DOMAIN BOUNDED ENGLISH TO INDIAN SIGN LANGUAGE TRANSLATION MODEL

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Abstract- This is a proposal for the English text to Indian Sign Language translation model wherein the system will accept the input text and then translates the given words in sequence by making an avatar to display signs of each word. The translation here is corpus based. There is direct mapping between the English and ISL text. Since it is very inefficient to make signs for each word our domain is bounded by certain criteria for which the translator translates the given text. Like, the system which we propose is for railway reservation counters for enquiry.

Keywords- avatar; ISL

I. INTRODUCTION

Indian Sign Language is used by deaf, dumb and hard of hearing people for communication by showing signs using different parts of body. The language came into existence because of the deaf, dumb and hard of hearing people in India. All around the world there are different communities of deaf and dumb people and thus the language of these communities will be different. Just like there are many spoken languages in the world like English, French, and Urdu etc. Similarly there are different sign languages and different expressions used by hearing disabled people worldwide. The Sign Language used in USA is American Sign Language (ASL); British Sign Language (BSL) is used in Britain; and Indian Sign Language (ISL) is used in India for expressing thoughts and communicating with each other. The interactive systems are already developed for many sign language e.g. for ASL and BSL etc. To help hearing impaired people in India to interact with others we present this system which translates the English text to Indian sign language. Since it is difficult to generate signs for each verb/phrase in the vocabulary or dictionary, we will limit experiments in a domain, like we will try to develop the system for railways that will display the signs accordingly .We will take all the possible conversations from the railways enquiry/reservation counters and will then analyze and find the respective signs used in ISL. India is a large country with the population of 1,241,491,960 (Google Public Data) .In India there are 30 states and the languages used in most of the states there are their local language e.g. Kashmiri is spoken in Kashmiri, Punjabi is spoken in Punjab similarly there is slight difference in the sign language in different parts of India. Since there is slight difference our system will be able to produce signs that will be understood by all. For efficiency we will tabulate differences. The "Indian Sign Language (ISL)" uses manual communication and body language (non-manual communication) to convey thoughts, ideas or feelings. This involves a combination of two or many hand shapes, orientation and movements of hands, arms or body and facial expressions to express a speaker's thought. ISL signs can be generally classified into three classes: One handed, two handed, and non-manual signs [1].one handed signs and two handed signs are also called manual signs where the signer uses his/her hands to make the signs for conveying the information. Non-manual signs are generated by changing the body posture and facial expression.

II. EXISTING RESEARCH

Purushottam Kar et al [2] in their work have developed a system named INGIT1. It is a cross-model translation system from Hindi strings to Indian Sign Language for possible use in the Indian Railways reservation counters. The system translates input from the reservation clerk into Indian Sign Language, which can be then displayed to the ISL user. They have used Fluid Construction Grammar (FCG) [3], for constructing the grammar for Sign language. In this the domain-specific construction grammar for Hindi converts the input into a thin semantic structure which is an input to ellipsis resolution, after which a saturated semantic structure is obtained. Depending on the type of utterance (statement, query, negation, etc.) a suitable ISL-tag structure is generated by the ISL generator. This is then passed to a HamNoSys [4] converter to generate the graphical simulation. For validating the system, they collected small corpus on six different days. This corpus was based on interaction with speaking clients at a computer reservation counter. They after evaluation found the interaction constituted 230 words, of which many were repeated. The vocabulary of 90 words included 10 verbs in various morphological forms (e.g. work, worked, working etc.), 9 words related to time, 12 words specific to the domain (e.g. ticket, tatkal, etc.), Other words were numerals (15), names of months (12), cities (4) and trains (4) as well as digits particles etc. The INGIT system has three main modules:
- Input parser
- Ellipsis Resolution Module
- ISL Generator (including ISL lexicon with

HamNoSys [4] phonetic descriptions)
Their system cannot show the non-manual features like facial expressions, gestures, etc. Their system has a restricted domain i.e. it is only applicable for railway systems. The vocabulary of sign language will be very small. Ian Marshall et al [5] has developed a system that translates English text to British Sign Language. Their system is mainly a pipeline of four main translation stages:

• English syntactic parsing,
• Discourse Representation Structure (DRS) generation,
• Semantic transfer,
• Generation of HamNoSys [4] SL phonetic descriptions

For Parsing they have used Carnegie Mellon University (CMU) link grammar, parser [6] to produce an appropriate linkage which characterises syntactic dependencies (i.e. structural dependencies, it gives the linkage between different words of a sentence on the basis of its meaning etc.) .Next step is Discourse representation Structure generation in this the parsed data is subjected to discourse representation theory e.g. "Ram own a dog" is represented as [x ,y : Ram(x), dog(y) owns(x ,y)] .Then in Semantic transfer English oriented DRS is transformed into a SL oriented DRS. In particular, the number of arguments for some predicates is modified to a different number of arguments expected of a corresponding SL sign. Then the last step is the HamNoSys [4] generation.

Their system could not show the non-manual components. It will only be applicable for the manual components. It won't be able to show the gestures, facial expression. XU Lin et al [7] have proposed a text-based transformation method of Chinese-Chinese sign language machine translation. They have created gesture and facial expression models. For this their idea is first to recognise the words from the sentence, this is a task in morphology analysis which includes identifying the grammar attribute of each word in sentence i.e. the property of the word is specified e.g. is the given word a noun, a verb etc. and judging the punctuation mark in the end of the sentence to decide the mood of the sentence. Then the sentence will be subjected to syntactic analysis, here according to them the sentence structure of CSL-(Chinese Sign Language) needs to be done because Chinese and CSL does not have same word order e.g. certain type of verb comes after the noun in CSL but in Chinese it will come before noun. Now the sentence is disintegrated up to the words so, their next step is to find the equivalent in CSL to every Chinese word. But there is a great difference in the number of words of CSL and Chinese so there arises three issues:

• The situation that Chinese word has equivalent in CSL but its synonym has mark of the sign word.
• The situation that Chinese word has no equivalent in CSL, but its synonym has.
• The situation that neither the word nor its synonym has equivalent in CSL.

To counter these issues they have proposed following equivalent transformation rules suitable for words. For the first situation the Chinese words can be mapped into the sign words directly .For the second situation the Chinese words can be replaced by its synonyms that can be mapped into sign words directly .For the third situation it needs to be divided into the following concrete situations:

• The word is measure word
• The word is connective or auxiliary word of structure
• The word is well-known proper noun which represents person's name place name etc.
• The word is a punctuation mark Accordingly the sentence is then translated to the CSL, at the end the obtained codes of CSL sentences are transformed in modality and they are displayed in computer window.

The draw back here I propose is that the author has not restricted the domain so generating signs for each word is not a feasible work to do. But the plus point here is they can show both manual as well as non-manual movements.

Matthew P. Huenerfauth [8] in his survey compared and analysed four most promising research systems for translation of text into American Sign Language animation. He has given the special challenges of a language without a writing system, an explanation of the use of human figure animations, and a motivation for Machine Translation task. He has four systems under consideration:

• ViSiCAST translator
• TESSA
• TEAM
• ZARDOZ

According to Dorr et al [9] the machine translation systems can be grouped into three basic designs:

• Direct
• Transfer
• Interlingual

In direct there is word to word conversion, none of the other aspects of the sentences are taken into consideration. This means that the transfer rules that perform this type of conversation fully depend on the source language. The transfer systems analyse the input text to syntactic and semantic level, here the transfer rules that perform this type of conversation is dependent on both source and target language. And for the last interlingual architecture the analysis of the source language text should result in the representation of the text that is independent of the source language.

ViSiCAST translator is a part of the European Union's ViSiCAST project et al [10], Ian Marshall and Éva Sáfár et al [5] at the University of East Anglia implemented a system for translating from English text into British Sign Language. TESSA (Text and Sign Support Assistant) [10] was made in collaboration with UK Post office system .The system combined with the speech recognition system first

converted the speech to text then to sign language, displaying both English text as well as related signs for text to sign conversion it took English input text, looks up each word of English string in English –to-Sign dictionary, concatenates those signs together and blends them into an animation. The system is not scalable because a small set of standard sign sentence templates to compensate for these phenomena.

TEAM project was also English to ASL Machine Translation system proposed by Liwei Zhao et al [11]. They used Lexicalized Tree Adjoining Grammar based system for translating between English sentences and ASL glosses. Because of the increased linguistic information, this architecture could handle many syntactic divergences between English and ASL. In the TEAM system it seems like there is word-to-sign mapping but actually there is syntactic transfer approach. The input English strings need to be analysed with TAG parser during the translation process, and the syntactic information revealed helps the bilingual lexicon2 look-up process.

There is another system, eSign (Essential Sign Language Information on Government Networks) project by R. San-Segundo et al [12] which has been developed for assisting the people in applying for, or renewing the Nation Identification certificate and the Passport. It is a Spanish speech to Spanish Sign Language translator (for specified domain). In this system the developers have specified the domain for which the system can be used. For developing the system the most used phrases had been selected from normal dialogues between officers and users (135 phrases).For natural language translation two approaches have been implemented and evaluated: rule-based approach and statistical translation [13]. In the rule based approach they have used bottom-up strategy. They have generated 153 translation rules for the specific domain and by tagging the words with the confidence level for its semantics they generate the 2 The bilingual lexicon here means that the respective sign according to the given word revealed from parsing since the "transfer rules" in this system would be each of the paired entries in bilingual lexicon (list of vocabulary or words that are paired). respective signs for that word and then for the whole sentence .in the statistical approach the phrases are taken into consideration, but since the system constant domain the rule based translation gave the better results. Considering the 4 situations reported in, it is possible to classify the rules in 4 types [14]:
   • One word corresponds to a specific gesture
   • Several words generate a unique gesture
   • One word generates several gestures
   • Generate several gestures from several words

To resolve the above give aforementioned situations R. San-Segundo et al [15] proposed to consider both context-free grammar (semantic analysis module) and the generation rules. The semantic analysis and the gesture sequence generation modules are designed for restricted domain services, i.e. the Context-Free

Grammar and the Generation rules used in these modules do not contain all the possibilities for any interacting context. When the number of interacting contexts grow, the system complexity increases causing a drop in performance. Because of this, these modules must be adapted to a specific domain like railway, flight. For the Greek-to-Greek Sign Language translation Eleni Efthimiou et al [16] proposed a system for the sign synthesis. Their tool consisted of three sub modules, the shallow parsing for Greek which is done by previously developed statistical parser for Greek, the Greek-to GSL Mapping and GSL Synthesis. The shallow Parsing results in the structured chunks that are grammatically adequate Greek syntactic units, these chunks serve as an input to the Greek-to-GSL mapping. This Greek-to-GSL Mapping module transfers written Greek chunks into equivalent GSL structures, and aligns input tagged words with corresponding signs or features on sign heads [17].

III. PROBLEM FORMULATION

In India for Indian Sign Language the only one system has been developed i.e. INGIT. For many different countries there is work going on sign language to help the deaf and dumb people of their country .So to help the deaf and dumb people of our country I am taking an initiative towards building this system . It will help these people that have been off-track from present fast growing world to communicate with us.

As mentioned above India is a very large country which is 2nd largest in population. Thus in proportion to population it can be predicted that it might have the largest number of the deaf and dumb people. So for these people we are developing this system. Since it is a large system I am going to work on the part of the system where I am going to translate the English text to sign text.

IV. PRAPOSED SYSTEM:

The proposed translation system takes the English text as the input and the signing avatar translates the given string into Indian sign language by showing the signs for the entered words for translation. There is direct word to word mapping. As there in no particular grammatical rules for the Indian sign language like there is for other languages, it is not feasible to make the rule based system for translation where syntax and semantics of the language could be checked.

System Architecture
The system consists (1)input module which takes the input text for translation,(2) tokenizer which splits the text into words (3) resource were the signs for different words are stored (4) a translator which checks for the sign in the resource for the respective word entered for translation (5)accumulator which accumulates the words to be translated and at last the(6) display which includes avatar that displays the

visual of the sign for the respective word to be translated. Input Module:

It is in the form of text box which takes the text or sentence for the translation as an input. It takes all words weather scrambled or a letter.

Tokenizer:
It splits the English text or sentence entered into the input module to the individual words.

Resource:
It contains the respective ISL signs for the English words. Since the domain is specified for railway enquiry so it will contain the signs of the different words that will be used for the enquiry at railway reservation counter. If the sign for the entered word has no sign representation the synonym of that word is used to represent that word in ISL.

Translator:
It checks for the sign in the resource for the respective word entered for translation and helps accumulator to filter the entered text Accumulator:

It filters the words to be translated by ignoring the words for which there is not respective sign in the resource and then accumulates the words in the sequence they were entered in the input module.

Display:
It is the 3D character that displays the sign for the respective word by hand movements. The Indian Sign Language has no grammar as there is for other languages so rule based system is not feasible for the translation, there is no syntax to compare the sentences. Thus the system will perform the translation by direct word to word mapping and there is no checking for tenses. The system will translate the entered text if the entered words are present in the resource directory.
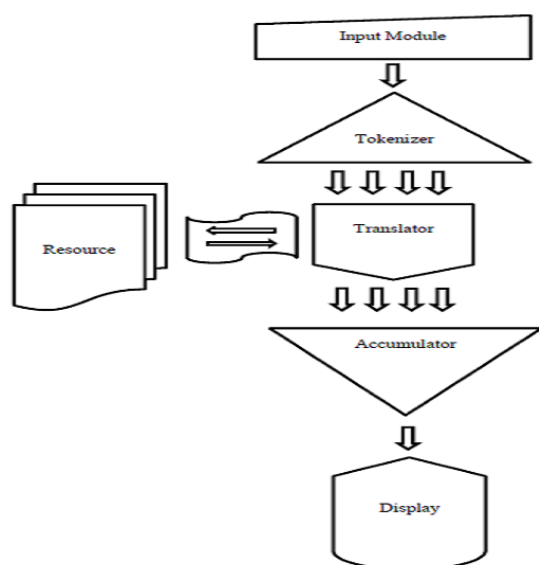

Figure : System Architecture

V. CONCLUSION

The sign languages like BSL, ASL have got the particular grammar which makes it feasible for the rule based systems and the syntax and semantic analysis can be performed to get the appropriate translation. In contrast for Indian Sign Language there is no particular grammatical rule which makes it difficult for the syntax and semantic analysis as there are no rules to compare the English text with. Thus appropriate translation of the English text is not feasible. The text in other systems can be checked for the tenses and syntax which this system lacks. This system might help the deaf and dumb people to communicate with at the railway reservation enquiry counter.

VI. FUTURE WORK

The system can be improved by feeding the resource directory with the signs by specifying different domains like for hospital enquiry etc. and changing the translator module for filtration process.

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