Text to Sign Language Conversion

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Abstract

Owing to the prevalence of the computer network, Email has been the most convenient communication tool for most of people, except for deaf-people. The non-deaf people are easy to use Email techniques to communicate with other people. Thus, they cannot understand how difficult a deaf people studies the nature language. As to deaf-people, the condition is totally different. They have a hard time to write a good sentence because of their limited vocabulary capabilities and language skills. The poor language capability such as limited vocabulary ability or poor syntax training for a deaf people is because most deaf people cannot listen and practice the basic language techniques. When they read a sentence, they always translate by vocabulary and guess the meaning of the whole sentence. They don't really understand the whole sentence. Therefore, they are difficult to read a text article, to write a composition, or even a short mail. The Education Bureau of Taiwan has defined the standard of sign language recently. In this paper, we propose a method to convert Chinese words or texts to a speech and sign language simultaneously. A deaf people can easily read an Email or article by a translated sign language stream. On the contrary, a non-deaf people can read the Email by listening the conversion speech.

Keywords： Deaf, E-mail, sign language, hashing, speech

1. Introduction

Owing to the popularity of the WWW or Internet, E-mail has become the most convenient communication tool in the current world for individuals or business enterprises. In this network age, most people like to use Email to contact their parents, friends, and teachers etc. Most business enterprises use Email as a tool to provide their service to customers in order to get customer loyalty. The prevalence use of the Email as a communication tool is because of the cheaper of personal computer, the well-established computer network, and the fast and convenient of the Email. Hence, the age of the Email user is younger year by year. More and more young people, even the agedness, like to

use Email electronically as a communication tool instead of stamp mail. Recently the deaf school has detected the importance of Email and started the Email training program for their senior high school students. Based on the Email communication between deaf students and non-deaf teachers, we found that most deaf students' language capabilities are poor and couldn't write the mail fluently. Hence, most deaf students hardly understand what is teacher wrote. They have a hard time to figure out the meaning of the mail contents. Even they can, they still take more time than non-deaf people. Since those mails must be written in characters. The word communication is easy for the non-deaf people but not for the deaf.

From the development procedure of human language, the most important factors of children language learning are the language dynamic interaction and acknowledgement [1,2]. Their hearing obstacles hinder all kinds of science learning for the deaf students. Many study reports show that even teenager deaf students are not familiar with grammar, the sentence making skills etc., which skills have easily been learned by non-deaf students on their childhood [3,4]. Brasel and Quigley [5] found that deaf students din't possess the language sense. Trybus and Karchmer have reported the mathematics ability of 1543 deaf students during three years. They found that the reading comprehension of a nine-year old deaf student is equal to a second grade non-deaf student but the reading comprehensive of a twenty-year old deaf student is just equal to a five grade non-deaf student. More over most adult deaf people, their average reading comprehensive ability is not better than four or five grade student [6].

The special education expert Dr. Samuel A. Kirk has said that the most difficult education for all kind of handicaps is the deaf student's education. That means the deaf student education needs much more teaching skills. The point is that a non-deaf student can learn language from hearing but deaf student cannot learn from listening. The language training for a deaf student is a very difficult and important task. We propose a method to convert Chinese word or text to a Chinese speech and sign language simultaneously. A deaf people can easily read an Email or article by a translated sign language stream. On the contrary, a non-deaf people can read the E-mail by listening the conversion speech. We hope that our conversion system can help deaf students to understand the words or texts written by non-deaf people.

2. Method

For converting text to sign language and speech, we consider the problem of maintaining a changing set *S* of elements. New elements will be added to *S*, and from time to time we have to answer the question, "Is the element *x* currently in *S*?" A dictionary models this problem naturally; we need a data structure that will permit sequences of *GETMEMBER*, *INSERT* procedures to be processed conveniently. We shall assume that the elements that can appear in *S* are chosen from an extremely large universal set, so that representing *S* as a bit vector is impractical [7].

A compiler or an assembler keeps track in a "symbol table" of all the identifiers. It has seen in the

program while it is translating. For most programming languages the set of all possible identifiers is extremely large. For example, in FORTRAN they're about $1.62x10^9$ possible identifiers [8]. Thus it is infeasible to represent a symbol table by an array with one entry for each possible identifier, irrespective of whether that identifier actually appears in the program or not. The operation, which a compiler performs on a symbol table, is that new identifiers must be added to the table as they are encountered. This job involves setting up a location in the table into which the particular identifier is sorted and into which data about the identifier (e.g. is it single or multi word) can be sorted. We consider hashing, a technique, which handles not only *INSERT* and *GETMEMBER*, as, needed in symbol table construction, but the *DELETE* instruction as well.

Fig. 1 represents a hashing scheme. There is a hashing function *h*, which maps elements of the universal set to the integers 0 through *m-1*. We assume throughout that, for all elements *a*, *h(a)* can be computed in a constant amount of time. There is a size m array *A* whose entries are pointers to lists of members of the set S. The list pointer to by *A[I]* consists of all those elements a in *S* such that *h(a)=i*.

To execute the instruction *INSERT(a,S)*, we compute *h(a)* and then search the list pointed to by *A[h(a)]*. If *a* is not on the list, it is appended to the end of this list. Similarly, *GETMEMBER(a,S)* is answered by scanning the list *A[h(a)]*.

Here, all the word elements *h(a)* are Chinese word or the phrase of two or three words phrase. When a text file is traversed, the system parses each word to find the matching sign language and the speech pattern from the hashing table then display the pattern with speech sound.

In our system, the elements of the symbol called Symnode are a record each field contains the Chinese word, the phonic, and the sign language.

```
Symnode
    {
      Chinese_word;
      Phonics;
      Sign_language;
     }
```

The hasing function is shown as follow and hashes the symbol table to return the symbol location index.

```
Function Hash
For I = 1 to 6 (6 is the number of bytes for a Chinese word)
   Address = Address + ORD (Symtable[I])
   Hash = Address Mod Symtablesize +1
End
```

Where

ORD is the order function to find the order in an ASCII table.

Mod is the module function for getting the remainders the correct hashing table index.

Symtablize is the symbol table size.

3. Experimental results

The beginning of our experiment has some results. The system has finished the character word to sign language pattern conversion and text to sign language pattern string conversion. For the character word to sign language pattern conversion, the system is just like a query system; a person key in a single word then the system shows all mapping sign language pictures containing the word. Those single sign language pictures represent single word or the phrase of two or three words. The user can easily selects the word he wants as shown in Fig. 2.1 and Fig. 2.2.

Fig2.1 is a main menu for sign language searching. In this menu, we can enter the key words or sentence we want to search in the blank box. Suppose we enter the Chinese sentence “老師制止你吸煙” in the blank rectangle area. The English meaning is “teacher forbids you to smoke”. Then the next screen will come out as shown in Fig2.2., which is a still (motionless) picture to transform each word to sign language for easy query, not a motion screen. Thus, this Chinese sentence was processed into four steps sequentially. The first graph means “老師” (teacher). The second graph is “制止” (forbids). The third graph shows “你” (you). The last graph is “吸煙” (smoking). Based on these four steps, the deaf-people can easily understand the meaning of the sentence that supported by Chinese words and sign language simultaneously. In here, we need to outline the characteristics of Chinese words and phrases. The basic framework of Chinese phrases is made of word by word, but the sign language is probably made of one word, two words, or three words to present each event or thing. For instance, the previous example “吸煙” (smoking) is composed of two different Chinese words and is only presented by one sign language, not two sign language. That is, 吸煙” (smoking) is presented by only one gesture, not continuing gestures.

For the word sentence to sign language pattern string conversion, the user types in a short sentence then the sign language pattern string has been shown on the screen as shown in Fig. 3., which is a motion picture to process Chinese texts or phrases to speech and sign language pattern string conversion. The translation process is the same as Fig.2.1 and Fig2.2 shown. When the non-deaf people receive this mail, which includes many Chinese sentences in the paragraph, they can easily understand what the message means. However, for a deaf-people, when they receive this message, it will take them a lot of time to identify the meaning of this message. Unless there is a sign language conversion system helps deaf-people to translate the meaning of message simultaneously, just as the Fig. 3 shows.

4. Conclusion

The scope of nature language is too complicate to find all the possible rules for syntax analysis in

the mean time. Our propose system is just a beginning for Chinese sentence and sign language conversion. Sign language and nature language are in the different system, how to convert each other and be learned by deaf students is a very challenging work. Our system has already finished the words to sign language pattern conversion and texts to sign language pattern string conversion. This kind of conversion is easy to use by non-deaf people and good for deaf people to read the sign pattern accompanied with Chinese sentence. In fact, a lot of advanced future studies need to solve including the sign pattern input system, the sign pattern syntax analysis algorithm, and even the conversion method of the semantic analysis from sign pattern to character words. At that time deaf people can easily use the conversion system for Email or edit article in the cyberspace no more fear.

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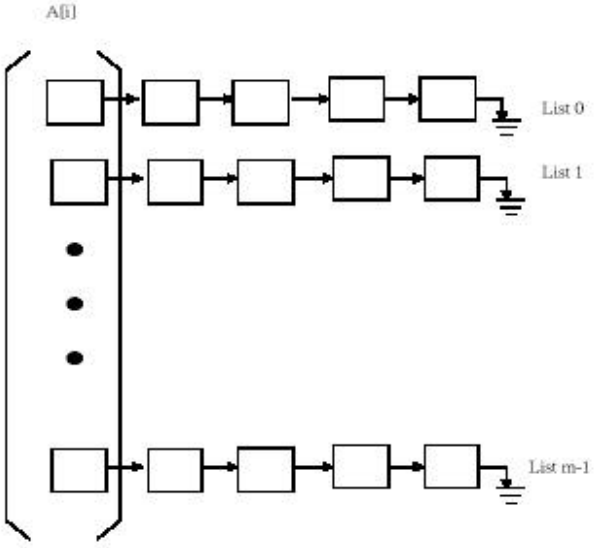
Figure Legend

Fig.1 Scheme for hashing algorithm

Fig.2.1 Sign language searching main menu

Fig.2.2 Sign language searching result

Fig.3 The processing of Chinese Text to Speech and Sign Language Conversion



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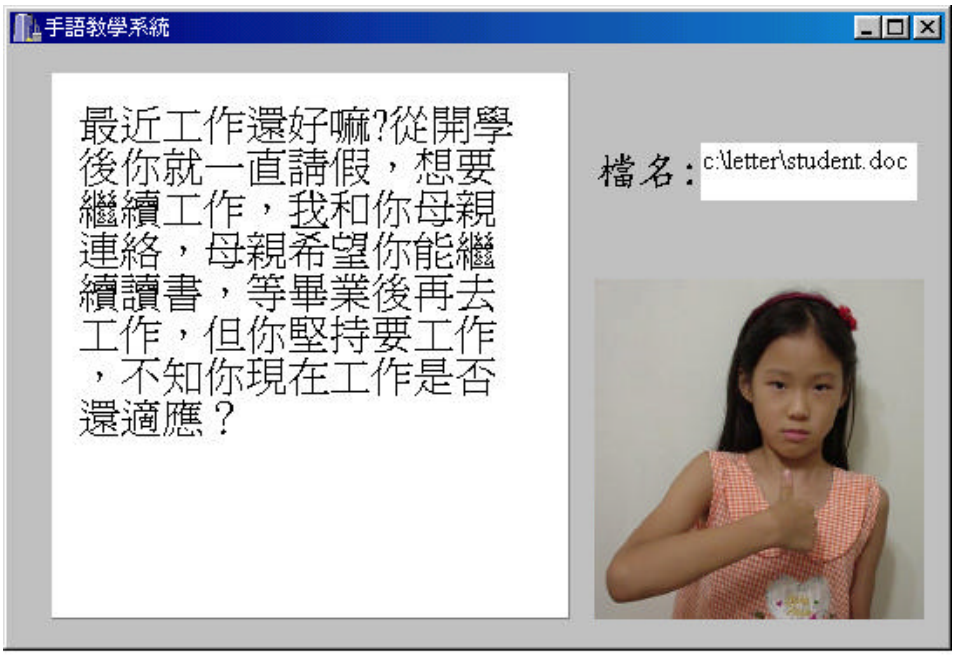

Fig.3 Chinese to sign Language Conversion