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Indian Sign Language (ISL) Translation System For Sign Language Learning

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Abstract:
Sign language is a language which uses visually transmitted sign patterns to convey meaning. It is the combination of hand shapes, orientation and movement of hands, arms or body, and facial expressions. Our System is capable of recognizing sign-language symbols can be used as a means of communication with hard of hearing people. Our paper proposes a system to help normal people can easily communicate with hard of hearing people. Instead we are using a camera and microphone as a device to implement the Indian Sign Language (ISL) system. The ISL translation system has translation of voice into Indian Sign Language. The ISL translation system uses microphone or USB camera to get images or continuous video image (from normal people) which can be interpreted by the application. Acquired voices are assumed to be translation, scale and rotation invariant. In this process the steps of translation are acquisition of images, binarized, classification, hand shape edge detection and feature extraction. After getting vectors feature extraction state then pattern matching done by comparing existing database. The GUI application is displaying and sending the message to the receiver. This system makes normal people to communicate easily with deaf/dumb person. Also in video calling or chatting this application helps the hard speaking and hearing people.

Key words: *Indian sign language (ISL), translation, image processing, hard hearing and hard speaking*

1.Introduction

In recent years, research has progressed steadily in regard to the use of computers to recognize and render sign language. Technology is rapidly changing and improving the way the world operates. Barriers for people who are hard hearing are diminishing as projects of the past two decades have unfolded. Through the use of image processing, artificial intelligence and pattern matching techniques, researchers are striving to develop hardware and software that will impact the way hard hearing individuals communicate and learn. Using sign language hard speaking and hearing people could communicate among them and with normal people.

Practically, world's normal people has been in a difficult situation in the society because of their inability to communicate vocally with hard hearing people in connection with that the indifference of others to learn their language, the sign language. With the arrival of multimedia, animation and other computer technologies, it is now becoming possible to bridge the communication gap between the normal and hearing-impaired person.

Sign language is a visual/gestural language that serves as the primary means of communication for hard hearing individuals, just as spoken languages are used among the hearing. Hard hearing individuals encounter the difficulty that most hearing individuals communicate with spoken language [12].Generally, there is no problem when two hard hearing persons communicate using their common sign language. The real difficulties arise when a normal (non-deaf) person wants to communicate with a hard hearing person [9].In such scenario there is need of sign language. Sign language (SL) is the native language for the hard hearing people. Although they successfully communicate with each other when using sign language. They face many difficulties when they try to communicate with hearers, especially those who are incompetent in sign language .Solutions such as pointing, writing, or lip-reading, combined with some new technological means, i.e., faxes, computers (e.g., e-mails), mobile phones (e.g., SMSs), facilitate such communication.

There are 700,000,000 deaf or hard of hearing people worldwide (World Health Organization) and the 143 existing different sign languages (types with dialects). Being as complex as any spoken language, Sign Language has many thousands of signs formed by specific gestures (related to the hands) and facial expressions, each differing from another by minor changes in hand motion, shape, position, and facial expression [17].

What is Sign Language? Sign language is a language which uses visually transmitted sign patterns to convey meaning. It is the combination of hand shapes, orientation and

movement of hands, arms or body, and facial expressions. Sign languages are not international. Every country has unique sign language. Ex: American Sign Language (ASL) has its own grammar and rules—it is not a visual form of English. Sign language is unique for every nation [1].Countries like Arabic, Bangla, and Malay, Taiwanese, Chinese, Japanese, Spanish and many has their own sign language. There are approximately 70 million people with hearing deficiencies in the world [1]. Sign language translator is system which converts voice to text or sign language in any native language. These systems are called as human computer interaction systems (HCI).It could be done in two ways (i) rule based translation (ii) statistical based translation.

A sign language translation system would make it possible to communicate with hard hearing people. Sign languages primarily consist of hand gestures performed by the hearing impaired as a means of communication. Machine vision methods for sign language spotting, i.e., detecting and recognizing signs in a known vocabulary, in videos of sentences and stories produced by native signers. The difficulty of sign language spotting is that instances of signs vary in both motion and appearance. For dealing with motion, previous vision-based methods have demonstrated some successes using Hidden Markov Models [15].

Gesture description involving hand shapes, movement, position, and palm orientation have been employed to recognize and segment sign image sequences. These methods focus on image processing more than machine translation and sign language analysis and have limited vocabularies [12]. Sign Language Translation System or software that translates voice or text into sign language animations could considerably improve hard hearing lives especially in communication and accessing information [13]. Sign language is a visual language and consists of 3 major components they are,

(i) finger-spelling: used to spell words letter by letter

(ii) word level sign vocabulary: used for the majority of communication

(iii) non-manual features: facial expressions and tongue, mouth and body position

In our proposed system we focus spelling alphabets letter by letter, Then natural language translation module converts a word sequence into a sign sequence..

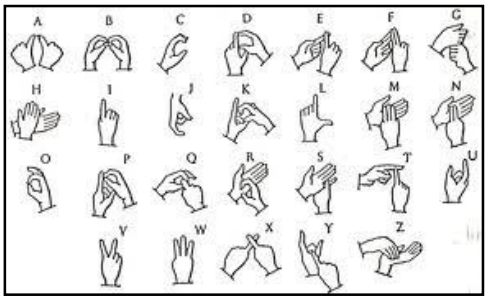

Figure1: Indian Sign Language Alphabet

Now-a-days voice calling-chatting and many facilities are offered for communication. Hard speaking and hearing peoples couldn't use these facilities effectively or fully. These people find difficulty in communicating with normal people. Our paper discusses solution to this problem and proposed a system for translation of sign language using mic in laptops or multimedia smart mobile phones.

2.Related Works

Gestures are expressive, significant body motions involving physical movements of the fingers, hands, arms, head, face, or body with the intent of conveying meaningful information or interacting with the background. The importance of gesture recognition lies in building efficient human–machine interaction. Its applications range from sign language recognition through medical rehabilitation to virtual reality. The tools surveyed for gesture recognition are HMMs, particle filtering and condensation algorithm, FSMs (Finite State Machines).The sign language translation system Speech to Sign. A practical low cost visual communication system for sign language translation using low bandwidth. It is made up of a speech recognizer (for decoding the spoken utterance into a word sequence), a natural language translator (for converting a word sequence into a sequence of signs belonging to the sign language), and a 3D avatar animation module (for playing back the hand movements).

3.Propopsed Methodlogy (ISL Translation System)

In this paper we are proposing our Indian Sign Language translation system. In this system we are giving two modes of translation. First one is if a deaf-dumb person can communicate with normal person (who doesn’t know sign language). And the second one is reverse of first one i.e. a normal person speaks, it is converted to text and then appropriate text meant sign will be displayed.

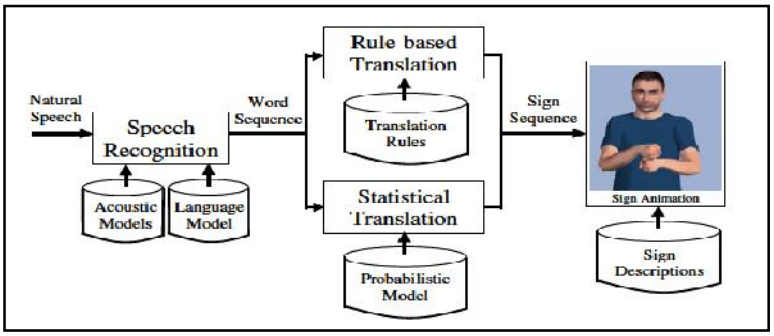

Figure2: Speech into sign language translation system

3.1.Speech To Sign Translation

The speech from normal person is taken via micro phone of cellular phone or computer. For the need of good quality of voice signal it will be sent for noise removal. Voice data is converted to text by speech-recognition module that is voice to text conversion with the use of trained voice database. The converted text is compared with database for finding meaning and symbol (sign). Display the Sign Symbol with text to the receiver (hard speaking and hard hearing person).

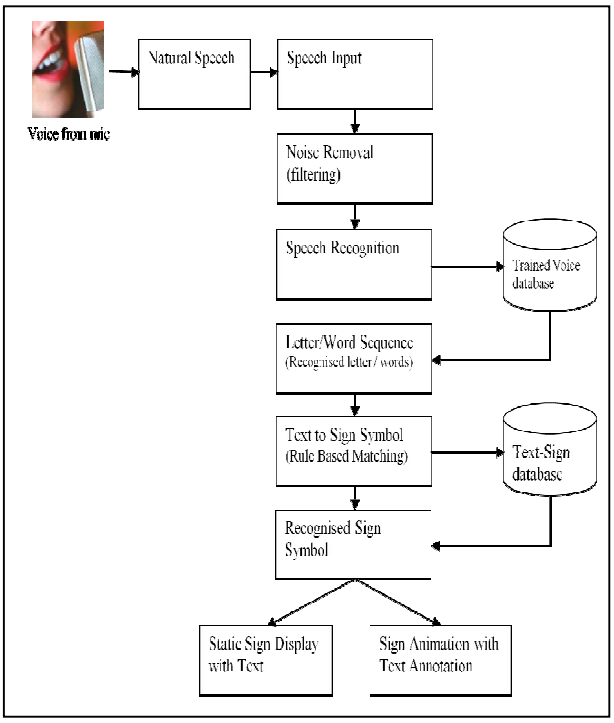

Figure3: Speech to sign translation system architecture

3.2.Noise Removal

The speech from normal person is taken via micro phone of cellular phone or computer and it will be sent to noise removal. There are several types of noise removal techniques like Filtering Techniques (spectral subtraction method, weiner filter, least mean square filter and kalman filter)[23] ,Spectral restoration(minimum mean square error short time spectral amplitude) and many. There are another two types of noise removal methods also, Modulation detection and Synchrony detection. This algorithm speech detector analyses in signal amplitude. Speech modulations are slow and have big amplitude fluctuations. Noise modulations are more constant with rapid and smaller fluctuations.

3.3.Speech Recognition

After noise removal the voice sent for speech recognition module. Here the speech recognizer converts voice into single letter (latter words and sentences).The system uses context-dependent continuous Hidden Markov Models (HMMs) built using decision tree state clustering: 1807 states and seven mixture components per state. These models have been trained with more that 40h of speech from the SpeechDat database. Although SpeechDat is a telephone speech database, the acoustic models can be used in a microphone application because CMN and CVN techniques have been used to compensate the channel differences. The influence of this aspect in the speech recognition results is small. For new user voice training has to be done for making trained voice database. In testing phase or real time the voice database used for quick and easy recognition .This paper proposes for single letter or alphabet into Indian way of Sign Language. Then we planned to implement this idea for individual words and then continuous word spoken.

3.4.Domain And Database

The experimental framework is restricted to a limited domain that consists of sentences spoken by normal people. In this context, a speech to sign language translation system is very useful since most of the normal persons do not know sign language and have difficulties when interacting with Deaf people. Once the ISL encoding was established, a professional translator translated the original set into ISE making use of more than 320 different signs. Then, the 416 pairs were randomly divided into two disjoint sets: 266 for training and 150 for testing purposes. The speech-to-sign translation purpose the same

test set has been used. The test sentences were recorded by two speakers (1 male and 1 female).

3.5.Rule Based Text To Sign Matching

Recognized voice is now in the form of text that is voice to text conversion module gives us text output. Then text to sign matching is done by rule based technique. Here the relationship between text and sign has been defined. Here the natural language translation module considering a bottom-up strategy. In this case, the relationship between signs and words are defined by an expert hand. In a bottom-up strategy, the translation analysis is carried out by starting from each word individually and extending the analysis to neighborhood context words or already-formed signs (generally named blocks). This extension is made to find specific combinations of words and/or signs (blocks) that generate another sign.

The translation process is carried out in two steps. In the first one, every word is mapped to one or several syntactic– pragmatic tags. After that, the translation module applies different rules that convert the tagged words into signs by means of grouping concepts or signs (blocks) and defining new signs. These rules can define short and large scope relationships between the concepts or signs. At the end of the process, the block sequence is expected to correspond to the sign sequence resulting from the translation process.

The rule-based translation module contains 153 translation rules. For evaluating the performance of the systems, the following evaluation measures have been considered: SER (Sign Error Rate), PER (Position Independent SER), BLEU (BiLingual Evaluation Understudy), and NIST. The first two measures are error measures (the higher the value, the worse the quality) whereas the last two are accuracy measures (the higher, the better). Forward and continuous matching we have to more because of word meanings and context meaning in sentence (continuous speech). The relationship rules are defined carefully with extreme logic to achieve good translation.

	SER	PER	BLEU	NIST
Exp 1	**31.60**	**27.02**	**0.5780**	**7.0945**
Exp 2	24.94	20.21	0.6143	7.8345
Exp 3	18.23	14.87	0.7072	8.4961
REF	**16.75**	**13.17**	**0.7217**	**8.5992**

Table 1: Results obtained with the rule-based translation system

3.5.1.Sign Confidence Measure

The translation module generates one confidence value for every sign: a value between 0.0 (lowest confidence) and 1.0 (highest confidence). This sign confidence is computed from the word confidence obtained from the speech recognizer. This confidence computation is carried out by an internal procedure that is coded inside the proprietary language interpreter that executes the rules of the translation module.

In other more complex cases, the confidence for the generated signs may be dependent on a weighted combination of confidences from a mixture of words and/or internal or final signs. This combination can consider different weights for the words or concepts considered in the rule. These weights are defined by the expert as the same time the rule is coded.

3.6.Delays Between The Spoken Utterance And The Sign Animation

One important aspect to be considered in a speech to sign language translation system is the delay between the spoken utterance and the animation of the sign sequence. This delay is around 1–2 s and it slows down the interaction. In order to reduce this delay, the speech recognition system has been modified to report partial recognition results every 100ms. These partial results are translated into partial sign sequences that can be animated without the need to wait until the end of the spoken utterance. Our system 40% delay reduction is achieved without affecting the translation process performance.

4.Conclusion

Our paper is to help those people to communicate with hard hearing people without sophisticated devices like power and etc. The ISL translation system is speech to sign a normal person speaks, it is converted to text and then appropriate text meant sign will be displayed. We planned to extend this idea for words and sentences by using new methodologies. We planned to implement the complete idea of this paper in smart mobile phones also. The Challenge in implementing this idea in mobile phone is implementing the methods used for image processing.

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