Phraze-It®
One-Handed DigitalTexting Method
For Communicating Words with a Hand, Electronic Glove, or a Robotic, Virtual or Prosthetic Hand

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ABSTRACT

This paper describes a visual alphabet and digital one-handed texting method for composing text with one hand, or with a sensing device or an electronic glove, robotic hand or prosthetic hand, for communicating person to person or for inputting text into computing and communicating devices, including mobile handheld devices. The method reviewed allows any letter in the alphabet and any numeral to be created using the thumb and fingers of one hand to form letters, words, numbers and text strings using only six simple gestures. Among the objectives of this visual language are creating a clear, consistent and unambiguous visual digital language for communicating effectively with a small number of common gestures using inputs provided by the thumb and fingers of one hand and creating a standard visual mode of communicating that is easily learned, easily retained and easily recognized by persons seeking to communicate digitally or with a significant segment of the population who need to overcome hearing and speech difficulties. The patented method is also useful in teaching both language and set theory to students.

ACM Classification Keywords

H. 5.2 User Interfaces

General Terms
Human factors.

Keywords
One-handed text entry, visual interface languages, digital sign language, fingerspelling, electronic gloves, input devices.

1. INTRODUCTION
There is a general awareness of the need for a greater segment of the population to communicate more effectively with persons for whom sign language is the standard method for exchanging information. The material limitations imposed by existing sign languages include the large number of characters and/or the ambiguous nature of such hand signals that are perceived as having a learning curve. Another obstacle is that existing user interfaces for inputting on mobile electronic devices are inefficient. The focus of this paper is to review a method for an accurate, consistent, easy to learn and efficient method encompassing both the use of one handed entry without any hardware and the use of hardware with the capability of inputting text into computing and communicating devices.

In many countries "A", "E", "I", "O" and "U" are instantly recognized as vowels appearing in a consistent and familiar order in the alphabet. From early childhood, it is known that the vowels form fundamental building blocks for composing language. "A","E" "I"" "O" and "U" are learned in an order and sequence in which they appear in the alphabet. Universally, the alphabet is recited in accordance with the prescribed order of the letters, beginning with the letter "A". Each vowel also has a list of consonants following and associated with that respective vowel. For instance, in English, the "A" is followed by "B", "C" and "D"; the "E" is followed by "F", "G" and "H"; the "I" is followed by "J", "K", "L", M, and "N"; the "O" is followed by "P", "Q", "R", "S" and "T"; and the "U" is followed by "V", "W", "X", "Y" and "Z". It is important to note that no vowel subset is longer than five (5) consonants. In this method, therefore, each vowel is followed by no more than five consonants, all of which remain in their familiar alphabetical order. Each vowel then is the lead character in a familiar and ordered subset of letters, which enables an easy to learn and effective form of communication. The vowels form a short list of ordered characters. Each vowel in turn contains a short, familiar and ordered set of consonants. Persons have at least a general knowledge of the order of such alphabetical characters.

This paper proposes a new method for communicating using one hand or implemented on an electronic glove. The alphabet is divided into five ordered sets, each led by a vowel. Each vowel

precedes a subset of consonants appearing in familiar alphabetical order, ending with the last consonant that precedes the next vowel or the end of the alphabet. This method initially assigns each of the vowels in sequence to the thumb and other fingers respectively for a first gesture and then upon the user gesturing with a chosen finger indicating a vowel, the subset of characters for the vowel so chosen is then assigned in alphabetical order to the same hand. The second gesture indicates the letter intended to be communicated. Accordingly, only the thumb and fingers of one hand are needed to indicate any intended letter. The method is consistent, intuitive, easy to learn and use because it assigns vowels and the consonants in their respective subsets in familiar and predictive alphabetical order to the thumb and fingers in the same alphabetical sequence, thereby creating an association in the minds of the users between each letter and its respective finger. In addition, this method is similarly applicable to communicating numerals.

Another significant benefit of the method reviewed is that it is related to an accurate, ergonomic and efficient text input solution for alphanumeric text entry upon mobile devices such as PDAs, cell phones, web tablets, digital remote controls and other handheld devices called Phraze-It®. As a result of the similarities in techniques between communicating with the visual alphabet described in this work and the method for efficient text entry with a small number of inputs on a reduced input area of handheld devices described in another paper submitted by the same author, opportunities are presented to unify the related methods to foster a common unified mode of communications for users of visual hand signal alphabets as well as all users of handheld devices.

2. OVERVIEW

This paper discusses a consistent method of communicating utilizing only the thumb and fingers of one hand for either person-to-person communications or for entering text into electronic devices. The entire alphabet or any numeral or other character from an ordered set can be efficiently communicated using only six (6) easy to learn gestures. Typically, a gesture is comprised of bending and straightening one of the thumb or the fingers. The thumb and each of the fingers of one hand are each initially assigned a lead character of a subset. For example, the lead members of the subset can be vowels such as "A", "E", "I", "O" and "U", or numerals such as "0" or "5" etc.), where such subsets are part of an ordered set of characters such as an alphabet or the numerals. Each subset contains its leading character and a known set of secondary characters that follow that leading character in familiar alphabetical or numerical order.

Two gestures in sequence indicate the intended character from an ordered set and can be used to create any letter of the alphabet. Any of the initial lead characters of a subset is indicated with a first gesture. The first gesture identifying the lead character and its subset is followed by a second gesture that identifies the character in the subset that the user intends to communicate. Thus, each gesture is meaningful and unambiguous.

The first gesture is comprised of bending one of the thumb, index finger, middle finger, ring finger or little finger toward or to touch the palm of the hand to indicate the intended lead character in the subset. Using the alphabet as an example, the vowels "A", "E", "I", "O" and "U" may be assigned to the thumb, index finger, middle finger, ring finger and small finger respectively of one

hand. Because the vowels are assigned as described in familiar alphabetical order, a clear and unambiguous association is made between the fingers and their assigned vowels for the first gesture. Bending and straightening any of the fingers directs the attention of the receiver of the communication that a particular vowel and its subset are intended.

The second gesture indicates the letter or numeral from the subset that the user actually intends to signal. The second gesture is comprised of either (a) bending a multiplicity of fingers toward or touching the palm of the hand to indicate a lead character of the subset is intended, or (b) bending one of the thumb, index finger, middle finger, ring finger, or little finger toward or to touch the palm of the hand to indicate the particular member of the subset is intended. When used in combination, any two sequential gestures form every letter of the alphabet as well as any single digit numeral. By way of example, performing any of the first gestures above and straightening the finger(s) followed by the second gesture of bending a multiplicity of fingers towards or touching the palm of the hand would indicate that a particular vowel has been chosen. When a person intends to communicate a consonant, the user will perform a first gesture to first indicate the vowel preceding the consonant in the alphabet, followed by a second gesture of bending one of the thumb, index finger, middle finger, ring finger or little finger for the intended consonant. Repeating the process forms words, text strings, or numerals of any length and can be used to communicate information, including full sentences. The described method enables unambiguous, accurate and efficient communication with the limited number of inputs presented by the thumb and fingers of one hand, with only one letter or number assigned to the respective thumb or finger at any time.

Alphabet

A user can communicate any number of words using one hand to perform the gestures described above. The thumb and fingers become inputs similar to keys and buttons on a touch screen, keyboard or keypad. As has previously been mentioned, this technique assigns each of the five vowels to a respective thumb or finger of one hand. In one embodiment, using the left hand for example, the thumb is assigned the character "A", the index finger is assigned the character "E", the middle finger is assigned the character "I", the ring finger is assigned the character "O" and the little finger is assigned the character "U". This approach orders the vowels and fingers in the same sequence and order as they appear in the alphabet. In addition, when the user holds up the left hand (with palm facing the other person) the second person sees the communicator's thumb on the left and small finger of the hand on the right. As seen by the intended recipient of the communication, this left to right orientation of the vowels from the "A" on the recipient's left to the "U" on the recipient's right appears in a similar fashion as the user would typically read those letters on a page from left to right. In the alternative, the same left to right orientation can be maintained using the right hand and assigning the "A" to the little finger, the "E" to the ring finger, the "I" to the middle finger, the "O" to the forefinger and the "U" to the thumb. Preference for using the right hand or left hand or for assigning the vowel "A" to the thumb or to the little finger, for retaining or changing the left to right orientation stated above will be a matter of preference and potential future standardization.

A vowel is communicated by bending the finger to which such vowel has been assigned (followed by straightening the finger)

and then by a second gesture of bending all of the fingers toward the palm or touching the palm. The letter "A" consists of the first gesture of bending and straightening the thumb, immediately followed by the second gesture of bending the other fingers toward the palm (common gesture). This is a clear and unambiguous entry of the letter "A". The letter "E" consists of first bending and straightening the index finger, immediately followed by the common gesture. The other vowels are signaled in similar manners.

Communicating a consonant is similarly simple and intuitive. For each vowel, the set of associated consonants are assigned to their respective fingers in the same order as they appear in the alphabet. As was previously mentioned, there are no more than five consonants associated with any of the vowels. This is significant in terms of the number of finger inputs available on one hand and results in one hand accommodating the signaling or entry of all of the consonants. For the first gesture that identifies the "A" subset of letters, the second gesture that identifies the "B", "C", or "D" is bending the thumb, index finger and middle finger respectively. Where a first gesture has identified the "E" subset, any of the "F", "G" or "H" are signaled by a second gesture of bending the thumb, index finger or middle finger respectively. A first gesture that indicates the "I" subset assigns the "J" to the thumb, the "K" to the index finger, the "L" to the middle finger, the "M" to the ring finger and the "N" to the little finger. Similarly, for the "O" subset, bending any of the thumb, index finger, middle finger, ring finger or little finger signals the choice of the respective letters associated with those fingers, "P", "Q", "R", "S" and "T". For the first gesture that has identified the "U" subset of letters (indicated in this example by the finger farthest from the thumb), the second gesture that identifies the "V", "W", "X", "Y" and "Z" is bending the thumb, index finger, middle finger, ring finger and little finger respectively.

For instance, the word "hello" is very straightforward, intuitive and quick to communicate using the following first and second gestures: E-H (index finger and middle finger), E-E (index finger and common gesture), I-L (middle finger and middle finger), I-L (middle finger and middle finger) , O-O (ring finger and common gesture).

Numbers

Alphanumeric text is often employed in communications and therefore it is beneficial for the same method as described for letters to also apply to communicating numbers. A hand signal visibly indicates that the user intends to switch from communicating letters to numbers or conversely from numbers to letters. On an electronic apparatus, this can be accomplished by selecting a certain input. In one embodiment, the thumb is assigned the zero ("0") and the index finger is assigned the five ("5"). The zero subset includes "0", "1", "2", "3", and "4". The subset beginning with "5" also includes "6", "7", "8" and "9". Thus all of the digits necessary to from all whole numbers can be

communicated using one hand. The first gesture for forming the "0" is bending the thumb and straightening it, while the first gesture for forming the "5" is bending the index finger and straightening it. The second gesture for either the "0" or the "5" is the common gesture of bending a multiplicity of fingers. For signaling the number "1', the user performs a first gesture of bending and straightening the thumb to indicate the "0" subset, immediately followed by a second gesture of bending the thumb. Similarly, a user can indicate a "9", by performing a first gesture of bending and straightening the index finger to indicate the subset, followed by bending and straightening the ring finger. To illustrate this method for signaling the year "1776, the user performs the following gestures 1: first gesture thumb and second gesture thumb; 7:first gesture index finger and second gesture index finger; 7:first gesture index finger and second gesture index finger; 6:first gesture index finger and second gesture thumb. The year "1948" is communicated with the sequence thumb-thumb, index finger-ring finger, thumb-ring finger and index finger middle finger.

To maintain a consistent and intuitive user interface and to also reduce memory work, the described technique for communicating with hand signals retains familiar alphabetical order and assigns unambiguous letters both for first gestures and second gestures. As an aid to memory, the user recognizes that the thumb is used during the first gesture for indicating the first vowel and also in the second gesture for indicating the first consonant following each vowel. This predictive arrangement of letters is continued by the user quickly learning that for the first gesture, the index finger represents the second vowel and for the second gesture the index finger represents the second consonant of the chosen subset. Users tend to have a specific knowledge of the consonant immediately following a vowel and a general knowledge of the other consonants and their positions in the alphabet relative to both their vowels and the consonants that precede and follow each consonant. This is also true of the knowledge of users of the relative position of numerals. Placing the second numeral following the leading numeral on the thumb helps users associate the order of numerals with a particular thumb or finger. As an examples, it is generally known that the "B" follows the "A" or that the "1" follows "0".

3. FUNCTIONS AND PUNCTUATION

Along with the need for letters and numbers, communicating text also requires certain functions and punctuation to express thoughts in an effective manner. For example, moving the thumb to and then away from the index finger can, by way of illustration, act as the "space bar" to separate words. Similarly, a period can be formed by touching the tip of the thumb to the tip of the index finger. A comma can be conveyed by touching the tip of the thumb to the tip of the middle finger. Also, a question mark can be signaled by touching the tip of the thumb to the tip of the ring finger. An apostrophe may be formed by touching the tip of the thumb to the tip of the little finger. Other symbols may similarly be created for easy recognition by the recipient of the communication. An additional example is the common index and middle fingers bending in unison to convey quotation marks.

4. RELATED WORK

Existing visual sign languages in widespread use that address a method for fingerspelling with hands include British Sign Language and American Sign Language. In addition to the cited patent below, additional patent applications addressing this topic and related topics in this field are pending. The method described herein is one of a number of integrated methods for communicating with hands and entering alphanumeric text onto electronic devices such as handhelds, personal digital assistants, mobile phones and remote controls invented by the author.

5. CONCLUSION

The purpose of this paper is to describe aspects of a visual sign language that can be effectively communicated with a small number of gestures performed by one hand or with an electronic glove. The technique proposed in this paper enables communications by hand or an electronic glove or similar device, utilizing a small set of easily learned and easily recognized gestures. Familiar alphabetical and numerical characters in familiar order are assigned to the thumb and fingers to remove the cognitive burden for novice and casual users inherent in the ambiguity of sign languages with a large number of gestures. As a result, users can easily associate the order of the vowels and of the consonants with their assigned position on the thumb and fingers. The natural and ergonomic method for communicating text with one hand or electronic glove or the like, proposed in this paper is easy to learn because it utilizes a familiar order of universally known lead characters such as vowels, each assigned to a respective finger. Each of those lead characters represents its respective subset of associated characters, each of which is also assigned in familiar alphabetical order to the thumb and respective fingers. The familiar order of vowels is small enough to be expressed for finger spelling with one hand. This is also true for the subset of consonants. In other words, finger are easily associated not only with vowels and consonants, but with their familiar alphabetical order that is retained by this method. This association is aided by the unambiguous assigning of familiar characters in a consistent manner, the small number of gestures, the small number of vowels, the small number of vowel subsets, the small number of letters in each subset and by the recognition that the initial vowel in the list of vowels and the initial consonant of each subset are both identified with the thumb (or alternatively with the same finger when, for instance, the little finger represents the first vowel). With minimum practice, users can experience increasing levels of automaticity in forming and in recognizing words. The universal familiarity with alphabetical characters and numerals and their order is mimicked on the hand, or electronic glove or other sensing device, or on a prosthetic or robotic device or similar apparatus.

The Phraze-It ® One-Handed Digital Texting method reviewed in this paper is also related to efficient text entry using a reduced number of inputs on mobile electronic devices, thereby unifying the efficient user interface method and system for alphanumeric text input on reduced-size handheld devices with an easy to learn and use visual sign language for one-handed communications with the hand, electronic glove, or other electronic, prosthetic or robotic device. Thus an easily learned method for communicating with visual sign language that encourages the general public to become conversant with meaningful hand gestures and is related to an efficient input solution for mobile handheld devices provides opportunities for expanding communications between persons who have not learned existing sign languages and those persons who rely upon visual sign language.

6. REFERENCES

[1]This finger texting method is patented.

[2]Patents have issued in respect to the Phraze-It® Keyboard.

[3] The Phraze-It® Keyboard for touch screens is available for typing with the fingertips on large on-screen keys for typing with index fingers or thumbs (www.prevalentdevices.com)

Phraze-It® Finger-Vowel Texting

First Gesture:

A
Set

E
Set

I
Set

O
Set

U
Set

Second Gesture:

First Consonant	Second Consonant	Third Consonant	Fourth Consonant

Fifth Consonant	Common Gesture For Vowels