such as words, meanings, syntax, etc. It also contains rules for retrieval and presentation that culminates in the cognitive processing of the material presented. In the final stage of processing, one or more of the five senses is utilized for bridging between delivery and cognition. It could be vision, when one reads text or watches Sign Language, or even motion with the eyes - a "body language" meaning, auditory when listening to other parties directly, or via electronic media, or by touch such as in the case of Braille reading or interpreting Morse code. We concentrate in this book on the communication with the sense of touch, as the primary mode of communications being a utility for deaf and blind persons (deafblind), considering the scientific foundation for it.

Introduction

The choice of the palm as the main receptor for cutaneous excitations was not accidental, nor a matter of convenience albeit its value, but rather based on the psychological and neurological interpretations of such excitations as will be discussed below.

The skin is a complex sense organ and is the largest sensory system in the body capturing 6% of the body weight and covers 1.75 meter square in surface area (Kline, D). The skin contains multiple sensory systems, such as the sense of cold and warm, pain or touch. However, it is the touch sensitivity that interests us in building the foundation for Touch Language. The sense of touch is a mechanoreceptor and the human skin has about 17,000 mechanoreceptors in the

grasping surface of the hand that encompasses five major receptors (Liu et. al. 1988+). The practical importance can be immediately realized when we consider that touch sensitivity differs not only from person to person, but also for the same person, depending on the circumstances. For example, a person with well-developed touch sensitivity would experience a reduction in the sensitivity when the skin is cold and is less pliant. The implication is obvious, as Touch Language is limited in severe environmental conditions. Thus, when a person relies on Touch Language to navigate with an eCane (Liebermann, 2002) while being outdoors in a rough and cold winter, the experience could be disastrous as it can reach a state where communication to the skin is no longer perceived. Wearing mittens or gloves in winter blocks any delivery of sensation to the palm and therefore does not offer a solution.

The sensory system of touch is more than perceiving contact with an object. It encompasses how we feel shapes with our hands. The perception of the firmness of the object we touch, its texture, and the force of impact to it by an object. The sensory system is also gender dependent as females are more sensitive to touch than males and thus directly affect impacts on the skin and in particular on our object of interest, the palm. Thus, the force of impacts delivered to the palm needs calibration before use by any particular gender. Too light of an impact may not be perceived by a rough dry skin palm of a male, while that very same impact may result in tickling for a female and thereby miss its object of information so transmitted.

From the skin sensitivity point of view, we can eliminate areas not suitable for Touch Language delivery. The stomach and the back are the least sensitive and should be ruled out from the outset. While the lips can sense even minute pressure, they are not practical for the majority of Touch Language users. On the other hand the human fingertips that come next to the lips in their touch sensitivity are prioritized as a candidate for Touch Language delivery. Reading Braille by blind persons is one example of such usage for our target population.

Trying to induce sensation in an afferent fiber through touch, calls for some decisions from the outset. In order to provide “equal access” to such afferent fibers, we obviously rule out any non-glabrous skin areas for the major sensation inducing agents. Such a decision leaves only very few areas in the gender independent body. The list contains the lips, the palm, the sole of the feet, the face of the fingers and possibly the forehead. There are some other areas that even though may not be in the category of glabrous skin, they can receive limited type of information, such as a mechanical impacts on the area, with an object that presents enough minimal force to register a contact. A specific candidate for the latter case would be the back of the hand and the back of the fingers. They are mentioned here due to their proximity as well as being the back-side of glabrous skin areas considered useful for afferent fiber pathways.

The fiber adaptation to afferent fiber conduction can be slow or fast and therefore has ramifications in its utility, when response time is meaningful to Touch Language. They are associated with four major groups that represent nerve ending, corpuscles and receptors that we will encounter again below.

Speed of Fiber Adaptation

Speed of Adaptation	Type	Group Receptor
Slow	I	Merkel *receptors*
Slow	II	Ruffini *ending*
Fast	I	Meissner *corpuscles*
Fast	II	Pacinian *corpuscles*

Mere touch is not the only way to deliver information to the human skin. Vibrations are as important and in particular valuable if their frequency range is about 200Hz. Such touch mode, also referred to as vibrotactile sensitivity, has its own parameters of effectiveness as well as limitations. Contrary to the very high sensitivity of the fingertips as discussed above, they are not vibrotactile sensitive. However, the palm of the hand is sensitive to vibrotactile lending itself for use in Touch Language. Moreover, studies have shown aging to demonstrate only small decline in sensitivity to vibrations in the low frequency range of 25 to 40 Hz. Therefore, it appears that at least from the outset, a case has been made for using the palm of the hand and the fingers as the major receptors for touch language. Moreover, studies have shown that where touch sensitivity is greatest, the localization is also most accurate. However, such remarkable consistency in perception of vibrations by the palm has its own limitation and is frequency dependent. Namely, as we elevate the frequency range, and double it to about 80 Hz, we find that age does play a role in vibrotactile perception that can start as early as the age of 20 or 35. Since speech transmitted over telephone lines is at about the same range of frequency, it is rather poetic that we are directed by the psychological and biological effects to utilize the palm of the hand as the major receptor for perception of communication with the outside world. The poetic becomes more scientific when we consider studies that show (Gesheider et al. 1992) adjusting of auditory click with perceived onset and offset of vibrotactile stimulus. Noticeable, is the fact that the studies were done both for the lower mean age of 21 years, as well the advanced mean age of 72, where delays on offset showed 200 ms delays.

It should also be mentioned that sensory substitution, i.e, functionally equivalent devices based on vibrotactile have been used for persons with low vision. However, unlike the palm of the hand that shows little decline with age on sensitivity, the fingertips show reduced sensitivity with age, which makes it problematic to aging Braille readers. Such biological effect makes the simpler Morse (Liebermann, 2000) code attractive for delivery of text messages that appear to be age independent. Not surprisingly, palm and fingertips are quite useful at a young age where they are used in Tadoma. Tadoma, developed at the Perkins School for the Blind in Massachusetts, is a method for teaching students with dual sensory impairment how to speak. It is achieved by placing the thumb on the lips and the palms of the hands on the cheeks of the speaking persons to enable unique recognition of the vocal sounds.

Principal Types of Cutaneous Receptors

Various receptors are involved in the psychological perception of cutaneous excitations. Some do not relate in a direct way to our discussion of relevancy for Touch Language, such as pain perceived by free nerve ending close to the skin area, that also affect the sense of temperature.

However, such free nerve ending cannot be disregarded, as they are also important to the sense of touch. The important sensations relevant to our discussion are the senses of touch, vibration and pressure and to a lesser degree the sense of perceiving heat. These senses are generally categorized in terms of their rapidity to adaptation to mechanoreceptors and the size of the receptors field, namely, large or small.
Furthermore, mechanoreceptors are layered in different depth under the skin and can be excited by different frequencies, as we will further discuss below when we consider how and what messages to deliver to the palm. The table below summarizes the distinctions for the mechanoreceptors.

Modality of Receptors

The Receptors	Slowly Adapting Mechano-receptors	Rapid Adapting Mechano-receptors	Small Receptor Field	Large Receptor Field	Modality
Ruffini Receptors	1	0	0	1	Pressure
Merkel Receptors	1	0	0	1	Touch
Pacinian Corpuscles	0	1	0	1	Vibration
Meissner Corpuscles	0	1	1	0	Touch
Free Nerve Ending					

0 = No; 1 = Yes

Receptors are layered in different depth beneath the skin. For example, Meissner corpuscles, named after Greog Meissner (1829 – 1905) are touch receptors found in the upper papillary region of the skin dermis, where each consists of a mass of dendrites that are encapsulated by connective tissues. Not surprisingly, they contribute to our choice of the palm and fingers as receptors for touch language since the corpuscles are found in abundance both in the palms of the hands as well as the fingertips.

Threshold Issues

It has been established (Stoodley et. al., 2000) that individual variance in threshold frequency is not systematically different between groups, leading to affirmation for global use of Touch Language. Threshold for variance detection is important for variety of reasons, such as in somatosensory deficits seen in developmental dyslexia. However, our interests are in threshold measurements for vibration detection in efferent fibers for determination of frequencies and their choice of somatosensory pathways relevant to touch inducement language element.

Another threshold relevant issue relates to the scope of users. Namely, if Touch Language is to be useful for the largest range possible of deafblind persons, certain range of frequencies need to be avoided in triggering efferent fibers. For example, while the 30 Hz range does not show differences compared to various groups (Stoodley et. al., 2000), in contrast, the 3 Hz difference between dyslexics and non-dyslexics persons is approximately 2.6 dB (32 microns). It is of interest to note, that the 3 Hz vibration deficit of dyslexics, is consistent with the neural mechanism deficiency in visual and auditory systems (Stein and Walsh, 1997), (Witton et. al. 1998). Thus, a deafblind person with both audio and visual impairments will also show the same deficiency in vibrotactile sensitivity at the 3 Hz frequencies. We find (Liu et. al, 1988+) that mechanoreceptors distribution in the glabrous skin area and their relative frequencies, as an omen for Touch Language utility, as can be seen below.

Mechanoreceptors Usage and Location

Mechanoreceptor	Best used to **Detect**	Glabrous Skin **Location**
Free receptors		Permeate entire thickness Of the dermis lying Perpendicular to skin surface
Meissner	Motion across the skin. Velocity	upper papillary region of the skin dermis
Merkel's disk	Pressure Intensity	Fingers [found only in basal Layer of the epidermis of the Ridges in the fingers]
Pacinian	Acceleration Vibrations	found in deeper part of the dermis [only incidental Connection to the skin
Ruffini	Intensity Pressure Shear on the-skin	Subcutaneous tissues of the pulp of the fingers

Mechanoreceptors Targeted During Touch Language Execution

We will assume (Asamura 1998) that very small magnets of approximate sizes of 1mm by 0.5mm by 2mm are placed on the target receptors (e.g., the palm) and spaced 2mm apart of each other. We further note that with the magnate mass of 0.006 gr. the impedance is determined to be less than the mechanical impedance of the skin surface below several hundred Hz. When we apply electrical current to any of the cylinders making contact with such magnets, the normal force to the skin will be proportional to such current. If we further execute common phase and

reversed phase driving modes, we realize that we can reach distinctly different layers of receptors. Namely, we are provided with the ability to cause shallow and deep receptors comparable stimulation. Moreover, since the deep receptors receive smaller stress than the shallow receptors in the reversed phase driving mode, we can cause different signal perception at the palm. It should also be noted that since the magnets are small, the deafblind could not sense that they are attached to the hand. This is somewhat functionally equivalent to person with sights who cannot sense the discrete nature of the static frames flashed on the TV at the rate of 30 frames per second.

That is:
Let $f_1(t)$ and $f_3(t)$ be deep receptors and $f_2(t)$ a shallow receptor, then the two modes are represented (Asamura 1998) as:

$(f_1(t), f_2(t), f_3(t)) = (1,1,1)\ f(t)$ in the Common phase driving mode, the shallow and deep receptors receive comparable stimulation, and

$(f_1(t), f_2(t), f_3(t)) = (-0.5, 1, -0.5)\ f(t)$ in the reversed phase driving mode, the deep receptors receive smaller stress than the shallow receptors.

The above leads us to delineate in the table below the background for the decision table of choice among excitations to various specific receptors.

Background for Decision Table

Tactile Surface *Area*	Stimulation Frequency	Stimulated Tract / Fibers	Time (Sec)	Human Perception (Sensation)	Tactile Form	**XX**
1.5 mm e.g.	200 PPS	Ruffini	1/60	Pin/sponge	Verticon	?
	30 Hz	Meissner/FA I		Flutter		V
	100 Hz	Pacinian/FAII		Vibration		V

Current, Frequency and Time versus Perceived Sense

Current (mA)	Frequency	Receptor Type	Time (Sec)	Perceived Sense	Tactile Form
70	<200 PPS	Ruffini	0.5	sponge rubbed on palm	Verticon
			<250	Continuous movement of stimulous along the skin	
	<30 kHz		0.5	Smooth object sliding without	

	friction
>200	Feels only vibration
30	Pin moving on the hand

Various Facts and Corollaries

- Different vibration frequencies supplied by the same detection threshold are processed independently
- Detection threshold at 30 Hz and 100Hz are strongly correlated, while the 3 Hz is not
- Avoid the usage of 3 Hz as dyslexics are less sensitive to that frequency, and they ought to be included in the users group of Touch Language
- The 3 Hz vibrotactile perceptions are mediated by different neural coding mechanism.
- The fingertips are more sensitive to touch than the palm. For example, a 4μm indentation in the fingertips will excite a mechanoreceptor, whereas the same 4μm indentation in the palm does not. Thus, tactile excitations to the fingertips remain unassigned in our development and held in reserve, for the eventuality that there may be an embodiment whereby Braille is used in conjunction with Touch Language.

The Biological translation of senses

With the initial selection of the palm and the fingers of the hand as the target receptors for Touch Language, we turn our attention to the idiosyncratic interpretations of excitations to these receptors. The reason lies in the fact that what is delivered to the receptors is not always perceived as such when the biological sensation is translated to psychological perceptions. We turn next to examine this aspect and its significant importance for Touch Language.

Knowledge of our intentions and motor commands are directed by somatosensory cortical activity. It is used to distinguish the sensory consequences of our actions from externally produced sensory stimuli. Thus, self produced or self-induced tactile sensations are perceived differently than externally produced ones (Blakemore et al.1999). Therefore, it should not be difficult for any person utilizing Touch Language to distinguish between tactile description of activities, and tactile information and confirmation of self-induced activities. Such proved assertion enhances the utility of Touch Language and relieves users from potential ambiguities related to uncertainties of signals received directly or indirectly from those that are user generated.

(Preliminary)

Current, Frequency and Time versus Perceived Sense

Current (mA)	Frequency	Receptor Type	Time (Sec)	Perceived Sense	Tactile Form
70	<200 PPS	Ruffini	0.5	sponge rubbed on palm	Verticon
			<250	Continuous movement of stimulous along the skin	
	<30 kHz		0.5	Smooth object sliding without friction	
	>200			Feels only vibration	
	31			Pin moving on the hand	

Scientific Foundation Through Intuitive Imagery

It may appear that scientific foundation is insufficient in its basis for Touch Language and other elements are needed to augment the foundation.

The scientific foundation for Touch Language is based on our knowledge of biophysical human sensory perception. However, Touch Language is in its infancy, is an uncharted territory and requires more than the bare scientific foundation. There is another major segment that should be incorporated into such a foundation. Besides the biophysical sensations available for the deafblind, Touch Language relies heavily on utilizing human imagination, in lack of any other audiovisual basis for perceiving images. In fact, biophysical sensation and human imagination have a symbiotic relationship for the deafblind who utilizes Touch Language. Imagination itself without pertinent sensory perception is disconnected from an ongoing scene happening on the TV. Likewise, sensory perception not resulting in imagery pertinent to the TV show has no relevant bearing. As we will shortly realize, even the seemingly intuitive imagery, not based on a scientific platform from the outset, ends up enhancing the scientific foundation of Touch Language.

To this end, it should behoove us to explore the role of imagery in visual perception, reaching to constructs that might be totally unrelated to its forming components. It is more than plausible to reach to the mind of painters who translate real images, as well as figments of their imagination to artistic expositions that can be viewed by persons with functioning sense of sight. In that regard, our quest is to infer from their works about the reverse route, from images on paper or canvas to the images formed in the brain and the emotions resulting from it. Who could be better

than a master draftsman and inventive engineering genius like Leonardo Da Vinci to assist posthumously our task by studying his creative creations.

Studying Leonardo's late drawings from the period of 1506 and to 1519, we realize that "Leonardo understood imagination as *fantasia*, the ability to recombine images or parts of images into entirely new compounds of ideas" [Leonardo, 2003]. Leonardo who is credited with establishing our scientific procedure with empiric evidence for a scientific basis, demonstrated departure from the scientific approach by taking pictorial representations and reaching "for the storytelling devices of classical mythology rather than scientific explanation" as can be witnessed in his "Cataclysmic Storm Striking a Landscape with Cavalry".

It is therefore, quite enlightening to observe the drawings by Leonardo Da Vinci, as studying his masterful work, helps us in gaining reassurance in our intuitive construct of Touch Language attributes. For example, Leonardo's Studies of Ballistics (1483- 1485) portrays at the lower left of the drawing a spherical object, such as shell or grenade catching fire as it roles. We notice his intuitive moment in time, when Leonardo chooses to show the emanating lines describing flames shooting outward rather than depicting the dynamic roll of the spherical object. The emphasis on the former rather than the latter appears to fix the object as a static snapshot in time, albeit the curvature of the symbolizing lines of fire bespeaking of motion. Namely, if we are to provide intuitive Touch Language description of fire or explosion, it is the environmental impact that carries the dynamic expansion aspects of shock waves resulting from it, rather than the dynamics of the exploding object that appears to be fixed in time for that particular instant, when the explosion takes place. Leonardo vindicates our expansion motion of Touch Language in the PalmScreen, embodying both scientific, as well as imagination and perception of a master draftsman with the eye for the detail. However, it goes beyond a picture frozen in time portraying dynamics, and in order to better understand its relevance to Touch Language and the scientific foundation for it, we need to discuss first another drawing by Leonardo, the Military Technology.

Military Technology

The Military Technology drawing by Leonardo Da Vinci (1482-1484) shows a mortar fires a spray of small stones

The drawing includes in it the combination two components"

- The component of reality (i.e., the tract of the stone, with the stone at its end at some position in space).
- The component of employing of the imagination of a tract that either:
    - Shows the remaining imaginary tract of the former stone, since in reality the stone does not leave a visual trail, and even if it were to do so, it could not possibly match exactly the track of the current stone in its position and in doing so be consistent, likewise for all current stones in the air; or
    - Employ the imagination for construing where the stone would shortly be and its upcoming tract.

In either case, even while the imagination is used, an important component that cements the image in our mind is the *visual component* portraying the future:

- Line symbolizing the future tract; and
- The line symbolizing the former tract

Such visual components are not available to the blind. Thus, we need another complementing component to simulate the dynamics, without reliance on the visual sense. Therefore, we cannot utilize an image frozen in space and time and need to supply the dynamics of a non-intuitive process.

In Touch Language, we utilize both PalmScreens for such purpose, where the dominant hand (DH), that is the right hand for right-handed persons, provides the dynamic element via facsimile tracts generating through sensation of motion, while the functional equivalent picture of an element frozen in time, is provided by the complementary hand (CH), that is the left hand for right-handed persons.

We notice that for seeing persons the eye captures a view, the imagination is employed in translation, and the connectivity between visual and imagination happens by an instantaneous process in our brain. The deafblind who utilize Touch Language, employ a functionally equivalent process. The connectivity still happens in the brain, the component of imagination still prevails, but the "visual" component is supplied in two simultaneous parts.

- The tract is provided by motion on the PalmScreen of the dominant hand, and
- The object is provided by functionally equivalent means on the PalmScreen of the complementary hand.

In that regard, we could equate the PalmScreen of the dominant hand with the same side brain hemisphere of creativity for lines depicting motion, and the other side brain hemisphere of facts and rigor to depict the evidence of impacts of stones. Namely, we have the scientific basis for splitting the visual component into two parts that supply the human needs according to the functionality assigned by the brain.

Morse Code in Touch Language

Some of the readers may wonder the choice made for the Morse Code as the communication tool, so a brief justification follows.

Morse code appears intuitively appropriate for communication, where impacts on body parts as intake and impacts transmitted are based on short cutaneous excitations and where larger segments employ vibrations. The question remaining, is whether the intuitive idea is useful when exercised in reality. To this end, we cite below an experiment conducted at Signtel (www.signtelinc.com) with its well over one hundred deaf and blind employees, working as assistant developers in product development.

All the assistant developers were first taught Braille (assuming not all knew it). Subsequently, on that day and in a successive session, they were all taught the Morse code. When it was all done

and no questions left, they were asked to transmit their name on their electronic device, first in Braille and then in the Morse code. Once transmitted, they were all asked, which of the two (Brails or Morse) was easier. The answer was unequivocal that Morse was easier. This result, was not only an affirmation for the intuitive surmise, but also laid the grounds for the subsequent development of Touch Language, with the Morse code at its base, since the president of Signtel who orchestrated the experiment was also the developer of the ensuing Touch Language.

Global Translation Language (GTL)

Touch Language has been evolved since its initial development, into a tool that enables universal communications and automatic translation between languages and cultures for individuals who do have their sense of hearing and sight intact. Such technology operates without the need for electronic gloves that are simulated by an electronic translation engine. This new Global Translation Language is patent pending that is expected to be issued in 2017.

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Appendix A

(Static Parameters)

Ring: A circular closed loop with a variable radius

Large Ring: A Ring that goes almost to the edge of a Palm (note size differences)

Small Ring: A ring with a small radius, so that it allows fitting nine of them, organized as 3 by 3 in the Palm.

Round Plate: A circle that is filled to create a solid unit.

Large Plate: A Plate that goes almost to the edge of a Palm (note Palm size differences)

Small Plate: A Plate with a small radius, so that it allows fitting nine of them, organized as 3 by 3 in the Palm.

Vertical Line: A solid vertical line (90 degrees to Base) between North and South of the Palm

Horizontal Line: A solid horizontal line (Parallel to water level) between East and West.

Curved Line: A solid line that when one side is extended until it meets the other side forms a circle with a radius.

Semi-circle: A solid line that forms a complete circle when used with its mirror image.

North Apex Semi-Circle: A semi-circle with its convex apex at the North center of the Palm.

South Apex Semi-Circle: A semi-circle with its convex apex at the South center of the Palm.

West Apex Semi-Circle: A semi-circle with its convex apex at the West center of the Palm.

East Apex Semi-Circle: A semi-circle with its convex apex at the East center of the Palm.

Base of Oblique Line: A solid straight line starting either at left South of the

Palm and ending at or before the right North of the Palm or starting at the right South of the Palm and ending at or before the left North of the Palm.

Top of Oblique Line: A solid straight line starting either at left North of the Palm and ending at or before the right South of the Palm or starting at the right North of the Palm and ending at or before the left South of the Palm.

Oblique Line – Right Base: A Base Oblique Line starting on the right hand side.

Oblique Line - Left Base: A Base Oblique Line starting on the left hand side.

Oblique Line – Top Right: A Top Oblique Line starting on the right hand side.

Oblique Line – Top Left: A Top Oblique Line starting on the left hand side.

Appendix B

(Basic Dynamic Parameters)

Clock Hour: A circle drawn on the PalmScreen followed immediately by a moving radius imitating a clock handle and stopping at the correct time, followed by a single short impact at clock center for AM and double short impacts for PM.

Upper Moving Vertical Line: A vertical straight line as it is formed by starting at the base of the Palm and moving up North of the Palm.

Lower Moving Vertical Line: A vertical straight line as it is formed, starting at the Top of the Palm and moving up South of the Palm.

Right Moving Horizontal Line: A straight horizontal line as it is formed, starting at the West side of the Palm and moving towards the East of the Palm.

Left Moving Horizontal Line: A straight horizontal line as it is formed, starting at the East side of the Palm and moving towards the West of the Palm.

Parallel Vertical Lines: Two or more Vertical lines impacting on the Palm, either simultaneously, successively, or in rotation.

Parallel Moving Vertical Lines: A Vertical Line forming, followed by another Vertical Line forming. The forming Vertical Lines can all start South and form towards the North, all start at the North and form towards the South, or alternating between starting at the North of the Palm and starting at the South of the Palm.

Expanding Semi-Circle: A Semi-Circle with an expanding radius.
Contracting Semi-Circle: A Semi-Circle with a contracting radius.

Appendix C

(Combinatory Dynamic Parameters)

Moving Oblique Line – Right Base: Oblique Line forming at the Right Base.

Moving Oblique Line - Left Base: Oblique Line forming at the Left Base.

Moving Oblique Line – Top Right: Oblique Line forming at the Right Top.

Moving Oblique Line – Top Left: Oblique Line forming at the Left Top.

Moving North Apex Semi-Circle: Descending North Apex Semi-Circle towards the South.

Moving South Apex Semi-Circle: Rising South Apex Semi-Circle toward the North.

Moving West Apex Semi-Circle: Moving West to East of a West Apex Semi-Circle.

Moving East Apex Semi-Circle: Moving East to West of an East Apex Semi-Circle.

Moving Base of Oblique Line: An Oblique where the North ens remain fixed while the South end moves rather from West to East or frm East to West. line.

Spiraling line (snake like): A line that progresses along a certain direction while changing a few times slightly in curvatures of small radii of half circle each along

such path, East to West, the back to East, them West repeatedly until reaching the end point, all being contiguous.

Moving First Right Base to
Left Top Crossed Oblique Lines: Crossed Oblique Line moving with starting point of South East and moving towards ending at North West. contiguous.

Moving First Left Base to
Right Top Crossed Oblique Lines: Crossed Oblique Line moving with starting point of South West and ending at North East.

Moving First Right Top to
Left Base Crossed Oblique Lines: Crossed Oblique Line moving with starting point of North East and ending at South West.

Moving First Left Top to
Right Base Crossed Oblique Lines: Crossed Oblique Line moving with starting point of North West and ending at South East.

Moving First Right Base to
Left Top Crossed Oblique Lines: Crossed Oblique Line moving with starting point of South East and ending at North West.

Moving First Left Base to Right Top Crossed Oblique Lines: Crossed Oblique Line moving with starting point of South West and ending at North East.

Moving First Right Top to
Left Base Crossed Oblique Lines: Crossed Oblique Line moving with starting point of North East and ending at South West.

Circle with Oblique Line – Right Base: Circle crossed in the middle by a strait line extending both sides of the circumference, starting at South East and ending at North West.

Circle with Moving Oblique Line – Right Base: Circle where an oblique line is moving from one side of the circumference to the opposite side, starting at South East and ending at North West.

Circle with Oblique Line – Left Base: Circle where an oblique line is moving from one side of the circumference to the opposite side, starting at South East and ending at North West.

Circle with Oblique Line – Top Right: Circle crossed in the middle by a strait line extending both sides of the circumference, starting at North East and ending at South West.

Circle with Moving Oblique Line – Top Right: Circle where an oblique line is moving from one side of the circumference to the opposite side, starting at North East and ending at South West.

Circle with Oblique Line – Top Left: Circle crossed in the middle by a strait line extending to both sides of the circumference, starting at North West and ending at South East.

Circle with Moving Oblique Line – Top Left: Circle where an oblique line is moving from one side of the circumference to the opposite side, starting at North West and ending at South East.

Circle with Crossed Oblique Lines: Circle with crossed lines symmetrically traversing it where the locus of the circle and cross section point of the cross occupying the same point.

Appendix D

(Attributes of Touch Language)

ON: Upper Moving Line created by impact of dots.

OFF: Downward Moving Line created by impact of dots.

Problem: Impacts of Top Left Diagonal Line followed immediately by Top Right Diagonal Line. The impacts can continue throughout the duration of the problem or happen either once or multiple times.

Bad (TV) Reception: The "Problem" signal where the crossing Diagonal Lines progress downwards in a Snake Motion.

Emergency in TV Broadcasting: A Large Ring impacting on the PalmScreen a number of times.

Serious Emergency: The "Emergency" signal, where the Large Ring impacts rapidly several times.

Silence: An North Horizontal Line impact followed by a slow sliding of the Horizontal Line from North to South.

Noise: A South Horizontal Line impact followed by a slow sliding of the Horizontal Line from South to North.

Loud Noise: A Noise signal where the Horizontal Line impacts on the PalmScreen several times when it reaches the North of the Palm.

Fire: expanding ring-motion where the points of the ring are discretely spaced from each other. Starting at the center of the palm and expanding to the edges.

Garage Door – Opening: fore finger moves from south to north of palm and when reaching the north it impacts twice in succession at the north of the palm

Garage Door – Closing: same as above except that the move is from north to south of the palm and the two impacts are provided at the south of the palm

Sea Waves – Small: the five fingers of a hand start from the edge of the palm towards the center of the palm in a smooth and even motion

Sea Waves – Large: same as above but the motion is rougher.

Surf Wave in Sea: semicircle finger moves in counterclockwise motion and the circles it describes gets slowly smaller

Sea Waves breaking at a Breaker: four fingers gliding slowly from south of palm to north of palm and end with a simultaneous light impact at the north of the palm. The stronger the waves, the stronger the final impact.

Hammering – Small Hammer: A thin line hammering at north half RHS of Palm

Hammering – Large Hammer: A finger hammering impacts on north half RHS of palm

Firing Revolver: half finger impacting on palm the trajectory shown to a point of impact (even if there is no impact) and a final impact on the palm with a marble ball

Firing Shot Gun: as above, except that the marble is larger and each point of the trajectory is an impact of the marble

Firing Canon: Same as above except that the trajectory is in location 0 i.e., center of palm, where a much larger marble impacts on it several times.

Soaring Eagle: from South east to north west a slow motion of two fingers apart where between then id a marble moving in the same direction with a moving impact, i.e., constant pressure on the palm as it moves.

Airplane taking off: same as above except that it moves from central South of palm to North of palm and starts with a pressure movement that eases as it progresses to the North of palm and then stops abruptly when reaching the North

Airplane in decent: same as above BUT starting from north of palm to south of palm and the pressure starts from minimal and gets stronger as it reaches the south of the palm and then gives a final double impact at south of palm.

Airplane Touch Down: the double impact described above. Without the double impact, there is no touchdown. Change to take of motion while continuing towards the south of the palm means touchdown abandoned and plane took off back to the skies.

Raining: light impacts of several simultaneous dots in arbitrary positions on the palm. The timing of each impact is mostly different from each other

Hailing: same as above, except that the impacts are stronger

Thunder: oblique line impacts strongly once then vibrates strongly rapidly 2 to 3 times at northwest of PalmScreen, then vibrates in reducing strength its way down (i.e., 4 or 5 more times) to the Southeast of PalmScreen.

Rolling Ball: A circle is formed in one location of the PalmScreen and then it is repeated multiple times in continuous consecutive manner in the direction that the "ball is rolling". Its starting position is from where the ball starts to roll.

Rolling Person: A thick half-line is rolled as a cylinder 360 degrees on the PalmScreen, then it moves a bit (towards the direction of rolling) and repeats the rolling motion, moves further again (discretely) and rolls, until it reached the desired location or the edge of the PalmScreen.

Rolling Car: Same as a Rolling Person, except that the KeyWord changes from "Person" to "Car".

Forest of Trees: Multiple small circles (between a dozen or two) are simultaneously described on the PalmScreen, at distance from each other.

Forest of skyscrapers: Same as forest of trees, except that instead of circles, small squares are described on the PalmScreen.

Collision: Two half-lines slide on the PalmScreen to wards each other and upon their edges meeting (the impact), there is a strong impact on the PalmScreen at that point followed with a short strong vibration at that point.

Collision with object penetrating: Same as in "Collision", except that at the end of the vibrations there is a short impact motion backward in one direction (the direction symbolizes the car that was penetrated).

Pulling Gun From Holster: Two half-lines forming a "V" shape with the apex at North East or North West of the PalmScreen and the open part pointing to the center of the PalmScreen impacting on the PalmScreen followed by a third half-line first impacting in the middle of the "V" shape and immediately thereafter sliding away from the "V" shape and the center of the PalmScreen and in a direction opposite the apex of the "V".

Door Opening: A half-line impacting the South end of the PalmScreen starting at either the South East or South West of the palm (depending on the hand as it should be on the opposite side of the thumb), followed by a gyrating movement where the South East (or South West) point remains stationary while the half-line moves towards the north of the PalmScreen.

Door Closing: Same as "Door Opening", except that it starts from the end status of the "Door Opening", gyrates back to its beginning position at the South East (South West) and when the half-line becomes parallel to the South Base of the PalmScreen it impacts rapidly twice on it.

Roof Collapsing: Two half-lines forming an inverted "V" shape with the apex at the North center of the PalmScreen and their other ends terminate respectively at either side (East and West) side in the middle of the PalmScreen. The "V" impacts once in its location, followed by two rapid strong vibrations, and then followed by the inverted "V" shape apex movement from North to South of the PalmScreen while vibrating modestly and its two forming legs open up (to West and East) ending when the apex reaches the center of the PalmScreen and together with its two legs it forms a straight line from Mid West to Mid East of the PalmScreen and then undergoes a series of several vibrations that diminish in strength, until they die out.

Building Collapsing: Same as a "Roof Collapsing" except that the inverted "V" shape is replaced by three half-lines forming the upper part of a square and the vibrations start from the Top line at the North and when the North line starts to vibrate while moving towards the middle of the PalmScreen the other two half-lines forming the legs of the upper part of the square become shorter while the upper half-line gets proportionately longer ending as a line touching the sides of the PalmScreen.

Breaking a Window: A solid square plate size of (minimum 50% maximum 90% of PalmScreen size) impacts on PalmScreen once followed by several (3 to 6) half lines where one end of each is centered in the center of the PalmScreen and the other end of each is separated away from the other ends of the others at various uneven degrees where each such degrees of separation is between 15 to 30 degrees, all vibrating twice simultaneously, followed by uneven (between 2 to 5) vibrations of small plates (approximately size of one quarter of an inch diameter each at various locations of the PalmScreen.

Moving Vehicle: The movement pattern is described on the PalmScreen, while the KeyWord describes whether the vehicle is a car, truck, bus, bicycle, train, etc.

Stationary Vehicle: Same as "Moving Vehicle", except that a rod impacts continuously on a single location on the PalmScreen.

Train Car: Same as "moving vehicle", or "stationary Vehicle", as appropriate.

Subway car: Same as for the Train Car

Motorcade: Same as “Moving Vehicle”.

Cycling on Bike: Same as “Moving Vehicle”.

Riding a motorcycle: Same as “Moving Vehicle”.

Walking: Light successive impacts on the PalmScreen that are appropriately timed to imitate the forefinger and middle finger “walking” on the PalmScreen in a motion that is left to right or right to left

Climbing: Same as Walking, however, the motion in from South to North of the PalmScreen

Descending: Same as Walking, however, the motion is from North to South of the PalmScreen

Jumping: Two circular plates impact strongly on the PalmScreen simultaneously one in the South and one in the North (like the impression made by the first and middle finger forming an inverted “V” pressed onto the palm). The motion is repeated a few times.

Jumping up and down: Same as “jumping”, except that the impacts on the North and South of the Palm are not simultaneously but rather interchangeably one then the other, repeated several times.

Jumping up: Same as “jumping up and down”, except that the motion is dome only once. That is a single impact on the South of the Palm followed by a single impact on the North of the palm.

Jumping Down: Same as jumping “up”, except that there is a single impact in the North of the palm followed by two rapid successive impacts on the South of the palm made by two adjacent plates with a space between them.

Parachuting: A large (empty) circle that is almost to the edges of the Pam and which wobbles slowly. [When the circle become quickly and significantly smaller with an impact that increases its pressure and ends up with a raising and a strong bang signify a parachute malfunctioning, rapidly falling to the ground and ending in an impact of death.[

Falling out of a building (roof, window, etc.): A line progressively stretching from North West to South East and ending with a double impact if reaching the ground.

Falling in Air (like from airplane): Same as falling out of a building, except that the motion is not of a straight line but rather a light touch of a progressively advancing helix from North West to South East and ending in double impact if reaching the ground

Jumping out of a building: Same as Falling out of a building, except that it starts with a single impact on the palm at the starting point.

Jumping out of an airplane: Same as Falling in air, except that it starts with a single impact on the palm at the North West starting point.

Reversed, Backwards: Performing a single circular motion ending with the motion on the palm reversed in direction.

Rolling

Swinging an Item at Somebody:

Swimming: Circular (helix like) motion starting at the South East of the Palm and advancing with continuous motion towards the North West through a light touch of a small plate making the motions on the palm.

Diving: A thick stick impacts once on East of the PalmScreen pushing into the palm while advancing to the West of the palm. (Could also be from West to East).
No// do like swimming but with pushing impact east to west ???

Sinking (or drowning): A pushing impact of a small circular plate starting at the north of the palm and slowly advancing in a straight line towards the South of the palm.

Smile: Slight opening of two Nibbles that subsequently slide in parallel from Left North of the PalmScreen to the Right North.

Laugh: Two parallel Lines that open up simultaneously at the North of the Palm and immediately subsequently to it are replace by the same parallel contour made of discrete Nibbles with noticeable horizontal space between then and they impact on the North of the PalmScreen rapidly and simultaneously. [NOTE: define the rate of impact and the space of opening of the line. The larger the latter opening and the more rapid the impacts the harder the laugh is by the person.

Intercourse action: A finger comes to rest on the PalmScreen and then starts to push into the palm while pushing it also towards the north (northeast or northwest) of the Palm in several successive motions. The speed or frequency provided by the nibbles action.

Appendix E

(Possible Embodiments For Receptors)

Possible Embodiments For Receptors

There are various possibilities for selection of body receptors. We have already discussed the embodiment where the receptors are the Palm, the tips of the fingers, the back of the hand and the back of the fingers. There are other possibilities for body receptors that can either function by themselves or in combination with other, such as from the group of receptors we have already discussed. Given below are some additional possibilities for receptors. Each of the possibilities operates on the same principle, where the (potential "receptor") area receives impacts from various portions of the part that is adjacent to it. For example, if the receptor is an arm bracelet, then the bracelet might have nail-like sections that could impact on the arm as a receptor any series of small single impacts, multiple impacts or seemingly random series of impacts. The list below shows some such embodiments, however, we will proceed with the embodiment chosen for the presentation discussed hereto.

- *The Earphones Embodiment*
- *The Necklace Embodiment*
- *The Arm(s) Bracelet(s) Embodiment*
- *The Leg(s) Bracelet(s) Embodiment*
- *The Thigh(s) Bracelet(s) Embodiment*

Appendix F

(Touch Language Representation)

>L: Back of Finger
L<: Face of Finger
<G: The Back of the Hand
G<: The Palm (inner part of the Hand)

1>L: Back First Finger (the "thumb" in our representation)
2>L: Back Second ("Pointer") Finger
3>L: Back of Third ("Middle") Finger

L<1: Face of the First ("Thumb") Finger
L<2: Face of the Second ("Pointer") Finger
L<3: Face of the Third ("Middle") Finger

Appendix G

(Lower &Upper Nibble Impact Representation)

No. Of Upper Nibble Impacts	Profession Type
1	Law & Order / Criminal
2	Blue Color
3	Education
4	Medical
5	Miscl.

Upper Nibble Impact ^^1: Law & Order / Criminal

No. Of Lower Nibble Impacts	Profession
1	Detective
2	Policeman
3	Criminal (Robber, thief, etc.)
4	Defense attorney
5	Prosecutor
6	Judge
7	Bailiff

Upper Nibble Impact ^^2: Blue Color

No. Of Lower Nibble Impacts	Profession
1	Plumber
2	Mechanic
3	Driver
4	Janitor
5	Roofer

No. Of Upper Nibble Impacts	Profession Type
1	Landscape
2	City
3	Buildings [hospitals, offices,….
4	Transportation [airplanes, cars, trains, choppers
5	Activities [dancing, walking, running, jumping,
6	Fighting [boxing, karate,

L<4>: Upper Nibble Impact ^^1: Descriptive

No. Of Lower Nibble Impacts	Profession
1	Trees
2	Bushes
3	Desert
4	Mountains
5	Cliff
6	(Reserved)

Appendix H

(Multiple Meaning in Visual Human Signs)

- Face of the fingers or Palm behind the Ear.
  - *Description*: Putting the palm or the face of the fingers behind the ear while possibly also tilting the ear forward.
  - *Meanings*:
    - Cannot hear what you say, speak louder
    - I am waiting for you to say something

- Moving the eyes to one side or another.
  - *Description*: Moving the eyes to one side of the eye socket, without moving the head.
  - *Meanings*:
    - A hint saying “look over there”
    - Crossed eye look to the side without being notice

- Opening of the mouth and keeping it open**.**
    - *Description*: Opening of the mouth and keeping it open.
    - *Meanings:*
        - Signifying disbelief
        - Signifying fear

    :
- Hand and arm move while the
    - *Description*: Hand and arm move while the arm is approximately parallel to ground, the palm perpendicular to the ground and moves freely towards the edge of the torso where the other arm is located
    - *Meanings*:
        - A signal to move on and pass the location, such as given by a policeman
        - Slap on the face

- Hand faced down and lowered successively
    - *Description*: Hand faced down and lowered successively
    - *Meanings*:
        - Please lower your voice
        - Please sit down
        - Signifying a small person, such as a child

- Two arms open in parallel and moved towards the torso
    - *Description*: Two arms open in parallel and moved towards the torso, while the hands half-fold loosely towards the torso**.**
    - *Meanings*:
        - Come towards me
        - A challenge meaning, “let’s see you (e.g., fighting me)

- Loose waving of the hand(s) downwards
    - *Description*: moving either one or both hands from a position where the hand is about mid-torso section parallel to the ground and is lowered in successive motions downwards. The motion is either continuously in downward direction, or come up back and the motion is repeated.

    - *Meanings*:
        - Quiet down
        - Sit down

- Salute
    - *Description*: Raising the right hand open with fingers touching each other to an oblique position next to and touching the forehead with the first finger.

    - *Meanings*:
        - Salute, such as in the military
        - A friendly farewell sign when departing

- Pursing of the lips
    - *Description*: Pursing both lips together and inward pushed against the teeth so that are not seen at all.

    - *Meanings*:
        - Anger and hostility
        - Amusement

- Putting the hand on the hip
    - *Description*: Putting the hand on the hip with the palm facing the floor while the contact with the hip is made with a wide opening between the thumb and the first finger.

    - *Meanings*:
        - Challenging the other party
        - Waiting position for action of the other party

- Putting both hands on hips
    - *Description*: Same as putting one hand on the hip, except that both hands are used, each at the hip closed to the respective hand
    - *Meanings*:
        - *Strong challenging position*
        - Strong waiting position for action of the other party

- Hands folding
    - *Description*: Folding the hands in front of the torso , such that each hand is resting against the armpit of the other arm.
    - *Meanings*:
        - *Showing defiance*
        - *Waiting mode*

- Nose wrinkling
  - *Description*: Upper movement of the nose as a whole while moving the closed mouth slightly upward to show disgust.
  - *Meanings*:
    - *Showing disgust*
    - *Response to foul odor*

- Blinking with both eyes
  - *Description*: Rapid closing and opening the eyelids a few times.
  - *Meanings*:
    - *Surprise*
    - *Disbelief*

Appendix J

(Teaching Touch Language)

(TBD)

Appendix K

(Definition Structure for Signal Transmission)

Thus, E(k) = The element E(k); The boundaries of E(k) are its four adjacent elements, each at the respective side. That is, if we observe the left side of element E(k) along the positive Y axis and the bottom side of the element E(k) along the positive X axis, so that the lower left corner of the element is at the origin of the intersection point, then the following applies.

e(1)(0,0) = lowest left corner of element e(1)
e(1)(0,1) = upper left corner of element e(1)
e(1)(1,0) = lowest right corner of element e(1)
e(1)(1,1) = upper right corner of element e(1)

Where e(i) means e_i and therefore e(1)(0,0) means $e_1(0,0)$ and e(1) means e_1

Therefore the above element E(1) as defined in terms of its neighbors, is represented by the matrix

$$E(1) = \begin{matrix} e(1)(0,1) & e(1)(1,1) \\ e(1)(0,0) & e(1)(1,0) \end{matrix}$$

Therefore, in our coordinate system, the left adjacent elements to E(1) is:

$$E(2) = \begin{matrix} e(2)(-1,-1) & e(2)(0,1) \\ e(2)(-1,0) & e(2)(0,0) \end{matrix}$$

We note that the right hand side of element E(2) and the left hand side of element E(1), each has the same coordinates. Indeed, when the mechanical adjoining of elements E(1) and E(2) takes place, they will have common coordinates. However, those coordinates will not have any meaning once E(1) and E(2) are conjoined. Hence, the first rule of conjoining reads: Whenever coordinates of elements conjoined were the same before the conjoining, they are both canceled after the conjoining and stop to exist as independent coordinates.

The necessity in defining the coordinate and rules of associations will become apparent when forming instructions are issued for different shapes, sizes, their locations, and alterations, for the purpose of delivering the mechanical message to the deafblind.

To depict a line "drawn" on the PalmScreen by s series of Nibbles in terms of the above description we have:

$$\mathbf{E}(k) = e(i)\ t_i^{+}(n)\ t_i(m)\ t_i^{-}(j)$$

Next, we provide the specifics of the example of a moving object referred in the text:

The following execution will provide the perception, where:

E(K) = E(1), E(2), E(3), E(4), E(5)

E(k) = 0 means no raised element from its flat bed
E(k) = 1 means raised element to form an impact on the body part

E(1) = 1; e(2) = 0; e(3) = 0; e(4) =0; E(5) = 0
E(2) = 0; e(2) = G; e(3) = 0; e(4) = 0; E(5) = 0
E(3) = 0; e(2) = 0; e(3) = G; e(4) = 0; E(5) = 0
E(4) = 0; e(2) = 0; e(3) = 0; e(4) = G; e(5) = 0
E(5) = 0; e(2) = 0; e(3) = 0; e(4) = 0; e(5) = G

Or in a matrix form, this motion will be shown as:

$$E(K) = \begin{matrix} \mathbf{G} & 0 & 0 & 0 & 0 \\ 0 & \mathbf{G} & 0 & 0 & 0 \\ 0 & 0 & \mathbf{G} & 0 & 0 \\ 0 & 0 & 0 & \mathbf{G} & 0 \\ 0 & 0 & 0 & 0 & \mathbf{G} \end{matrix}$$

The individual E(k) elements will be depicted as:

$$E(1) = \begin{matrix} e(1)(0,1) & e(1)(1,1) \\ e(1)(0,0) & e(1)(1,0) \end{matrix}$$

$$E(2) = \begin{matrix} e(2)(1,1) & e(2)(2,1) \\ e(2)(1,0) & e(2)(2,0) \end{matrix}$$

$$E(3) = \begin{matrix} be(3)(2,1) & e(3)(3,1) \\ e(3)(2,0) & e(3)(3,0) \end{matrix}$$

$$E(4) = \begin{matrix} e(4)(3,1) & e(4)(4,1) \\ e(4)(3,0) & e(4)(4,0) \end{matrix}$$

$$E(5) = \begin{matrix} e(5)(4,1) & e(5)(5,1) \\ e(5)(4,0) & e(5)(5,0) \end{matrix}$$

Timing element needs to be provided, so that two timing aspects are known as follows.

- t(+) = When to protrude any E(k)
- t(-) = When to reverse the protrusion operation

The time lapse between t(+) and t(-), followed by the time lapse of its successive t(-) – t(+) represents speed of movement. That is:

Delta t(1) = [t(+) – t(-)]
Delta t(2) = [t(-) – t(+)]

Delta t(1), Delta t(2), Delta t(1), Delta t(2),…, Delta t(n) represents the speed of the moving object, where t(1) and t(2) represent each to the successive adjacent elements.

Adding vibrations to a short Delta t duration represents extremely fast speed.

Finally, the strength of the impact of each element E(k)

Appendix L
(Geometric Forms)

- **Linear line** – Line drawn on the PalmScreen before or from one edge of the palm to an opposite edge of the palm or before it. The line is drawn at an angle to the base of the hand describing the proper inclination, if any of the line.

- **Two lines (not parallel) -** The same as drawing a line, except that the two lines are drawn simultaneously on the PalmScreen.

- **Parallel Lines -** The same as drawing two lines, except that each of the lines starts with an impact nibble at its starting point before it is drawn.

- **Triangle** – Two separate lines starting from the apex and separating at a particular angle as they proceed away from the apex. At the point where each line connects to the base, each line drawn ends with an impact nibble, signifying a connected base to form a complete triangle and then proceed in a move facing each other and reducing the distance between them until they meet and coincide and end with a single impact nibble to indicate a complete unbroken line.

- **Right-angle Triangle -** The same as drawing a triangle, except that at the right angle (i.e., 90 degrees) two impact nibbles are provided instead of a single one.

- **Isosceles triangle** – The same as drawing a triangle, except that at the base each line ends with two impact-nibbles. (Obviously, a triangle cannot have two right angles and thus the two impact nibbles at each side imply isosceles.

- **Equilateral triangle** – Same as isosceles triangle, but with a second impact at the end of completing the base instead of a single impact nibble. Alternatively, the second nibble could instead be provided at the center of the triangle after the completion of the drawing to indicate symmetry.

- **Rectangle** – Two options:
  - Starting the (*first)* line, then double-impact when it continues in an angle (90 degrees) with the *second* line, again double impacts as it changes angle (90 degrees) to start the *third* line, then a double impact at the (90 degrees) when the *fourth* line is drawn and completed with a single impact to indicate end of process.
  - Drawing two parallel lines (*step one*), then (*step two*) a double impact nibble for each at the point of changing direction, then (*step three*) at the point of their next meeting a single impact to indicate closure. However, at the beginning of *step two*, and in a parallel drawing operation with *step two* there appears a double impact at each of the origination points of *step one* and similar operation to *step two* and *step three* occurs in parallel operation with *step two* and *step three* that constitute respectively *step four* and *step five*.

  Notes:
    - *Step four* and *step five* can be performed at the end of *step three* and *step four* rather than in a parallel operation with them.
    - The total number of impact nibbles at the origin point of each of the initial parallel lines is three. The first impact indicates parallel lines and the next two impacts indicate a right angle.

- **Square** – Same as rectangle except that a single impact nibble at the center after completion indicates symmetry.

- **Cube** – Same as a square, except that after completion, instead of a single impact at the center of the drawing (on the PalmScreen or NDH palm), three impact nibbles are provided to indicate three dimensional object.

- **Trapeze** – Draw two parallel lines, however, start first with the longer (base) line, reach opposite where the other parallel (shorter) line starts and stop while maintaining the contact with the palm, provide an impact nibble to the starting point of the opposite (shorter) parallel line and proceed to draw both lines as parallel lines up to the point where the shorter line terminates. Terminate the shorter line with an impact nibble and keep the contact with the palm thereafter while proceeding to draw the remainder of the longer line up to where it terminates with an impact nibble. Proceed next by providing a nibble to the end point of the shorter line (unless the angle is a right angle) and proceed to draw a line that will terminate at the end point of the longer line with an impact nibble. Next, proceed to touch the initial point where drawing the shorter line started and maintain the contact with the palm, provide a single impact nibble to the initial starting point of the longer (base) line, unless the angle is a right angle where a double impact nibble is provided. Proceed to draw the line to where the contact is maintained with the shorter line and provide closure with an impact nibble.

- **Isosceles trapeze** – Same as a trapeze, except that upon the completion of the drawing a single impact is provided at the center of the trapeze, for symmetry.

- **Circle** – Draw a circle and end it with an impact nibble, followed by a single nibble at the center of the finished circle, for a sign of symmetry. Alternatively, omit the inner circle impact nibble, but conclude the circle drawing with a double impact nibble rather than a single impact nibble.

- **Semicircle** – Start from a point where an impact nibble is provided and draw simultaneously the two opposite quarter circle to provide a semi-circle. When reaching the half circle end points, provide simultaneously a double impact nibble at each end.

- **¾ circle** – Same as a semi-circle, except that after the double impact, one side is continued to draw another quarter of a circle ending it with an impact nibble while at the other end point only contact is maintained with the palm subsequent to the nibbles provided earlier.

- **Ellipse** – Start like drawing a semicircle. At the conclusion of the half circle including the impact nibbles draw simultaneously a line to each of the two opposite edges of the hand, then complete to draw the remaining of a circle with the closing nibble as the final step.

- **Sphere** – Draw a circle and at the end there are two options:
    - To complete the final step with a triple impact nibbles, or
    - After completing the drawing, inclusive of the closing impact nibble, provide three impact nibbles at the center of the circle

- **Parabola** – Draw a semi-circle, then after the double impact at the end points proceed from the same position to draw two parallel lines, ending them with a simultaneous impact nibble.

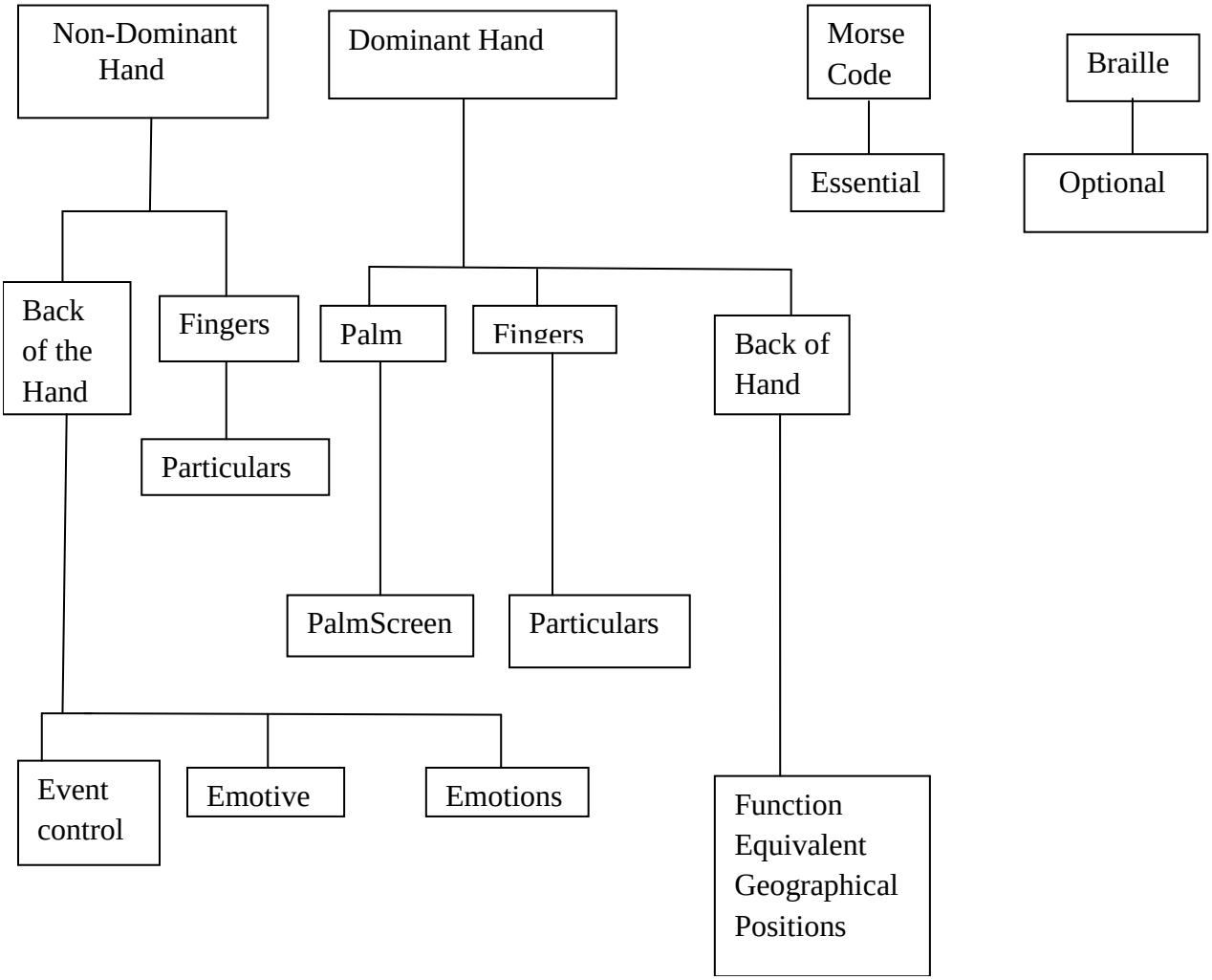
- **Hyperbola** – Start with an impact nibble at the base of the line and draw one leg of the hyperbola finishing with an impact nibble at the top of the line, then maintain the contact with the palm at the top of the line and provide an impact nibble at the top of the line of the other leg, proceeding to draw it to the end. Finish by providing a single impact nibble simultaneously at the top of the first line drawn and at the bottom of the second line drawn.

- **Asymptotic line** – Provide a single impact nibble and continue to draw a curved line, then provide another single impact nibble and proceed to draw a straight line. At the end of the straight line there is no provision of an impact nibble, however, the contact with the palm is maintained for a couple of seconds before it is broken.

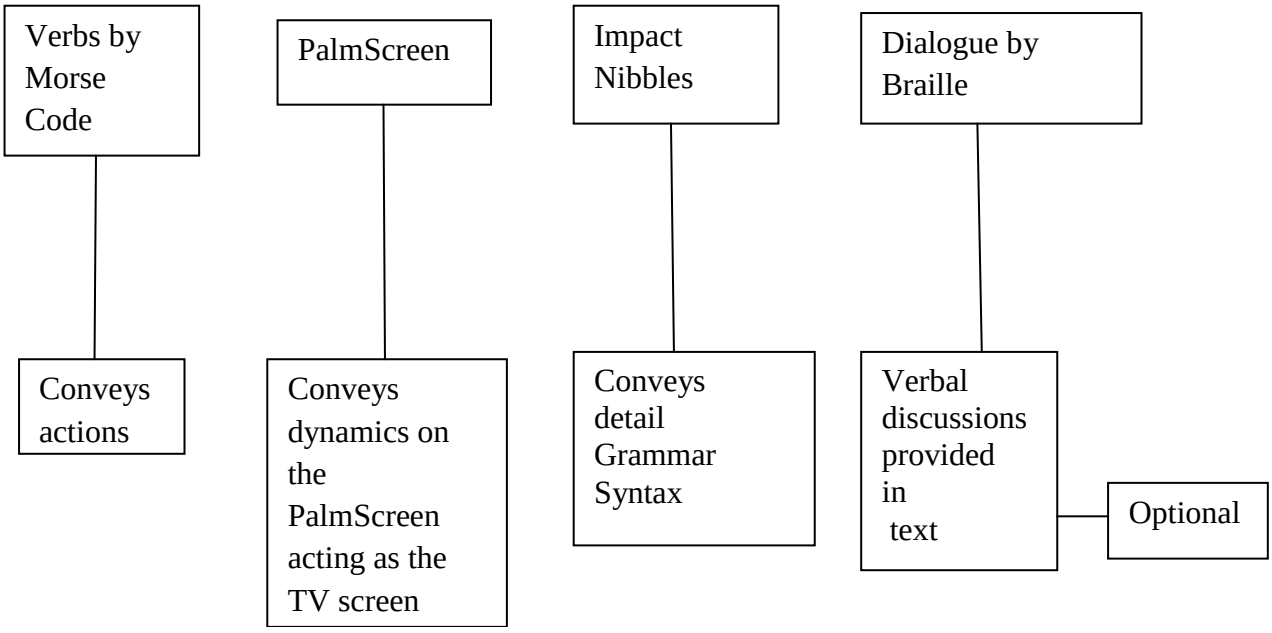
Figures

Some figures illustrating the usage of the hands and fingers may be of interest to some readers and are included below.

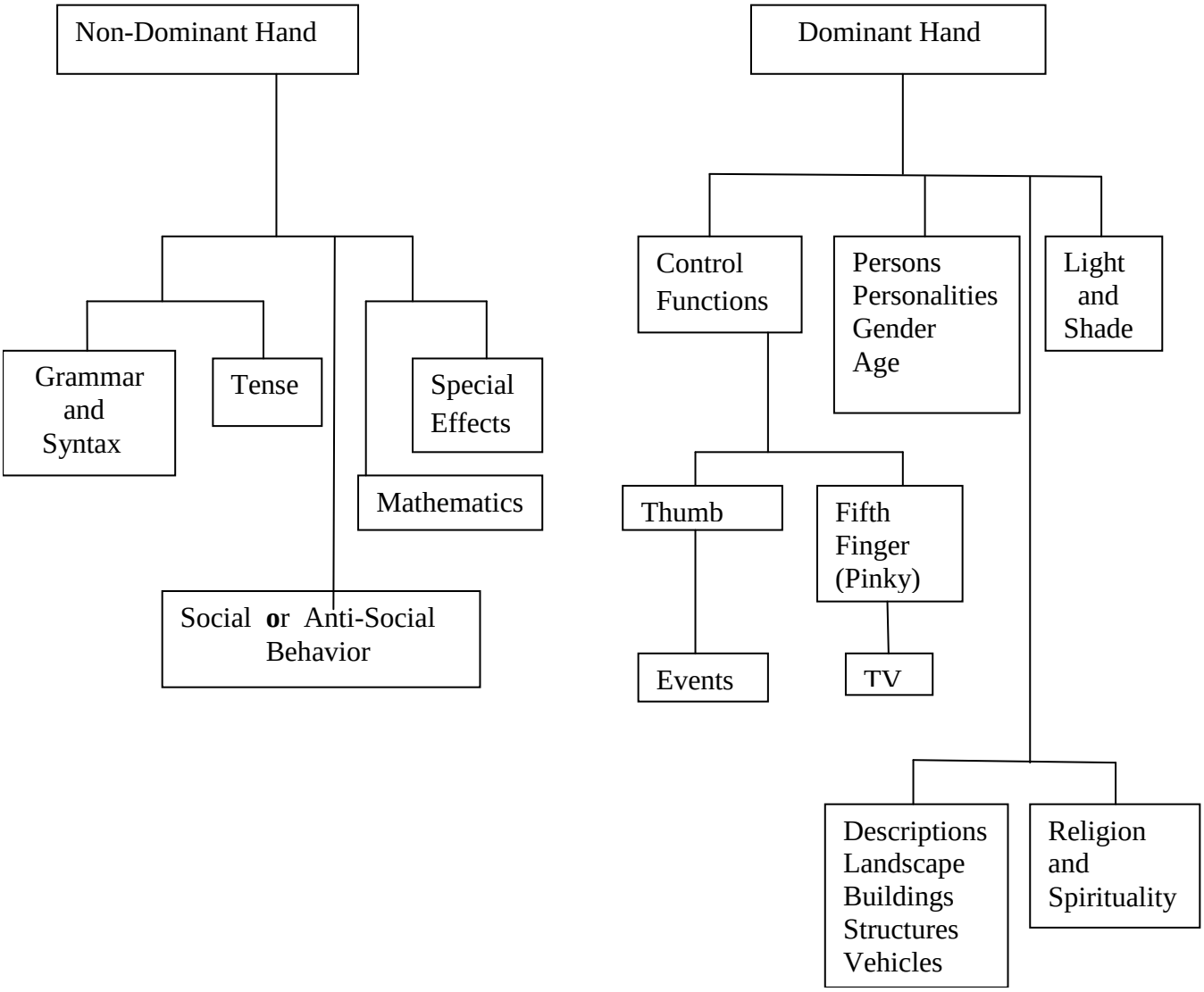
Touch Language Reception



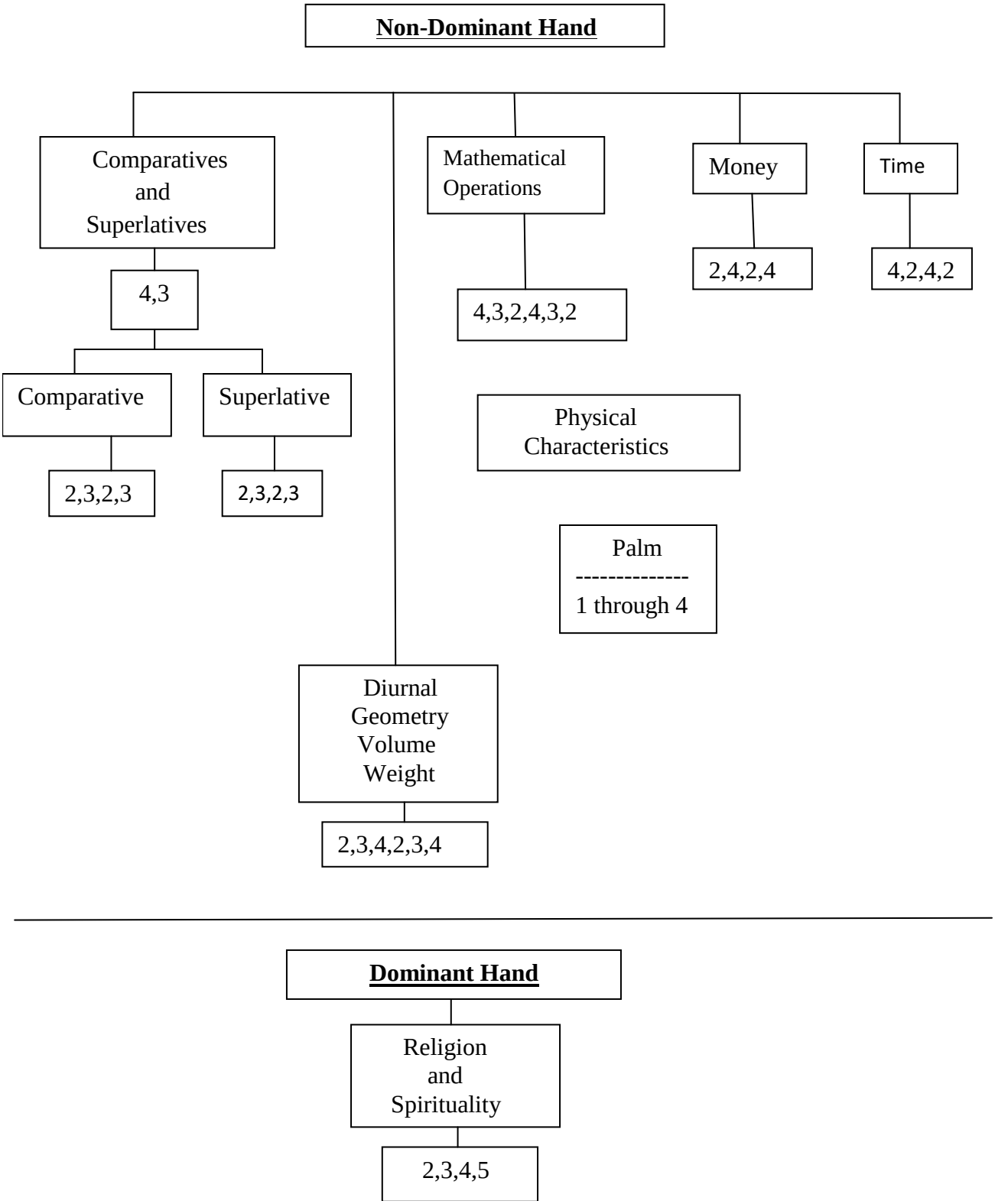
Touch Language Components

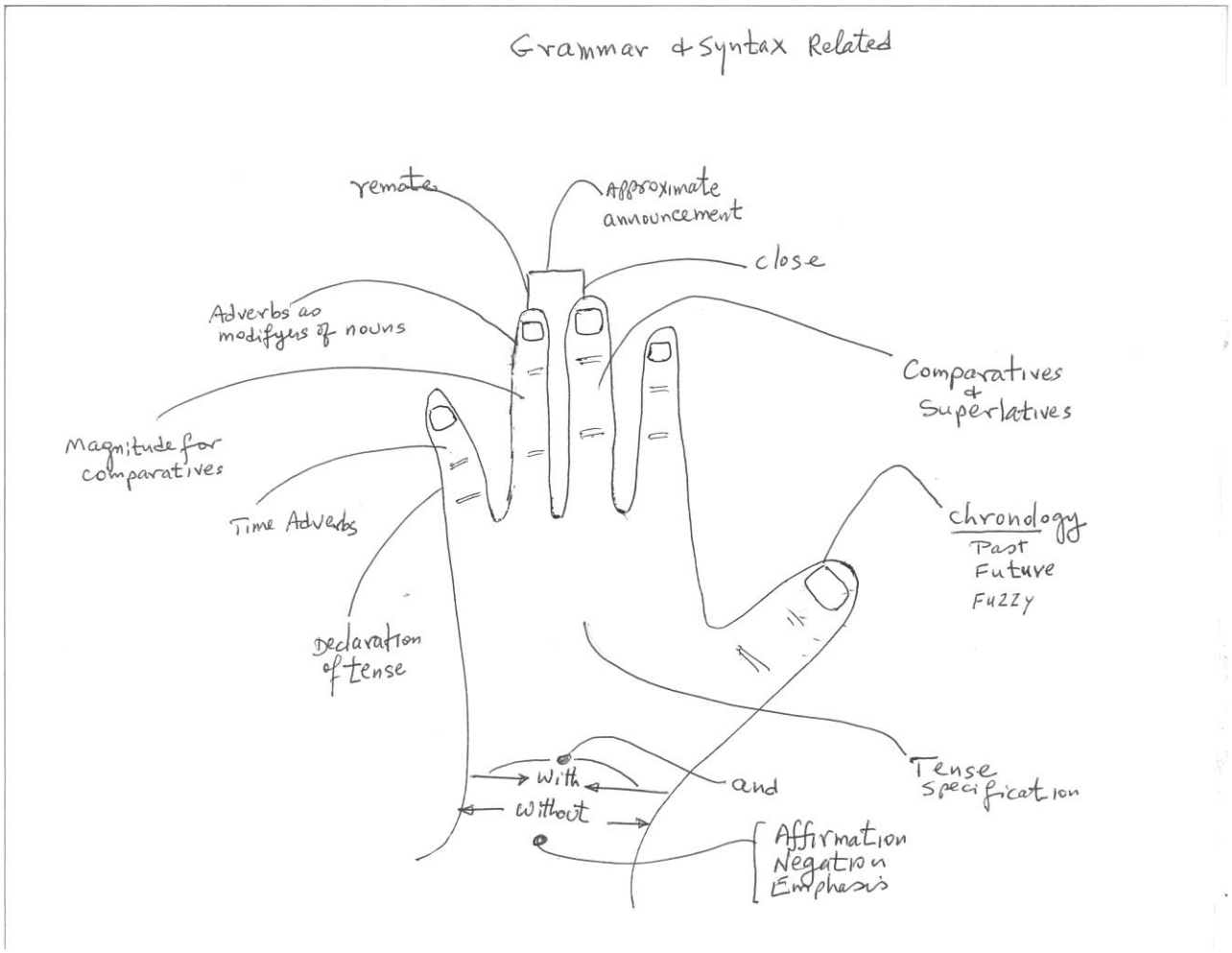


Particulars of Fingers



Declarations

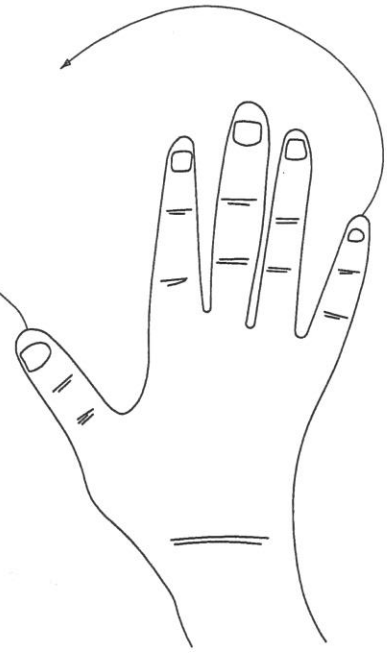



Grammar & Syntax Related
remote
Approximate announcement
close
Adverbs as modifyers of nouns
Comparatives & Superlatives
Magnitude for comparatives
Time Adverbs
Chronology
Past
Future
Fuzzy
Declaration of tense
Tense specification
with
without
and
Affirmation
Negation
Emphasis

Action

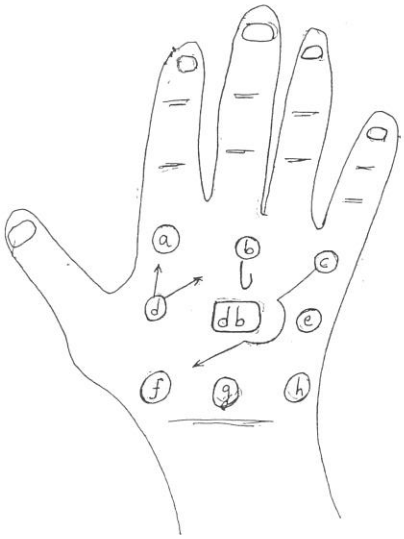
Reception	L to R	Center to L	Center to R
Reserved	Time Display Station ID Bookmark Stations	OFF Repeat Bookmark down Browse Down	ON Switch to Bookmark up Browse Up

R to L	Center to L	Center Position	L to R	Center to R
Someone is at door Phone/TTY rings	Call for person Call for dog Person entered house	Start Repeat Emergency Call for help Close/End	Water in House Intruder is in House	Where is Cane? Where is dog? Who is in house? Who entered the house? Fire Person exited the house



Functional Equivalent Geographical Positions Of Speaking and Acting Parties

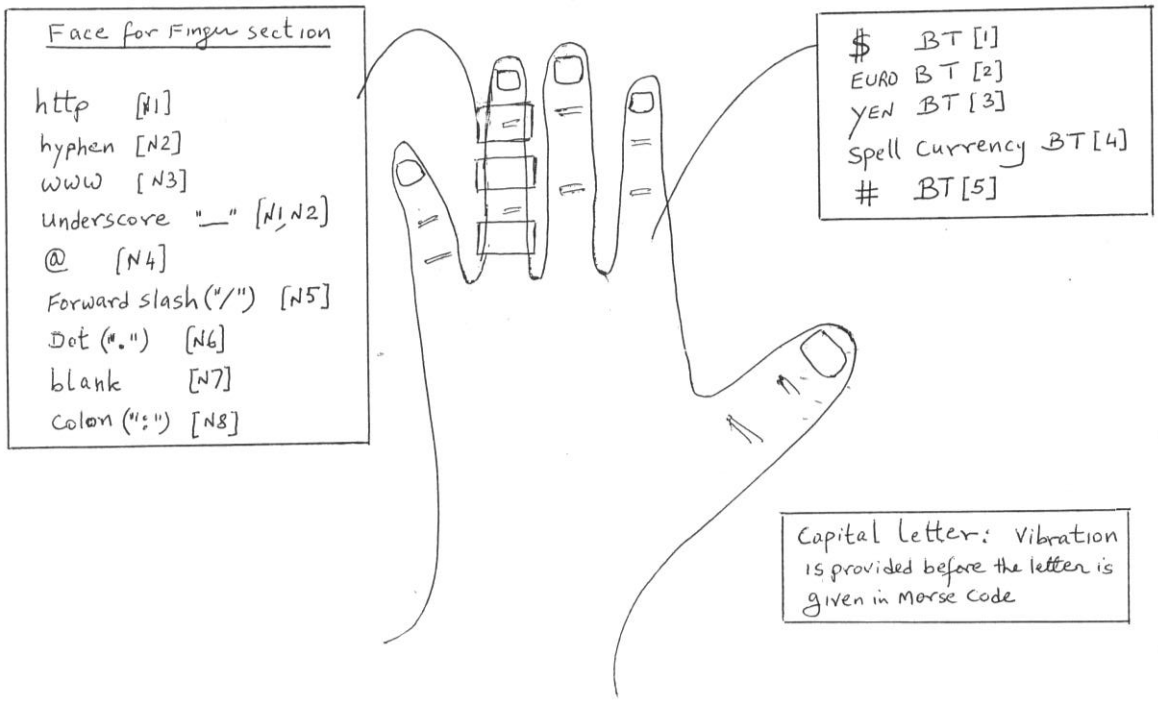
(8 Persons Plus the Deafblind ("db")

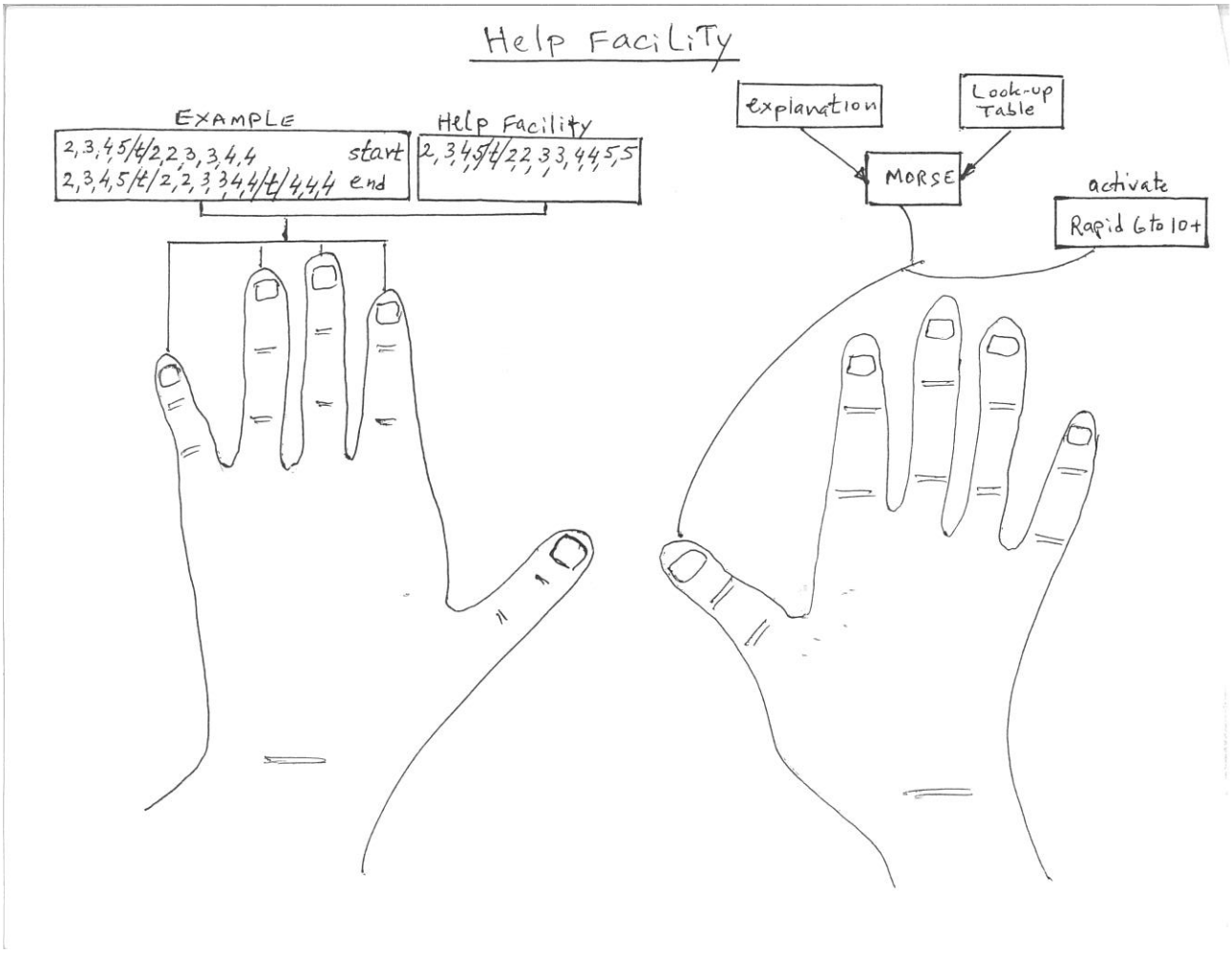


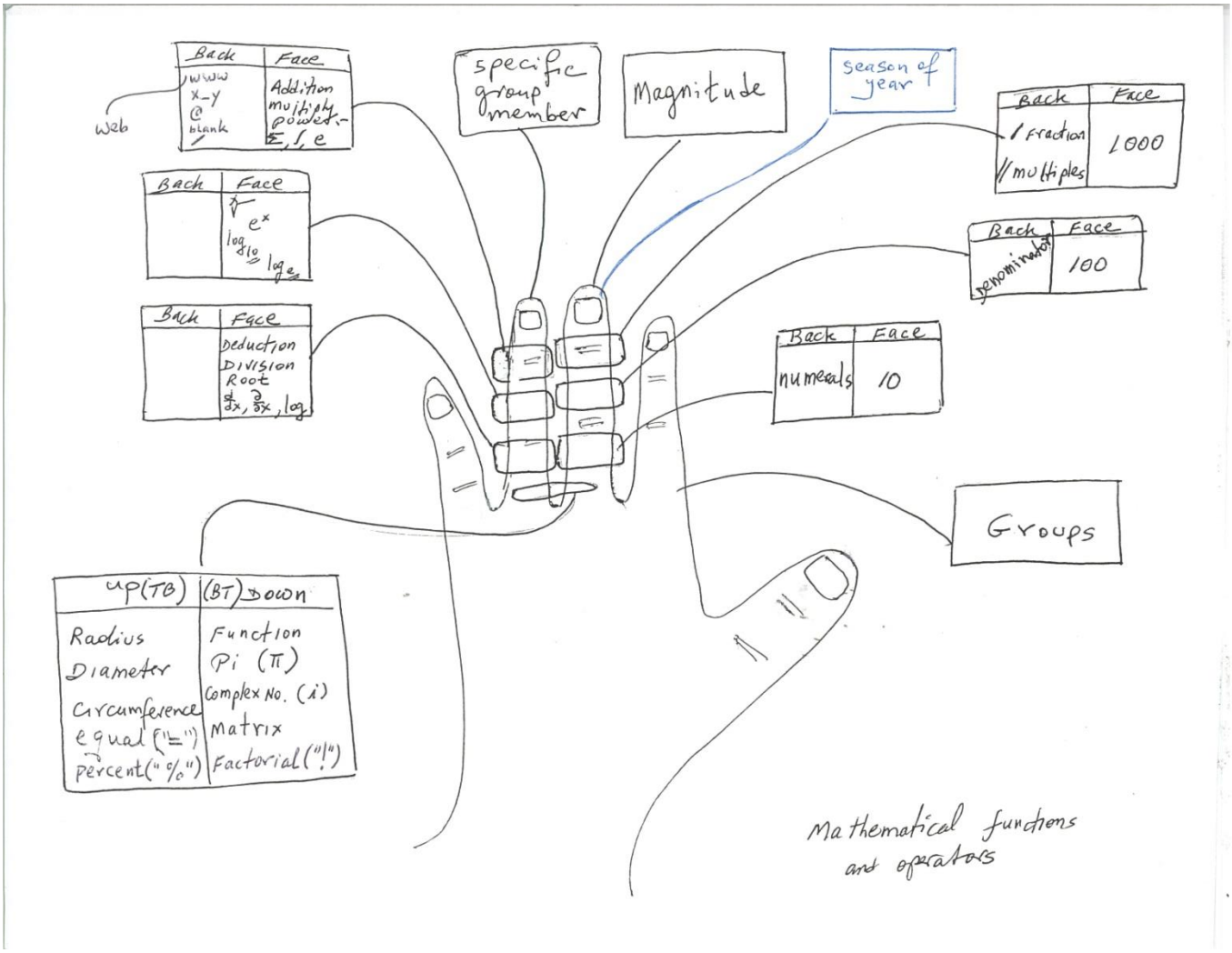
Examples of Identifying Speakers

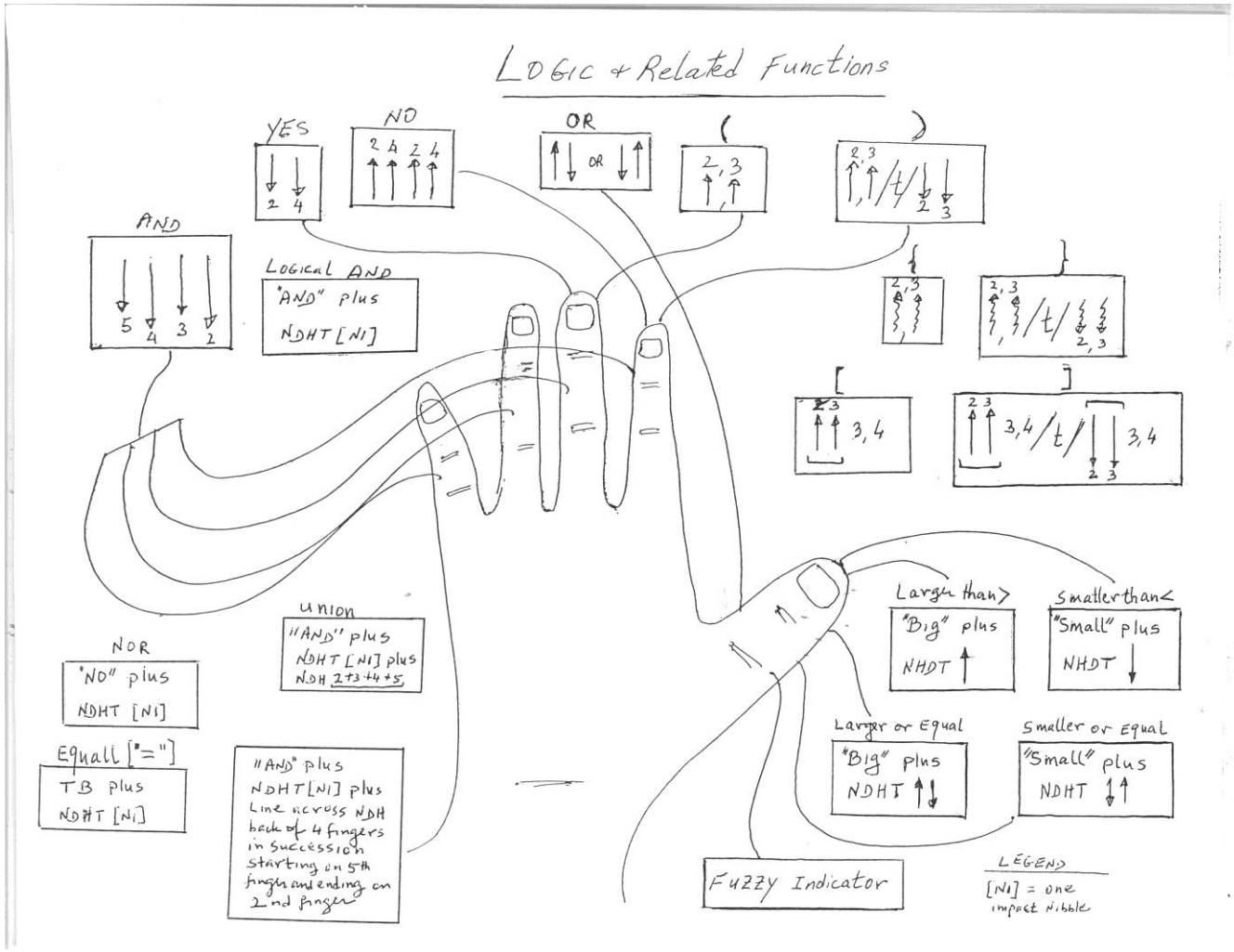
(1) The numbering (a) to (h) is arbitrary
(2) (b) Speaks to no one in particular
(3) (d) Speaks to both (a) and (b)
(4) (c) Speaks to (f)

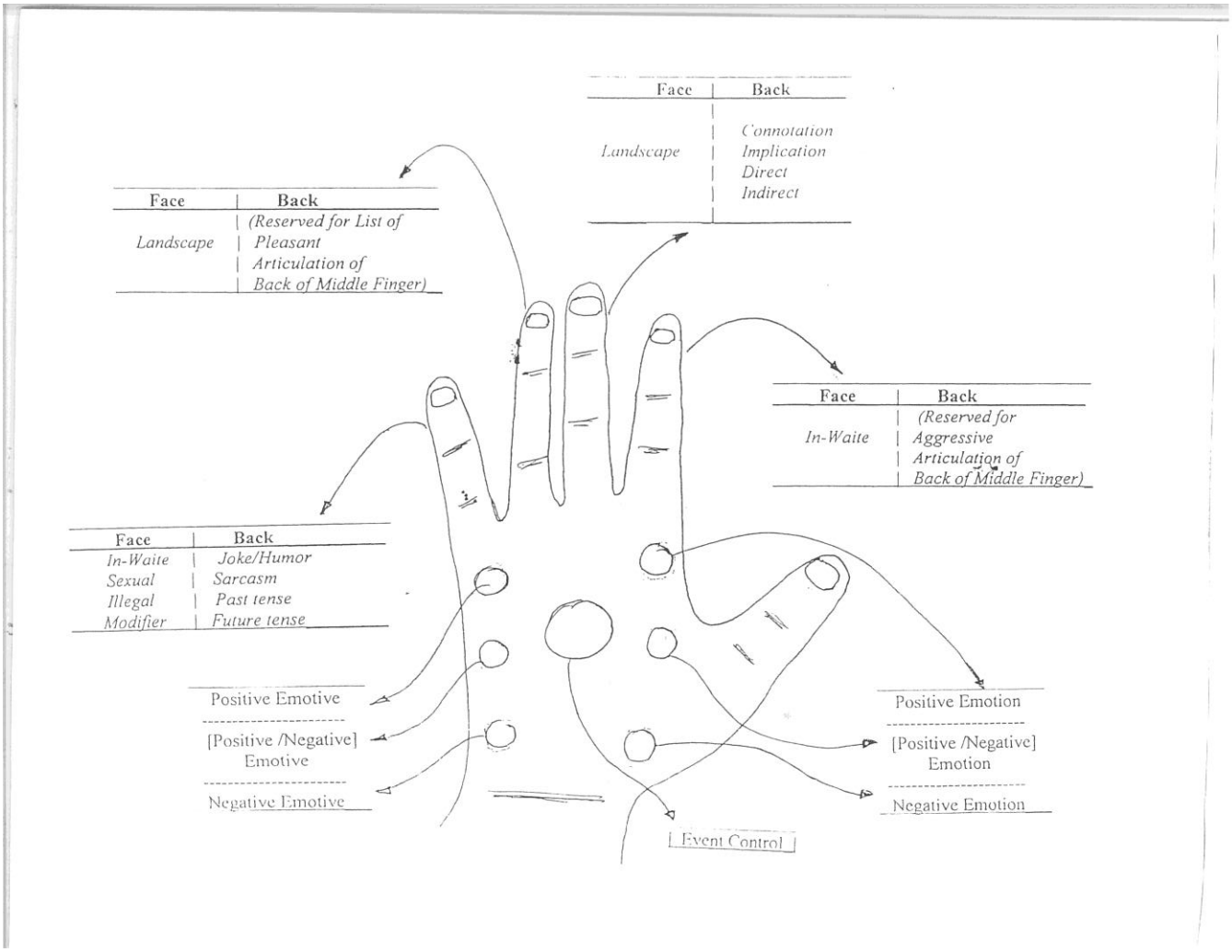
Internet and Currency

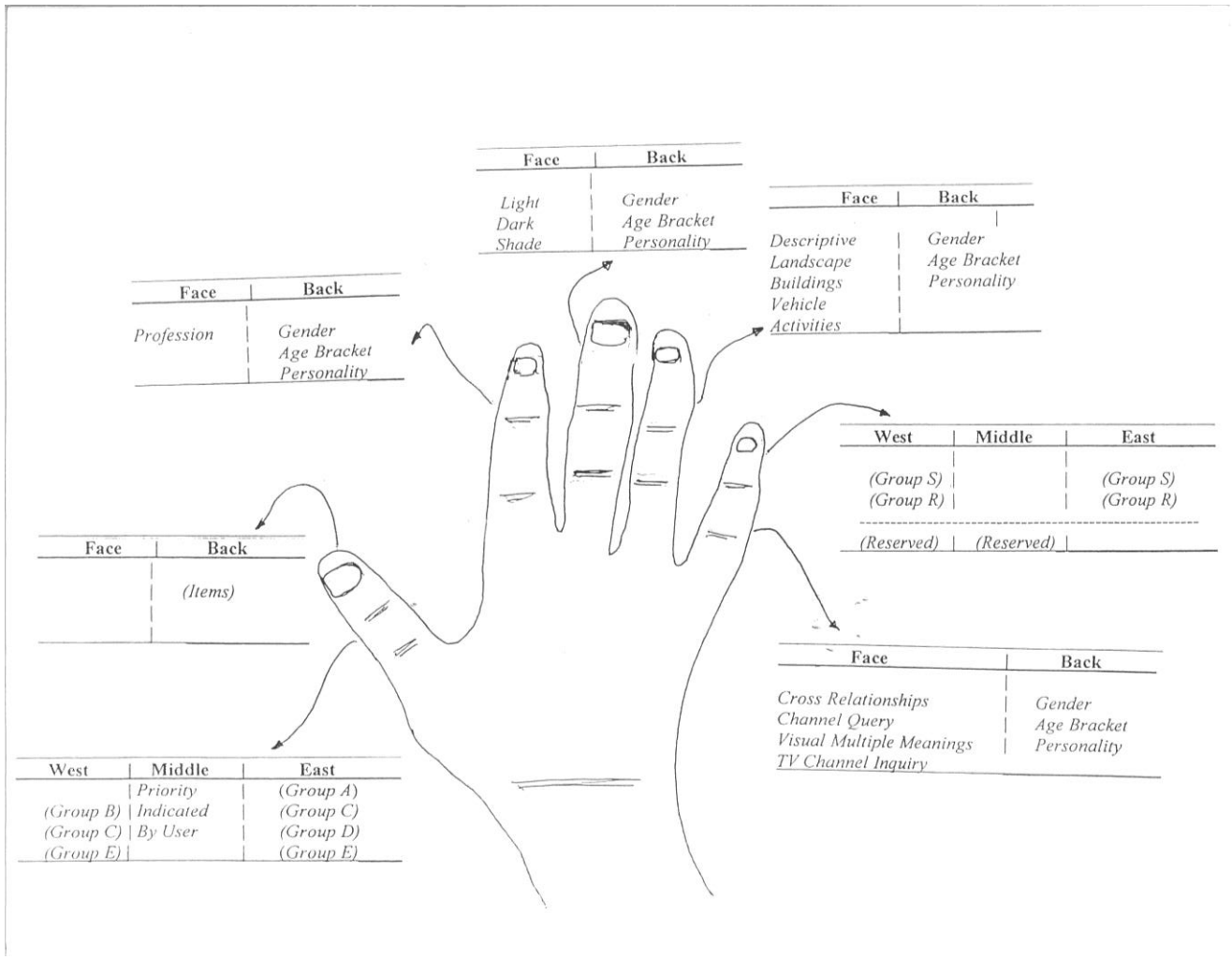



Help Facility
EXAMPLE
2,3,4,5/t/2,2,3,3,4,4 start
2,3,4,5/t/2,2,3,3,4,4/t/4,4,4 end
Help Facility
2,3,4,5/t/2,2,3,3,4,4,5,5
explanation
Look-up Table
MORSE
activate
Rapid 6 to 10+


Back
Face
www
x-y
@
blank
Addition
multiply
power
Σ, ∫, e
web
specific group member
Magnitude
season of year
Back
Face
/ Fraction
// multiples
1000
Back
Face
√
e^x
log10
loge
Back
Face
denominator
100
Back
Face
Deduction
Division
Root
d/dx, ∂/∂x, log
Back
Face
numerals
10
Groups
up(TB)
(BT) Down
Radius
Diameter
Circumference
equal ("=")
percent("%")
Function
Pi (π)
Complex No. (i)
Matrix
Factorial("!")
Mathematical functions and operators


LOGIC + Related Functions
YES
NO
OR
(
)
AND
LOGICAL AND
"AND" plus
NDHT [NI]
{
}
[
]
union
"AND" plus
NDHT [NI] plus
NDH 2+3+4+5
NOR
"NO" plus
NDHT [NI]
Equall ["="]
TB plus
NDHT [NI]
"AND" plus
NDHT [NI] plus
Line across NDH
back of 4 fingers
in succession
starting on 5th
finger and ending on
2nd finger
Larger than >
"Big" plus
NHDT
Smaller than <
"Small" plus
NHDT
Larger or Equal
"Big" plus
NDHT
Smaller or Equal
"Small" plus
NDHT
FUZZY Indicator
LEGEND
[NI] = one
impact Nibble


Face | Back
Landscape | Connotation
Implication
Direct
Indirect
Face | Back
Landscape | (Reserved for List of
Pleasant
Articulation of
Back of Middle Finger)
Face | Back
In-Waite | (Reserved for
Aggressive
Articulation of
Back of Middle Finger)
Face | Back
In-Waite | Joke/Humor
Sexual | Sarcasm
Illegal | Past tense
Modifier | Future tense
Positive Emotive
[Positive /Negative] Emotive
Negative Emotive
Positive Emotion
[Positive /Negative] Emotion
Negative Emotion
Event Control


Face | Back
Light
Dark
Shade
Gender
Age Bracket
Personality
Face | Back
Descriptive
Landscape
Buildings
Vehicle
Activities
Gender
Age Bracket
Personality
Face | Back
Profession
Gender
Age Bracket
Personality
West | Middle | East
(Group S)
(Group R)
(Group S)
(Group R)
(Reserved) | (Reserved)
Face | Back
(Items)
Face | Back
Cross Relationships
Channel Query
Visual Multiple Meanings
TV Channel Inquiry
Gender
Age Bracket
Personality
West | Middle | East
Priority
Indicated
By User
(Group A)
(Group B)
(Group C)
(Group C)
(Group D)
(Group E)
(Group E)

The Morse Code

A line in the code [i.e., "__"] means two rapid impacts [i.e., "."] immediately followed by another impact ["."], or ".", which is different from ". ."

A .-	N -.	0 -----
B -...	O ---	1 .----
C -.-.	P .--.	2 ..---
D -..	Q --.-	3 ...--
E .	R .-.	4 ....-
F ..-.	S ...	5 .....
G --.	T -	6 -....
H	U ..-.	7 --...
I ..	V ...-	8 ---..
J .---	W .--	9 ----.
K -.-	X -..-	Fullstop .-.-.-
L .-..	Y -.--	Comma --..--
M --	Z --..	Query ..--..

The Author

Raanan Liebermann holds a Doctorate in Astrophysics from the University of Oxford. Work experience encompassing professorship and top management positions in companies and recipient of recognitions and awards. He is published in the professional literature and the inventor of many patents, including the Telephone for the Deaf, the Electronic Cane (eCane) for the blind and deafblind for navigation and face-to-face communications, the Inclusive Emergency Alert System, the TV for the blind and deafblind, and more in other fields of technology.