Airport Announcement System for Deaf

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Abstract

People belonging to hearing-impaired community feels very uncomfortable while travelling or visiting at airport without the help of human interpreter. Hearing-impaired people are not able to hear any announcements made at airport like which flight heading to which destination. They remain ignorant about the choosing of gate number or counter number without the help of interpreter. Even they cannot find whether flight is on time, delayed or cancelled. The Airport Announcement System for Deaf is a rule-based MT developed. It is the first system developed in the domain of public places to translate all the announcements used at Airport into Indian Sign Language (ISL) synthetic animations. The system is developed using Python and Flask Framework. This Machine Translation system accepts announcements in the form of English text as input and produces Indian Sign Language (ISL) synthetic animations as output.

1 Introduction

Hearing-impaired people use sign language that is regarded as one of the 136 different language families from around 7105 known living languages of the world to convey their feelings and messages (Goyal and Goyal, 2016). Different region of the world have different 136 sign languages worldwide. Nearly 72 million of the nearly 7 billion people on earth are hearing-impaired. Only around 4.3 million sign language users are available from 72 million people. The rest of almost 67 million hearing-impaired people does not use any sign language for communication purpose. So almost 90% of the hearing-impaired people have very limited or no access to education and other information (Goyal and Goyal, 2016). Hearing-impaired people use sign language involving different hand forms, fingers positions, face expressions, hand gestures and other body postures (Goyal and Goyal, 2016). It is a visual-spatial language, as the signer often describes an event using the 3D space around his body (Anuja et al., 2009). As sign languages lack well-defined structure or grammar rules rendering signs less acceptable to outer world of hearing-impaired community. Until the 1960s, sign languages were not taken as bona fide languages but merely grouping or collections of gestures and mime. Dr. Stokoe's American Sign Language research was a great boast to render sign language a full-fledged language with its own grammar rules, syntactic and other linguistic rules/attributes. There are some other contributions to prove the same for other sign languages including the Indian Sign Language (Anuja et al., 2009).

2 Literature Review

The INGIT (Kar et al., 2007) system built for limited domain of railway reservation translates Hindi strings entered as input by reservation clerk to Indian Sign Language (ISL) in gloss string that is then converted using HamNoSys to animated human avatar. The INGIT system works in four modules. ISL generator module applies the ISL grammar rules to get the ISL tagged string. Then each word of the ISL tagged string is replaced with corresponding HamNoSys notation, which are animated using avatars after the conversion into SiGML tags. INGIT is based on hybrid formulaic grammar approach that uses fluid construction grammar (FCG). This project is validated only on a very small corpus of 230 utterances. A

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Prototype Text to ISL is a MT (Dasgupta and Basu, 2008) system based on rules of grammar transfer consisting 5 modules of Pre-processor and parser input text, representation of the LFG f-structure, rules of grammar transfer, generation of ISL sentences , and ISL synthesis. Applying proper transfer rules, the English word structure is translated to an ISL word structure. Then ISL sentences are outputted using a stream of pre-recorded videos or icons. Currently, the system is evaluated based on a set of 208 sentences that gives lexical conversion accuracy of 89.4 per cent. A Frame Based Machine Translation System (Anuja et al., 2009) for English to ISL designed for speech to Indian Sign Language in railways and banking domain. Their system has three modules, speech recognition module that takes input as clerk's speech, translates each uttered phrases into signs language using language-processing module and produces three-dimensional virtual animation using 3D animation module performing signs according to input speech on a display device. Their system use pre-recorded animations. The evaluation of system is done over 250+ phrases with 60% correct translation accuracy, 21% translation with semantic error and 19% incomprehensible translation. An Automatic translation system for English text to ISL (Goyal and Goyal, 2016) consists of parsing, elimination, sentence reordering, lemmatization, words to ISL and animation modules. English words are parsed to Phrase Structure Grammar (PSG) using ISL grammar rules by parsing module. Then eliminator module is used to remove any unwanted words from the sentence reordering module. Then root word is found using lemmatization. The synonym replacement module replaces the non-available word with its synonym words. Then each word is converted into HamNoSys notations that are converted into their respective SiGML tags. Synthetic animation module takes SiGML code as input and generates synthetic animation using various avatars.

3 Methodology

3.1 Creation of Bilingual English-ISL Dictionary

For our research work, we have collected announcements by visiting various airports. Firstly, all airport announcements are broadly categorized into static as well as dynamic announcements that are further sub divided and bifurcated into different categories. Then distinct words are extracted from these announcements. The list of total 1146 distinct words of airport is constructed which are then translated into ISL with help of ISL Teacher and a video footage of all words is prepared. Then these words are coded into HamNoSys one by one to create SiGMLs adding all non-manual components into each sign. Therefore, a bilingual English-ISL dictionary of 1146 distinct airport words is prepared for our system.

3.2 System Architecture

The system will have three modules. Firstly, the system categories the Input text as static, dynamic or randomly generated sentences with the help of corpus of various announcements used at airports.

A) **Mapping Module**: Static and dynamic announcements are passed to Mapping Module that directly maps English words into ISL gloss with the help of bilingual English to ISL dictionary where the static sentences are immediately passed to translation module for generation of synthetic animations. Dynamic sentences are passed to translation module after the replacement of dynamic parts.

B) **Text Processing Module**: Randomly generated sentences are passed to text processing module for parsing the English text using Stanford parser. Then phrase recording and eliminator module is used, to reorder the English sentences and for removal of unnecessary or unwanted word using ISL grammar rules, respectively. Then the root form of English word is obtained applying lemmatization rules after stemming which is passed to translation module for generation of synthetic animations.

C) **Translation Module:** It translates all the ISL words generated from mapping as well as text processing module into HamNoSys notations that are then translated into SiGML file of XML tags. Then a SiGML URL application will be used for converting SiGML into avatars performing animations in Indian Sign Language (ISL).

4 Result and Discussions

The overall accuracy of Airport Announcement System for Deaf system is found to be approximately 83%. In case of simple announcements, the output accuracy is tested to

be 82% and above whereas in case of complex and compound announcements the accuracy is found to be 84%. The system performance can be improved by incorporating word sense disambiguation of more ambiguous words. We have also consulted with ISL interpreters and various ISL experts by showing them the results and the response received was very encouraging and motivating. In various deaf schools, the overall translation accuracy was validated by demonstrating the system.

5 Conclusion and Future Scope

An airport announcement system for Deaf has been presented in this paper. The developed system is the first real-domain announcements translation system for Indian sign language. Our focus was to develop a system that can translate all the necessary information for travelling or visiting at public places into Indian Sign Language (ISL). Our system is able to translate all the announcements used at airports into Indian Sign Language (ISL) synthetic animations so that hearing impaired people can visit airports without any problem. In our system, three-dimensional animated avatars are used because pre-recorded video footage requires large amount of memory space for storage. Animated avatars are easy to upload and download, that's why their processing is fast as compared to recorded video footage and images. In the future, the Bilingual ISL dictionary can be enhanced with adding more words to it. In addition, the developed system can be extended into other public places.

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