A Proposed Algorithm for Translating English Written Text to Fingerspell Language

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ABSTRACT

Finger spelling (or dactylology) is the representation of the letters of a writing system, and sometimes numeral systems, using only the hands. These manual alphabets (also known as finger alphabets or hand alphabets), have often been used in deaf education, and have subsequently been adopted as a distinct part of a number of sign languages; manual alphabets have had a number of additional applications — including use as ciphers, as mnemonics, and in silent religious settings. In this paper a proposed algorithm for translating English written text to fingerspell, we execute the algorithm using python programming language on windows eight operating system and produce good results about accuracy, speed, and the size of text to be translated; also in this paper we will discuss types of fingerspell and its applications.

Keywords: fingerspell, sign language, deaf education

خوارزمية مقترحة لتحويل النص المكتوب باللغة الانكليزية الى لغة هجائية الأصابع

الخلاصة

عملية التهجي بواسطة الأصبع (finger spelling) ، هي تمثيل لنص مكتوب (نظاما كتابيا)، باستخدام الأيدي فقط. هذه الحروف الهجائية اليدوية (والمعروفة أيضا بـما يسمى هجائية اليد أو هجائية الاصبع) غالبا ما تستخدم في تعليم الصم والبكم، وكذلك تعتبر جزء مميزلعدد من لغات الاشارة (sign languages) المستخدمة في المجتمعات التي تضم أشخاص معاقين سمعيا. الحروف الهجائية اليدوية لها عدد من التطبيقات الإضافية بما في ذلك استخدامها للتشفير وفن الاستذكار والاعدادات الدينية الصامتة. في هذا البحث سنعرض خوارزمية مقترحة لغرض تحويل النص المكتوب باللغة الانكليزية الى هجائية الاصبع، وقد تم تنفيذ الخوارزمية باستخدام لغة البرمجة Python ونظام تشغيل WINDOWS8 وتحصيل نتائج جيدة من حيث الدقة ووقت التنفيذ وحجم النص المكتوب باللغة الانكليزية المطلوب ترجمته. كذلك في هذا البحث سنناقش أنواع هجائية الاصبع وتطبيقاتها.

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INTRODUCTION

Fingerspell is a described as a first step and an important part of translation system that translates an English text into American sign language system, in such system the English text must be processed. Several researches are available for this purpose; some of them for example tend to focus on non-linguistic features of the text, while the others focus on statistics information of the words. Another method of text processing that is called natural language processing that used in different useful technique such as text mining [1][2].

Finger spelling is a visual technique that used as part of sign languages. The first step to learn any sign language is to learn its finger spell part. Different sing languages in different societies according to different cultures and knowledge of the world.

In this paper we produce new algorithm for translating English written text to American Sign Language using fingerspell method and obtain good results about accuracy and speed. The algorithm will be explained in section five and the results and discussion will be explained in section six.

We used Python programming language because this language defines a dictionary data type that is very suitable to save our dictionary; this data type defines pairs of data as (Key, Value). By using this data type we can retrieve the 'value' to the corresponding key, (searching by index), in our algorithm the letters represent 'keys' and the images represent their 'values'.

The Relation between Sing Language and Finger spelling

Sing Language and Finger spelling

Sign Languages: A **sign language** (also **signed language**) is a language which, instead of acoustically conveyed sound patterns, uses manual communication and body language to convey meaning. This can involve simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to fluidly express a speaker's thoughts.

Wherever communities of deaf people exist, sign languages develop. Signing is also done by persons who can hear, but cannot physically speak. While they utilize space for grammar in a way that spoken languages do not, sign languages exhibit the same linguistic properties and use the same language faculty as do spoken languages. Hundreds of sign languages are in use around the world and are at the cores of local deaf cultures. Some sign languages have obtained some form of legal recognition, while others have no status at all.

Fingerspell: Fingerspelling is the process of spelling out words by using signs that correspond to the letters of the word. Fingerspelling has been introduced into certain sign languages by educators, and as such has some structural properties that are unlike the visually motivated and multi-layered signs that are typical in deaf sign languages.

In many ways finger spelling serves as a bridge between the sign language and the oral language that surrounds it. [3]

If someone decided to learn sign language, whether just a little or a lot, the first step is to learn to finger-spell the alphabet. Different regions use different alphabets, some of them using one hand and some of them using two hands.

Once the person learns the signs for every letter, he/she can spell any and every word there is, as well as understand anyone who may try to communicate with him/her through finger-spelling.

When persons fluent in sign language read fingerspelling, they do not usually look at the signer's hand(s), but maintain eye contact and look at the face of the signer as is normal for sign language. People who are learning fingerspelling often find it impossible to understand it using just their peripheral vision and must look directly at the hand of someone who is fingerspelling. Often, they must also ask the signer to fingerspell slowly. It frequently takes years of expressive and receptive practice to become skilled with fingerspelling. . [3]

Cases When It Is Useful to Use Fingerspelling

Fingerspelling is used in different sign languages and registers for different purposes. It may be used to represent words from an oral language which have no sign equivalent, or for emphasis, clarification, or when teaching or learning a sign language.

There are lots of times when fingerspelling is used. The typical "these things are spelled" list includes such items as [3]:

- people's names
- places
- titles, and
- brands

Using Fingerspell in Sign Languages

The ASL (American Sign Language) alphabet, which is in the United States, Canada, Malaysia, Germany, Austria, Norway, and used in Finland. [4]

An ASL user would use the American Fingerspelled Alphabet, (also called the American Manual Alphabet). There are many different manual alphabets throughout the world.

The American Fingerspelled Alphabet consists of 22 hand shapes that--when held in certain positions and/or are produced with certain movements-- represent the 26 letters of the American alphabet [2]. as in figure (1). [3]

In American Sign Language (ASL), more lexical items are fingerspelled in casual conversation than in formal or narrative signing.[5]. Different sign language "speech communities" use fingerspelling to a greater or lesser degree [6]. At the high end of the scale, fingerspelling makes up about 8.7% of casual signing in ASL [5] , and 10% of casual signing in Auslan [7]. The proportion is higher in older signers, suggesting that the use of fingerspelling has diminished over time. Across the Tasman Sea, only 2.5% of the corpus of New Zealand Sign Language was found to be fingerspelling. [8]

Fingerspelling has only become a part of NZSL (New Zealand Sign Language) since the 1980s [9]; prior to that, words could be spelled or initialized by tracing letters in the air [10]. Fingerspelling does not seem to be used much in the sign languages of Eastern Europe, except in schools, and Italian Sign Language is also said to use very little fingerspelling, and mainly for foreign words. Sign languages that make no use of fingerspelling at all include Kata Kolok and Ban Khor Sign Language. [11]

The speed and clarity of fingerspelling also varies between different signing communities. In Italian Sign Language, fingerspelled words are relatively slow and clearly produced, whereas fingerspelling in standard British Sign Language (BSL) is often rapid so that the individual letters become difficult to distinguish, and the word is grasped from the overall hand movement. Most of the letters of the BSL alphabet are produced with two hands, but when one hand is occupied, the dominant hand may fingerspell onto an "imaginary" subordinate hand, and the word can be recognized by the movement. As with written words, the first and last letters and the length of the word are the most significant factors for recognition. [3]

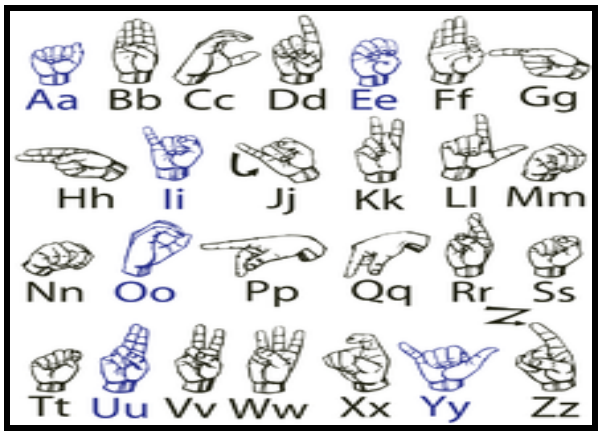

Figure (1) The American Manual Alphabet which is used in American Sign Language. Letters are shown from a variety of orientations [3].

Types of Fingerspelling

As with other forms of manual communication, Fingerspelling can be comprehended visually or tactually. The simplest visual form of fingerspelling is tracing the shape of letters in the air, or tactually, tracing letters on the hand. Fingerspelling can be one-handed such as in American Sign Language see figure (1), French Sign Language and Irish Sign Language, or it can be two-handed such as in British Sign Language see figure (2). [3][12]

One-handed fingerspell

There are two families of manual alphabets used for representing the Latin alphabet in the modern world. The more common of the two is mostly produced on one hand, and can be traced back to alphabetic signs used in Europe from at least the early 15th century. The alphabet, first described completely by Spanish monks, was adopted by the Abbé de l'Épée's deaf school in Paris in the 18th century, and was then spread to deaf communities around the world in the 19th and 20th centuries via educators who had learned it in Paris. Over time, variations have emerged, brought about by natural phonetic changes that occur over time, adaptions for local written forms with special characters or diacritics (which are sometimes represented with the other hand), and avoidance of hand shapes

that are considered obscene in some cultures. The most widely used modern descendant is the American manual alphabet.

Two-handed fingerspell

Two-handed manual alphabets are used by a number of deaf communities; one such alphabet is shared by users of British Sign Language, Auslan and New Zealand Sign Language (collectively known as the BANZSL language family), while another is used in Turkish Sign Language. Some of the letters are represented by iconic shapes, and in the BANZSL languages the vowels are represented by pointing to the fingertips.

Letters are formed by a dominant hand, which is on top of or alongside the other hand at the point of contact, and a subordinate hand, which uses either the same or a simpler hand shape as the dominant hand. Either the left or right hand can be dominant. In a modified tactile form used by deaf blind people, the signer's hand acts as the dominant hand, and the receiver's hand becomes the subordinate hand.

Some signs, such as the sign commonly used for the letter C, may be one-handed.

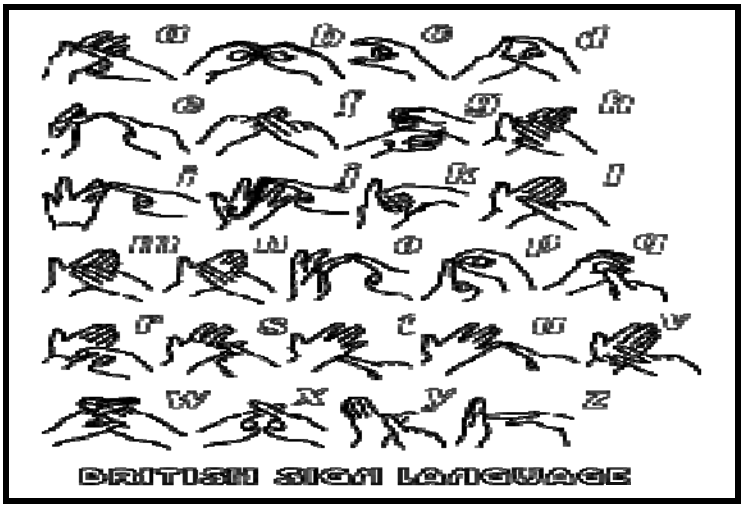

Figure (2) British Sign Language Chart [3]

The proposed algorithm

Algorithm Description

We proposed an algorithm for translating English written text to fingerspell according to American Sign Language Manual Alphabet figure (1) above. We construct a small dictionary that containing 26 letters of English alphabet with images that represent the manual alphabet of American Sign Language, such that for each letter we saved the corresponding image. After reading an English written text from a text file we preprocessed the text and then searched the dictionary to find the corresponding image for each letter and saved these images in one image file that each line in the output file represents the translation for one word from the read text. The entire output image represents the translation for the entire input text file.

The Proposed Algorithm

Algorithm Fingerspelling
Step (0): Initialization:
a. Initialize Data Dictionary that contains for each letter its corresponding ASL image.
b. Initialize Input Text file that contains the input written English text.
Step (1): read the input written text file.
Step (2): preprocess the read text:
a. Divide the text into sentences, according to the fill stop "." .
b. Divide the sentence into words.
Step (3): For each letter in the word do:
a. Capitalize the letter: convert it to the uppercase.
b. Search the dictionary to find the ASL image that corresponds to the letter.
Step (4): Display the images:
a. Display the images for all letters of the same word at the same line.
b. Display images for different words on different lines.
Step (5): Saving the output file:
Concatenate all images to be saved on one picture file where each line in the file explain one word in the text.
Step (6): End.

Implementation: Experimental Results:

We constructed a program that implements the above algorithm steps. We used python programming language and executed it on PC with wondows8 operating system.
The input text was the text file as in figure (3) below. We used the dictionary that we constructed such that it contains letters and their corresponding images according to the ASL manual alphabet as shown in figure (1).

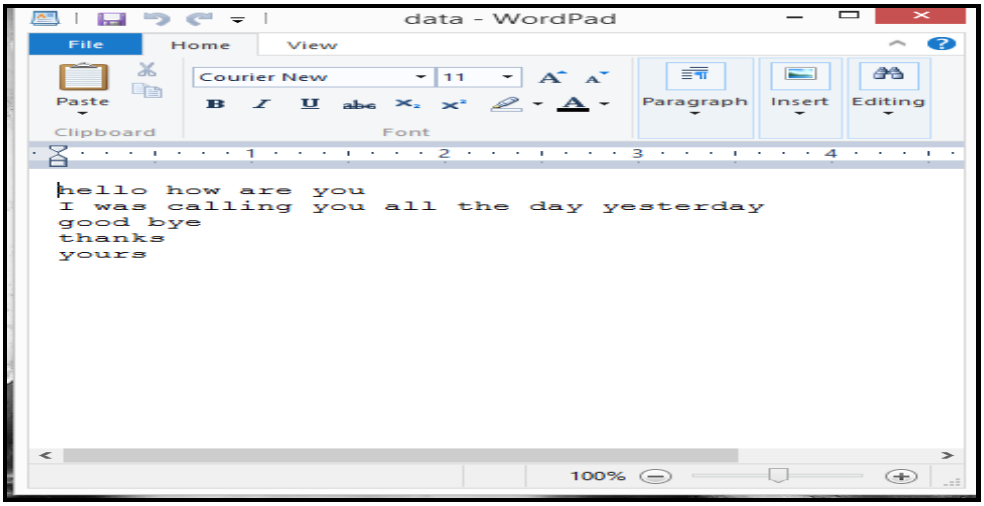

figure (3) : the input English written text file

The output of our example was PNG image (.png) displayed with windows photo viewer, as shown in Figure (4) below, such that each line of images represents the translation of one word from the input text, and the entire output file represents the translation of the entire text.

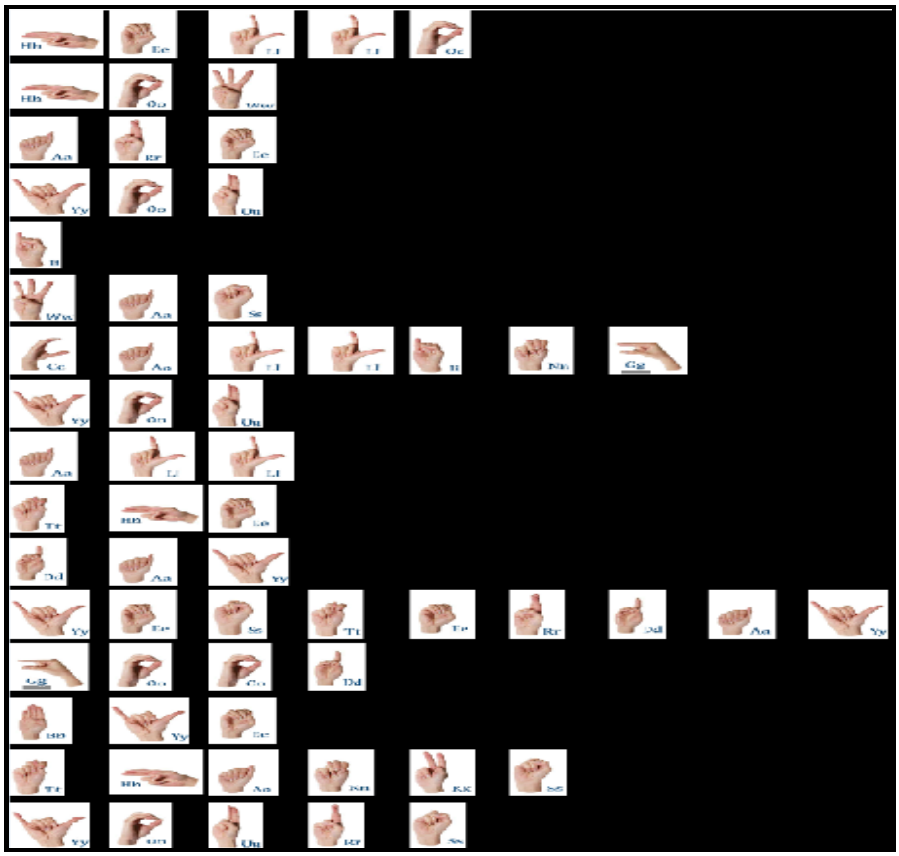

Figure (4): the output image file (ASL fingerspell the translation for the input text)

The Proposed Algorithm Performance:

Our proposed algorithm is considered a good algorithm according to two aspects: its accuracy and time consuming as will be discussed below.

The Proposed Algorithm's Accuracy

Our algorithm accuracy is 100% with respect to the English letters alphabet since the dictionary is size limited, the dictionary contains all the 26 letters of the English alphabet with their corresponding image files. Our algorithm is failed with respect to the numbers and punctuation marks and other special characters since they didn't be added to the dictionary. This method may be added to our algorithm as future work.

The Proposed Algorithm's Time

Our algorithm time is differ according to the input text length as shown in the table below:

Table (1): some examples of different executions

Input Text	Output Image	Execution Time (in seconds)
Text file as shown in figure (3)	The image shown in figure (4)	0.376285428369
"How are you"		0.306285428369
"Good bye"		0.249369532725
"GOOD BYE"		0.273356155743
"hello"		0.233356155743
"is"		0.234844729927
"a"		0.172134137606
A long text about 60 words		0.670744051883

As it is obvious the execution time is differ according to the multiple executions, but it is always small differences in time, the reason of this difference is that we used Python programming language and also used dictionary data type to save our dictionary. this data type is define pairs of data as follows:

Pairs = {'key':'value'}

By using this data type we can retrieve the 'value' to the corresponding key, (searching by index), in our algorithm the letters represent 'keys' and the images represent their 'values'. That is good result about small parts of second of time that can be used in real time translation as a future work.

The size of text can be translated

After getting the image file we create a thumbnail for the image in order to be fixed and small size. Thumbnails are reduced-size versions of pictures, used to help in recognizing and organizing them, serving the same role for images as a normal text index does for words. The maximum number of words can be processed and also the maximum number of letters in a word can be specified according to the size of thumbnail as shown in table (2) below:

Table(2): The relation between thumbnail size and maximum number of words in a text and also maximum number of letters in a word

Size of thumbnail (pixels)	Maximum number of words in a text	Maximum number of letters in a word
(90,90)	35	11
(80,80)	40	13
(70,70)	45	15
(60,60)	50	17
(50,50)	60	22

As it is obvious from the above table that the relation between the thumbnail size and the maximum number of words in a text and also the maximum number of letters in a word is that if the size of thumbnail will be small more words in a text and more letters in a word can be translated, so for the largest text file to be translated must use the smallest size of thumbnail in order to save large number of thumbnails on the image output file.

Conclusions and Future Work

CONCLUSIONS:

1. Whenever the dictionary is size limited, the accuracy of the results will be high, since the dictionary contains all the 26 letters of the English alphabet with their corresponding image files.

2. Using Python programming language is very suitable to save the dictionary, since it can define a data type consists of pairs of data.

3. The largest text file to be translated must use the smallest size of thumbnail in order to save large number of thumbnails on the image output file.

Future Work:

1. According to our Algorithm the dictionary is limited to the English letters, as a future work this dictionary may be expanded to contain the numbers, special characters and the punctuations.
2. The proposed Algorithm may be added to other sign language systems to be used for translating English text into other sing languages such as British sign language that needs to update the dictionary to include the British sign language fingerspell images instead of American Sign Language fingerspell images.

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