Sign Language based SMS Generator for Hearing Impaired People

Thesis submitted in partial fulfilment of the requirements for the award of degree of

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Submitted By

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Certificate

I hereby certify that the matter which is being presented in the seminar report titled, "***Sign Language based SMS Generator for Hearing Impaired People***", in partial fulfilment of the requirements for the award of degree of Master of Engineering in *Computer Science and Engineering* submitted in ***Computer Science and Engineering*** Department of Thapar University, Patiala, is a survey carried out by me, under the supervision of ***Dr. Parteek Kumar*** and refers others researcher's work which is duly listed in the reference section. The matter presented in this thesis has not been submitted for the award of any other degree of this or any other university.

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Acknowledgement

This research work would be incomplete without acknowledging the people who supported and guided me for the successful completion of this task.

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Abstract

Sign language (SL) stands for the language which essentially requires manual communication to convey the meaning of a sentence or a word unlikely than the acoustically conveyed sound patterns. In addition to combining hand shapes, orientation and hands movement, body or arms, it includes facial expressions to convey the thoughts of a disabled speaker. A large portion of hard of hearing people are deprived of any education and just about 1-2 % of the deaf have access to schooling in this country by the use of sign language. Conferring to the available information, in India there are about 24 million persons who are hearing impaired and only 5% of them go to schools. Because of the scarce availability of sources in India that can give instruction as well as education to hearing impaired people, there is an absence of language and literacy skills among the disabled. Since SL does not have any theoretical form and producing signs using video approach is very expensive, Sign animation is best option available. Hence, there is a need of automated system in order to overcome this problem, thereby improving communications skills among deaf community.

In this study, the creation of an SMS generator for deaf people in Indian Sign Language has been proposed. The system will be supported with a virtual keyboard and corresponding signs for the words so selected from the suggested words will be shown on the interface. This system, has been deployed into four modular functionalities: the first one includes advanced visual interface for a deaf person to indicate sign sequence or enter ISL sentence which is to be converted into English with the use of a language translator , second one sends that English sentence as an SMS to the near and dear ones of the deaf person, third module converts the English sentence into speech using text-to-speech translation system, the fourth module is an animation module for playing the sign actions through the GIF file corresponding to the ISL sentence. Hence, in this way the system so proposed is extremely advantageous for interacting with deaf people face to face and is also beneficial for hearing impaired in communicating through SMS even with the people who are unaware about the Indian Sign Language.

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Chapter 1
Introduction

India, with its 1.25 billion people, is the second most populated country in the world. Although no exact figures are available, but there is an estimation of approximately over 24 million people who are deaf or hearing impaired [1]. As most of the studies done till date have mainly concentrated on urban areas and the survey of India does not list sign languages, so, it is very hard to evaluate the exact number of unresponsive people in India. But it would be realistic to believe that the actual count of deaf and hard of hearing people is much more that the estimated one. Based on these facts and figures, it is known that out of every five hearing impaired people in the world one lives in India [2].

There are very few sources in India to impart knowledge about sign language among the deaf communities. The use of ISL is limited only to short term courses and programs. The professionals in India believe that a very few schools are available for deaf children that can teach them sign language. These schools also do not have a proper and adequate audio-visual support in oral educational. This results in poor communication and language skills among the hearing-impaired people in India. In India, approximately 5% of the people who are hard of hearing attend deaf schools [3]. Due to which there is a need to build a system which can automatically generate the sign language content and for better communication with deaf community, so that it could be used at various educational institutions for teaching sign language to the deaf people.

To annihilate the social relations boundaries between hard of hearing people and society offered with hearing, it's essential not only to indicate sequence of signs by hard of hearing additionally to make verbal dialect from gestural dialect, allowing a smooth communication bi-directionally. The goal is to make a vision-based platform for distinguishing incessant sign language. Through this, a new communication substitute has been found built on SMS languages, using cell phones, chats and social platforms on the internet availability. The SMS language usage has been extended with instant message sending to the cell phone. Normally, with written languages, the hearing-impaired people face serious issues, since languages of SMS are simple than the on-paper languages, the hearing-impaired community has found these messages much more convenient to learn, as a result of finding a possibility for communication between normal and hard of hearing people, predominantly for young

individuals. Also, there was earlier no method available for storing the generated sign language data, so a sending SMS is made for better correspondence or reaching individuals in the event of crisis.

1.1 Sign Language

An important method of communication for deaf-dumb persons is "sign language", which includes interpreters, friends, deaf people and their relatives. Within deaf community, Sign Language appears naturally. It plays a significant role in eliminating barriers faced by differently abled people while conveying messages to others and contributing to the society. Instead of using sound patterns and verbal communication, signs in visual space are used by hard of hearing people for communication. A complete natural language, Sign language is that which uses various hand movements, facial expressions, hand shapes and various body positions for communication. Sign Language is the language consisting of its own syntax, grammar, syllable structure and phonology. The translated version of English is not Sign Language. Sign language comprises of various rules that guide and help the users to communicate properly.

For communication purpose, SL is used by hard of hearing community. According to World Federation of the Deaf there are about 70 million hard of hearing people who uses sign language for communication purpose [9]. In order to conveying messages between hard of hearing people and normal persons, Sign language is essential. It has been also used in providing education to deaf, for boosting up self-possession and increasing their communication skills, for gaining information of non-verbal communication, helps in keeping peaceful atmosphere at religious places and workplaces and delivers another direction to manifest yourself with inspiration.

1.2 Indian Sign Language (ISL)

On the planet, one out of five hearing impaired individuals live in India, yet the Indian hearing-impaired group is exclusively disappointed inferable from separation in the general public everywhere and the orals convention worldwide in hearing impaired schools. It has been contended that same Indian Sign Language is used in Bangladesh, Nepal, Sri Lanka, and in some areas of Pakistan [7].

It permits a hard of hearing individual to pass on considerations and thoughts utilizing hands, arms, additionally as confront. The syntax and grammar of ISL is totally different from that of spoken and written languages used in India. Regardless of normal confusions, late

research on ISL origin has built up that gesture based communications are finish regular dialects having their own linguistic structures, phonology, and complex arrangement of morphological properties. The morphology is mind confusing as in, it displays both successive and in addition synchronous attachment of its manual and also non-manual parts [8]. A sign is built by certain formational constraints like, dominant hand's shape, hand location as for the body, extended palm orientation, finger orientation, movements, and non-manual activities.

1.3 Sign Language Symbols

The linguistic studies of Indian Sign Language have started from 1978 onwards [10]. Sign language symbols can be classified as one-handed signs and two-handed signs as shown in Figure 1.1.

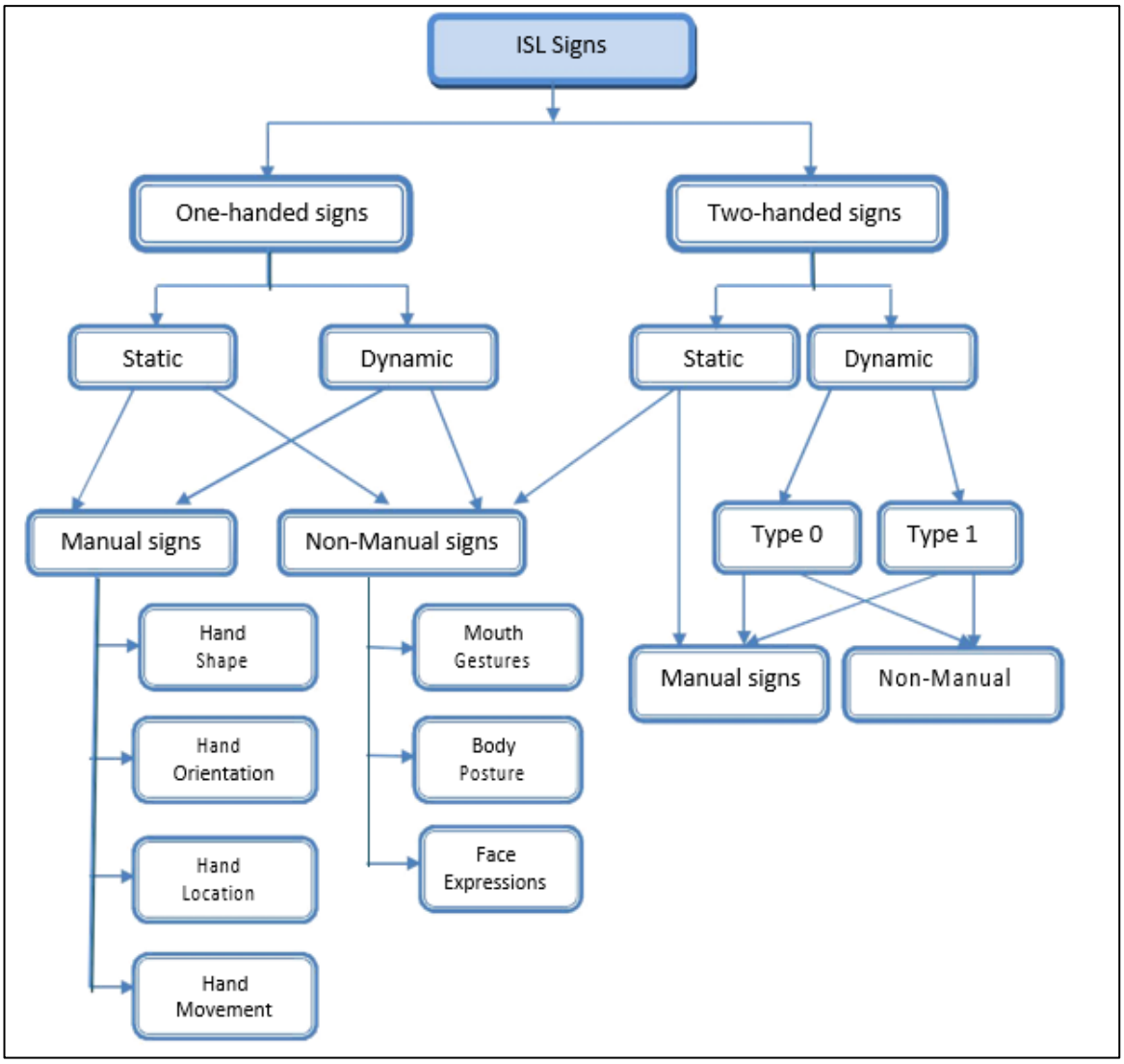


Figure 1.1: Hierarchy for Indian signs [11]

It contains lingual information which allows the use of face, arms, hands, head and body posture. Every signer who is using sign language for communication makes use of 3D visual space. Therefore, the channel used for communication is visual channel instead of sound as is used by a normal person for communication.

One-handed signs: For representing one handed signs single dominant hand is used. It can be represented by any static gesture or a gesture with motion. One handed signs are further divided into manual and non-manual elements.

Two-handed signs: To represent signs including two handed both the dominant and non-dominant signs are used while signing. These are further classified as:

- Type 0: In type 0 sign both the hands are active, as shown in Figure1.2.
- Type 1: In Type 1 sign dominant hand is more active as compared to non-dominant hand, as shown in Figure 1.3.

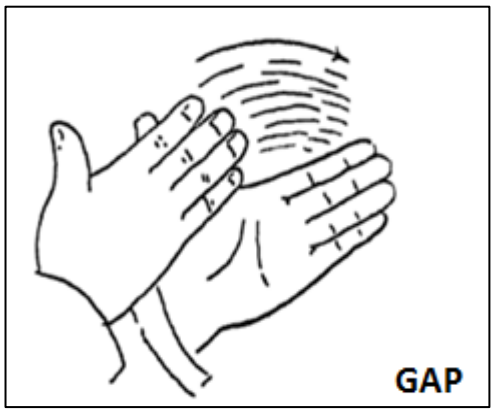


Figure 1.2: Two handed Type 0 sign (both the hands are active) [4]

Indian Sign Language(ISL) consists of manual and non-manual elements [5]. In manual signs only hands are used to express any sign and in non-manual signs body postures, mouth gestures and face expressions are used.

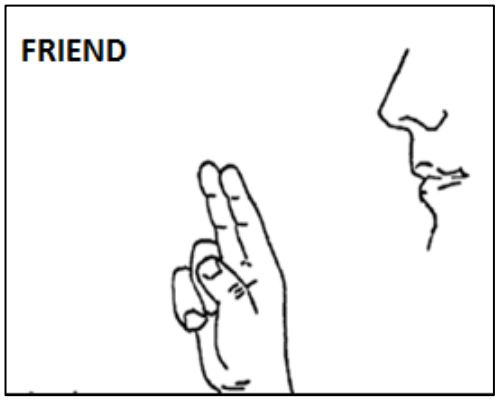


Figure 1.3: Two handed Type 1 sign (only dominant hand is active) [4]

ISL use either manual components or non-manual components or both the components for signing purpose. Single handed static manual and non-manual signs are shown in Figure 1.4(a) and 1.4(b) respectively.

(a) (b)

Figure1.4: (a) Single handed static manual sign, (b) non-manual sign [6]

1.4 Comparison of Various Sign Languages

Sign language differs from country to country and from one region to another region due to which they are not universal. List of Sign languages with number of signers is shown in Table 1.1.

Table 1.1: List of Sign Languages by number of signers

Language	Country	Estimated users
Brazilian Sign Language	Brazil	3,000,000
Indo-Pakistani Sign Language	India, Pakistan, Bangladesh	β, 700,000 in India
American Sign Language	USA	500,000
Hungarian Sign Language	Hungary	γ50,000
Kenyan Sign Language	Kenya	340,000
Japanese Sign Language	Japan	320,000
Norwegian-Malagasy Sign Language	Norway, Madagascar	185,000
British Sign Language	UK	125,000
Russian Sign Language	Russia	121,000
Philippine Sign Language	Philippines	100,000

Examples of some of the sign languages are the British Sign language which is used in England, Indian Sign Language used in India, Japanese Sign Language, American Sign Language, Hungarian Sign Language, Kenyan Sign Language and so on. BSL family contains British Sign Language, NZ Sign Language and Australian Sign Language. On the other hand, LSF (langue des signes française) family contains Irish Sign Language and American Sign Language.

Large amount of work is in progress on different sign languages in order to remove communication barrier between a normal person and hearing-impaired person. The semantic meaning of every component present in sign language is different, but there exist signs that represent a universal structure. For example, a gesture represented by using a single hand which expresses **"goodbye"** or **"hi"** has identical meaning in all the sign languages over the world.

The basic finger spelling system of ISL, ASL and BSL are different. For example, to represent **"WHERE"** in sign language BSL uses two hands, ASL uses only one hand and ISL make use of the hand movement in right and left directions as shown in Figure 1.6.

(a) (b) (c)

Figure 1.6: (a) Sign **"WHERE"** in BSL **(b)** Sign **"WHERE"** in ASL **(c)** Sign **"WHERE"** in ISL

"WOMAN" in BSL is represented by a sign as shown in Figure 1.7(a). In ASL, it is represented by touching the tip of the thumb with chin and then take it down to chest as shown in Figure 1.7 (b) and Figure 1.7 (c) shows the sign of **"WOMAN"** in ISL and hence representation of same sign in different languages.

(a) (b) (c)

Figure 1.7: Sign representing **"WOMAN"** (a) BSL (b) ASL (c) ISL

1.5 Grammar of ISL

Grammar in any dialect is an arrangement of standards about how that dialect might be utilised. These rules are not inflexible, but rather adaptable and may change with time or new ones might be presented. Indian Sign language has its own grammar structure.

ISL consists of three open lexical classes, distinguished on the beginning of their behaviour in space, i.e., not changeable in space, altering place of articulation, and includes directional manoeuvre between dual points in space. The preliminary two classes are multi-functional items and do not resemble in any way with semantic qualities or syntactic functions. The third class which includes directional signs, consists of the most verbal part belongings. The closed word classes include classificatory stems, functional particles, discourse particles, indexical signs and non-manual signs. ISL doesn't includes articles, modals or conjunctions or ad-positions [7].

In the marking of grammatical relations, constituent order does not play any role. These are coded completely by three-dimensional mechanisms (e.g., directional signs) or concluded from the context.

Many people trust that SL is the manual representation of verbal English or Hindi language. However, it is not true. ISL depends upon spoken Hindi or English language as well as on other sign languages. The exceptional and discrete features of ISL from which we can say that it is different from other sign languages are:

i) Number Signs: In ISL, the numbers from 0 to 9 are formed by holding up a hand with the proper

handshape for respectively number. The corresponding number of extended fingers forms the numeral sign, i.e., from 1 to 5, whereas for 0 and 6 to 9, the numbers uses special handshapes driven from written numbers. A number 10 can either be articulated by two 5-hands or by '1+0'.

ii) Family Relationship: For family relationship, the signs come first by the sign for 'male/man' and 'female/woman'.

E.g.: BROTHER: MAN + SIBLING

SISTER: WOMAN + SIBLING

iii) The WHAT, WHERE, WHICH, HOW etc. like question words are placed at the beginning of interrogative sentences.

English: Where is the Bank?

ISL: WHERE BANK

iv) The ISL includes various non-manual gestures like mouth gesture, eye gaze, body posture, head position, facial expression and mouth pattern [7].

v) There is no time-based variation in ISL. The past, present and future is represented by using symbols for before, then, and after. The timeline in ISL is shown in Figure 1.5.

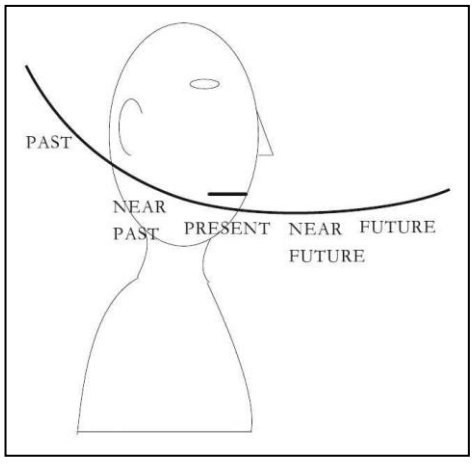


Figure 1.5: Timeline in ISL

In ISL negation, Negated conditions might be motioned by shaking the head during the whole statement. "NO" can be signalled by a side-to-side headshake. There are also various manual negative signs. A headshake is equivalent to neutral negation but cannot signal contrastive negation [7].

1.6 Challenges in Automation of Sign Language

At present, there is a little approach to signed content on the Internet for ISL and most of the content is in textual form. The sign language content in the form of text is complex and is not of much use to the deaf people.

The sign language depends on multiple components like hand shape, hand movement, hand orientation, cyclic or straight movement of hand or arm, body postures, mouth gestures and face expressions [12]. The sign language can change various components of manual signs such as shape of hand, hand movement, repetition of signs, path and the multidimensional space around signer while signing to convey the meanings of words more accurately. Due to which it is difficult to generate signs with as much accuracy and clarity as the natural sign language has. So, there is a need to build a system for automatic generation of sign language. An alternate solution of presenting the signed content as videos was adopted and this solution is somehow satisfactory in terms of usage by deaf people. The video approach is not only time and space consuming but expensive also. Each time when there is a slight change in the sign language content, a new video has to be created from beginning which results in increasing costs [13]. The best choice for automatic generation of sign language content is by generation of signs. The signs are generated from the user selected words in order to present it. Instead of video, GIF file of entered input is generated in order to remove the communication barriers.

1.7 Need of the Sign Language based SMS generator System

To eradicate the social relations barriers between hard of hearing people and society bestowed with hearing, it's important not only to specify sequence of signs by deaf, to create verbal language from gestural language, allowing a smooth communication bi-directionally is also important.

In this interface, the objective is to create a vision-based platform for identifying incessant sign language. Rest plans have been engrossed in identifying signs from information gathered. Through this, a new communication substitute has been found built on SMS languages: using cell phones, chats and social platforms on the internet availability. The SMS language usage has been extended with instant message sending to the cell phone. On the basis of the Theory of Communication, SMS language is an added manipulation of the selected message in one's own language. The quick growth of this language is because of the necessity to diminish cost of communication by preserving the structure of language. Normally, with written languages,

the hearing-impaired people face serious issues, since languages of SMS are simple than the on-paper languages, the hearing-impaired community has found these messages much more convenient to learn, as a result of finding a possibility for communication between normal and hard of hearing people, predominantly for young individuals [14].

Language of SMS is not common since every language is based on its own guidelines and regulations in the form of possible phonetics as well as symbols. But, generally, language of SMS is categorised on the basis of words related to the phonetical meaning of the language, deleting words and accents that are understood by situations, including emoticons, eradicating marks of punctuation, etc. For example, they can be utilized as a part of unexpected or serious situations to send messages to both normal or unresponsive people, can also send SMSs to visually challenged people or, in this scenario, to help the hard of hearing people to be in communication with normal people.

This work shows the evolvement of an SMS generator, a new platform for assisting hard of hearing part of society to communicate with us and create verbal English. This interface consists of two primary functions: one includes a verbal English generator from ISL and the takes the proceed of the Message communication (popularly taken in use by the hearing impaired for SMS communications) to boost the efficiency of face to face interaction with normal people or in case of emergency.

The proceeding work explains briefly the procedure of developing an open source code and ISL to written text Converter for English. While creating this system, it is mandatory to note that the hearing-impaired people belong to a linguistic community with the absence of any type of mental or reasoning abilities due to the lack of communication. Otherwise, the hearing-impaired community will feel retarded and boycotted by the society thus rejecting the system so developed. In this scenario, the graphical interface not only must contain images in order to make it convenient but also has to add a language factor, thus providing the flexibility as made in the mother language (ISL) of such people. They must feel that they are making use of well-versed languages (like ISL or SMS languages), and also not a new easy language which has been specifically created for such people.

1.8 Thesis Outline

This thesis is divided into 6 chapters. Chapter 1 includes introduction including development of ISL among deaf communities in India, about sign language, Indian sign language and Sign Language Symbols. The challenges in automation of sign language and comparisons of

various sign languages are described. Chapter 2 describes the existing systems and tools available for sign language generation and automation. Chapter 3 describes problem statement, objectives and methodology used for development of SMS generator. Chapter 4 includes detailed description of the proposed system and its implementation. The results for the ISL words tested on the system are discussed in Chapter 5. Chapter 6 covers the future scope and concludes the work done in this thesis.

Chapter Summary

In this chapter, sign language is described along with the growth and development of Indian Sign Language (ISL). In India, there is very little growth of ISL as only 5% of deaf people attend deaf schools. There is a need to build a system that can be used for communication among deaf communities. Due to which there are a lot of challenges and problems in creating sign language content by using video approach. It does not have any theoretical form and also producing signs using video approach is very expensive, hence sign animation is best explanation using GIF file. Deaf can be utilized SMS generator as a part of unexpected or serious situations to send messages to both normal or unresponsive people, can also send SMSs to visually challenged people or, in this scenario, to help the hard of hearing people to be in communication with normal people.

Chapter 2

Literature Review

2.1 Existing Systems for automation of Sign Language

There have been a number of considerable research activities in developing systems for generation and automation of sign language. These automated systems take either text or speech as input and generate sign language as output. Some of the available systems for sign language generation and automation are discussed below.

2.1.1 Sign Language Recognition by using HMM

Ouhyoung and Liang (1996) developed a system for identification of signs by using Hidden Markov Model (HMM). A statistic based context sensitive model is used for the recognition of both gestures and postures for a given sign. A sign gesture is divided into a string of postures. HMM is used to calculate the probability of each posture string. The probability outputted from Hidden Markov Model for each posture is used for identifying the input text in a linguistic way in real-time. The architecture of the sign language recognition system is exposed in Figure 2.1.

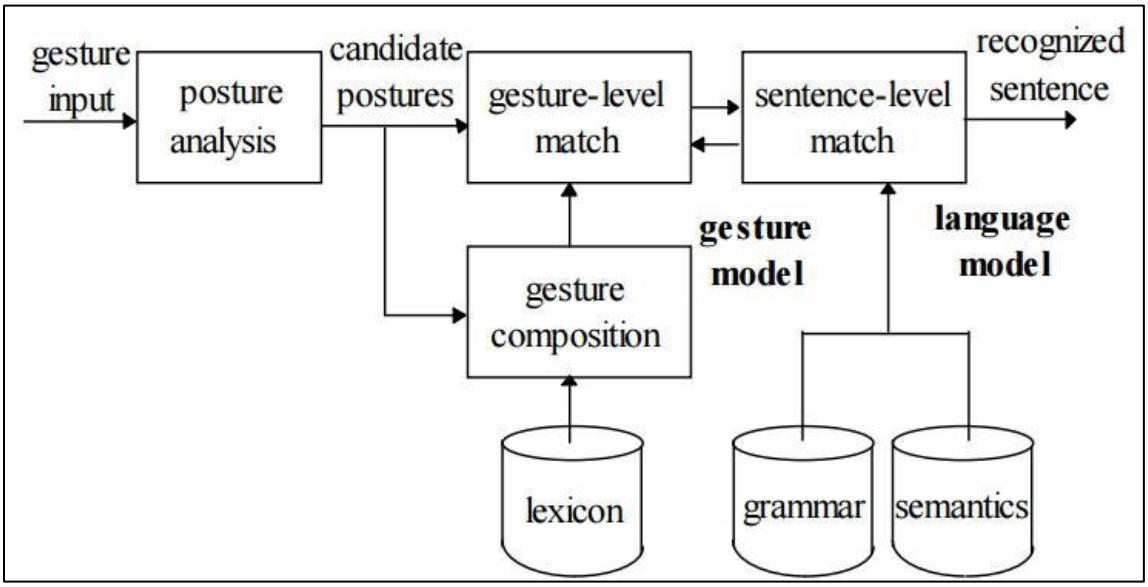


Figure 2.1: Sign Language Architecture using Recognition System [17]

The Posture analysis module receives input in the form of sign gestures. In this module, vector quantization is needed to estimate the probability of each frame of input data. In the hidden Markov Model, each gesture frame is defined as random process for a given sign. The received gesture frames are then fragmented into various postures.

In gesture composition module, the various gestures are constructed as per the stored lexicons. The generated probabilities of the posture frames are tested in the gesture level match. The storage grammar is used for generating sentence level probabilities of the gestures. This probability is aggregated with the probability generated from gesture level match. Then the sentence level match produces a sentence having the highest probability for a given sign. The output is generated according to the semantics to recognize the real-time gestures for the given sign. The recognized sentence is given as an output by the system for the inputted sign gestures [17].

2.1.2 Zardoz System

Veale *et al.* (1998) had introduced an application known as Zardoz, used for generating signs from given text. It uses a central blackboard structure for regulating the various modules. It is based on the frame-based Knowledge Representation language. The blackboard structure of the system is divided into eight panels as shown in Figure 2.2.

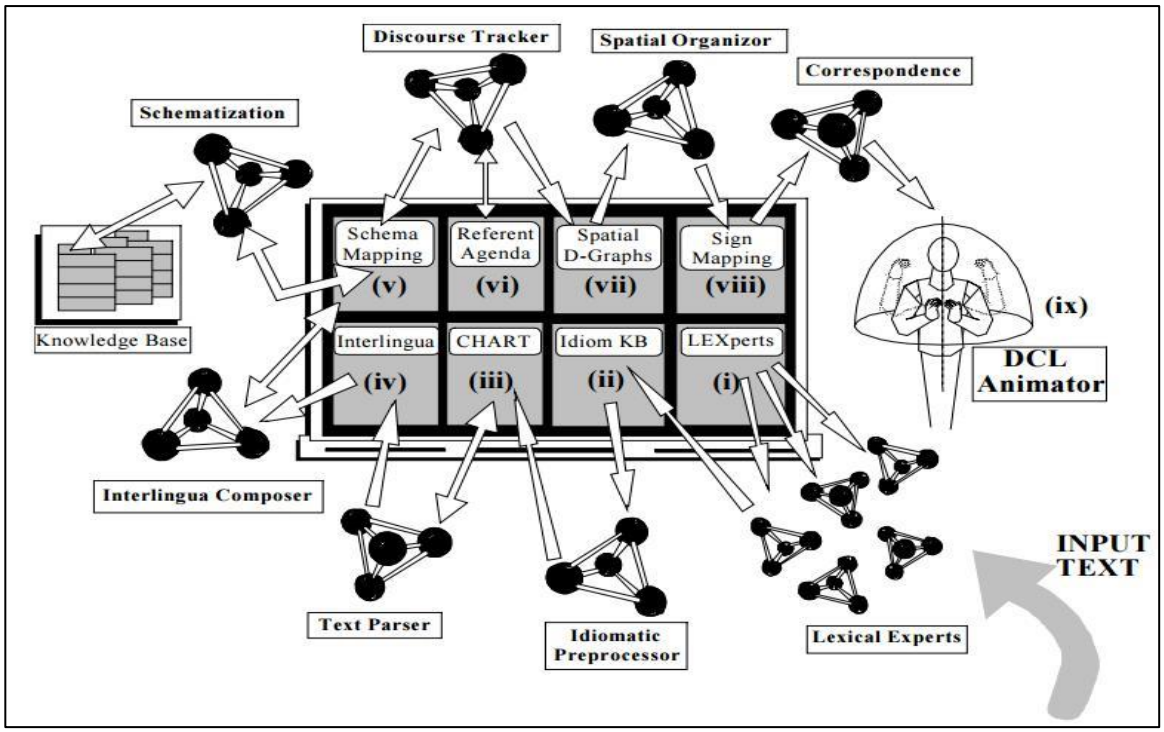


Figure 2.2: Architecture of Zardoz system [21]

The steps for the working of the Zardoz system by using the eight panels for input text stream to its animation are described below:

Step 1: The incoming text stream is processed by lexical experts (Lexperts) to implement morphological rules for converting the input text to know phrases.

Step 2: The identical expressions are used in place of idioms in idiomatic preprocessing.

Step 3: Text parsing is done to generate syntactic / semantic representation of text.

Step 4: The Interlingua composer generates an Interlingua frame format.

Step 5: Schematization process is used to remove metaphoric and metonymic constructs from text.

Step 6: The Interlingua representation is given to the discourse tracking agency.

Step 7: The sign syntax agency produces Spatial Dependency (SD) graphs.

Step 8: The direct lookup or heuristic measures are used for generating signs corresponding to the tokens of the Interlingua structure.

The Interlingua structure is converted to a stream of sign tokens. These tokens form an input for a Doll Control Language (DCL) program. The sign animation of the input text is done by DCL program for the gesture sequence of the generated tokens [25].

2.1.3 ViSiCAST System

Safar *et al.* (2001) had developed a system in order to converting English text into British Sign Language (BSL). It consists of a virtual signing technology for easy communication among deaf people. The system is divided into two major parts, first one is conversion of text to a semantic-based string and other one is translation from this string to a graphic output that can be used by signing player. The architecture of the system is given in Figure 2.3.

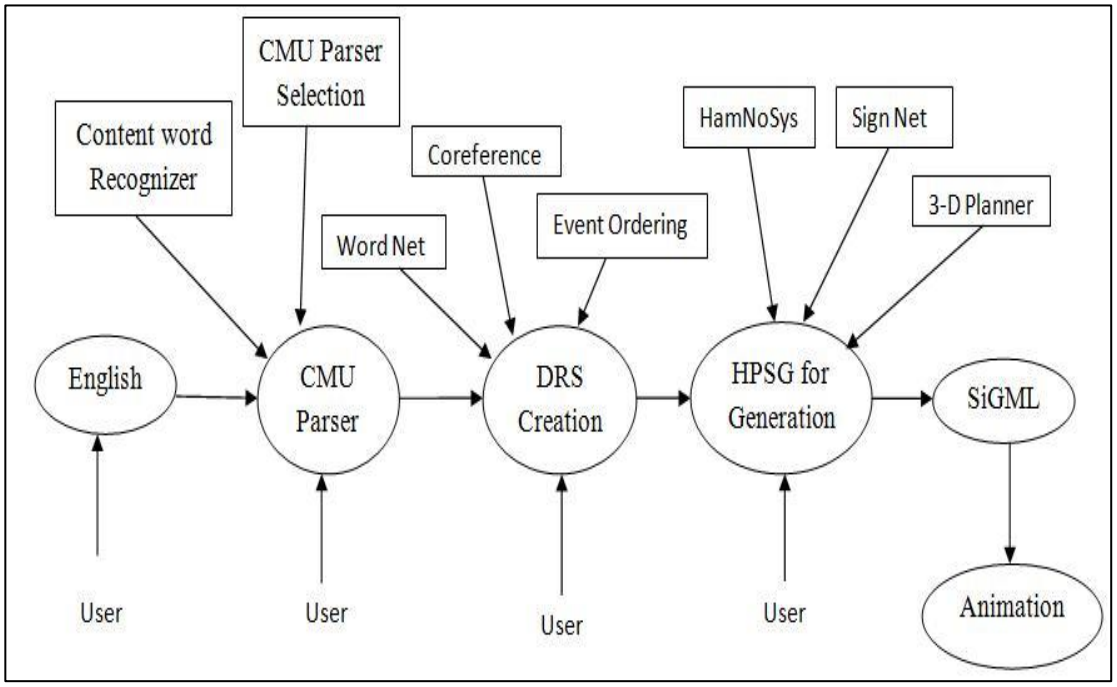


Figure 2.3: Architecture of ViSiCAST translation system from text to BSL [19]

2.1.4 The ASL Workbench

Speers (2001) had proposed and implemented a system ASL workbench. It is a Writing to ASL Machine Translation system. It analyses the input written text up to an LFG-style f-structure. It is represented using summaries, input written using some of syntactic specifics and then replace them with verbal features of the text. ASL architecture of workbench is described in figure 2.4. Workbench system comprised of a set of specially inscribed rules used for interpreting an f-structure rendition of English into ASL. It implements transfer module and generation module. Input for translation module is an English LFG f-structure. It is converted into an ASL f-structure using structural correspondence and performing lexical selection. The ASL f-structure becomes input to the generation module. Generation module creates American Sign Language c-structure and p-structure corresponding to the sentence. ASL workbench performs fingerspell of the word if the lexical element is noun.

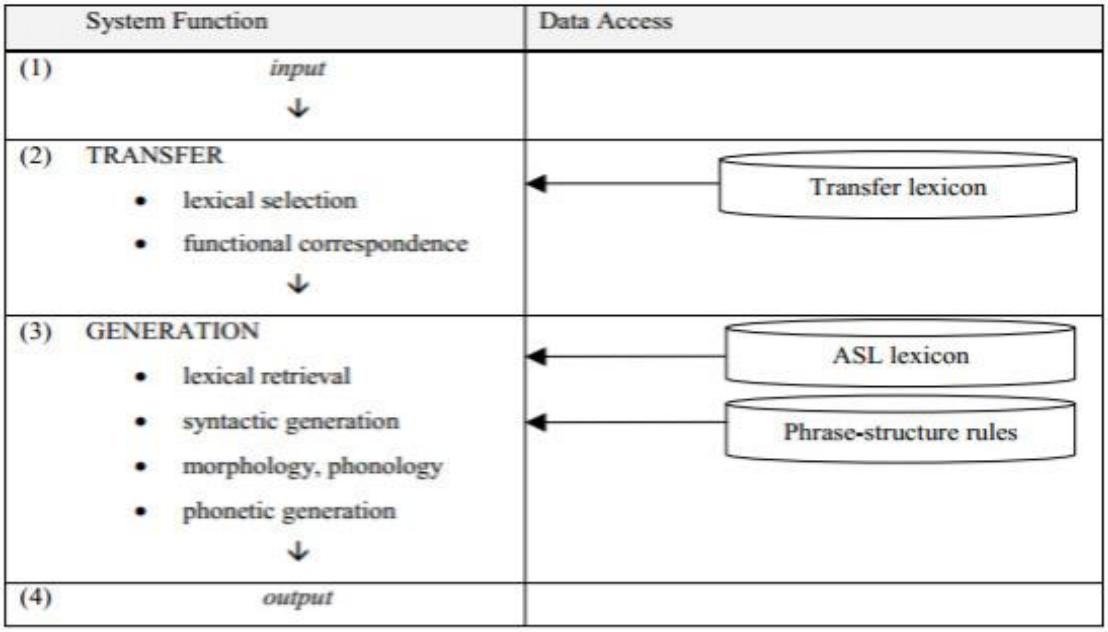


Figure 2.4: Architecture of ASL workbench [15]

If element is other than noun then translation fails, although translator can create entry corresponding to the word in ASL lexicon. It can also create entry in transfer lexicon if necessary and re attempt the translation [15].

2.1.5 TESSA

Cox *et al.* (2002) had developed a communication system for hard of hearing people. It is an interactive translation system which is used by the post office officials to carry out the transactions of deaf people. It works by taking the voice of the post office person as an input.

That voice is converted into British Sign Language. The resultant signs from that voice are represented by using virtual player avatars. The system converts the input voice to English text. It then matches each character of the text with the dictionary for English to Sign Language. Then it combines all the signs for animation by the avatar. Figure 2.5 shows the general structure of TESSA system.

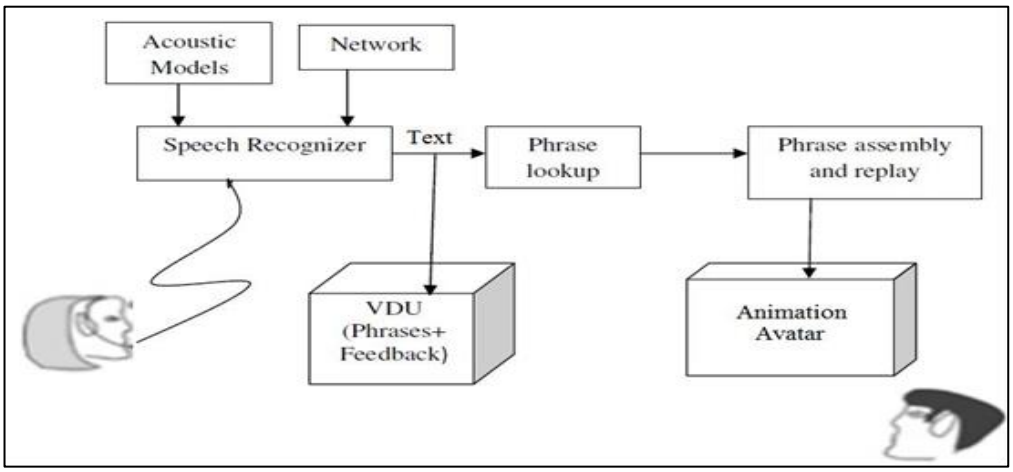


Figure 2.5: Architecture of TESSA system [26]

A headset microphone is used by post office officials. Whenever a sentence is spoken by an officer, the speech recognizer checks it from stored phrases in the grammar. As a result, a list of various facilities such as bill payments, postage and passports is displayed to the officer. The acoustic models are used for checking the input speech characteristics. The search of the speech recognizer is monitored by using various network models. The system has 370 predefined phrases in the phrase lookup table, which are adequate enough for carrying out all the transactions required in a post office [26].

2.1.6 English Text-To-Indian Sign Language Translator

Dasgupta *et al.* (2008) had introduced a structure for Text to ISL conversion. The input text is given in English to the translator. It converts the text to ISL format, after carrying out syntactic analysis. The Lexical Functional Grammar (LFG) protocol is applied for generating syntax of ISL. The pre-recorded video streams are used to produce output.

The architecture of the translator for text to ISL conversion is shown in Figure 2.6. It has four modules, i.e., Text Parser, LFG component, Sentence Generation and Sign Language Synthesis. A simple English sentence, containing only one main verb, is given as an input to the parser. The parsing is done by the Minipar parser. The classification of plural nouns is also included in parsing of the sentence. The plurality of nouns is identified by using an

English morphological analyser. The LFG component finds grammatical associations in the input phrase. It also represents the internal structure of the input text.

In the generation stage, grammar fundamentals are applied to translate English f-structure to ISL f-structure. During the generation phase, two main operations are performed which are lexical association and word order arrangement. For example, the input text ―Lunch‖ in English may be represented by sign of ―Afternoon Food‖ in ISL [16].

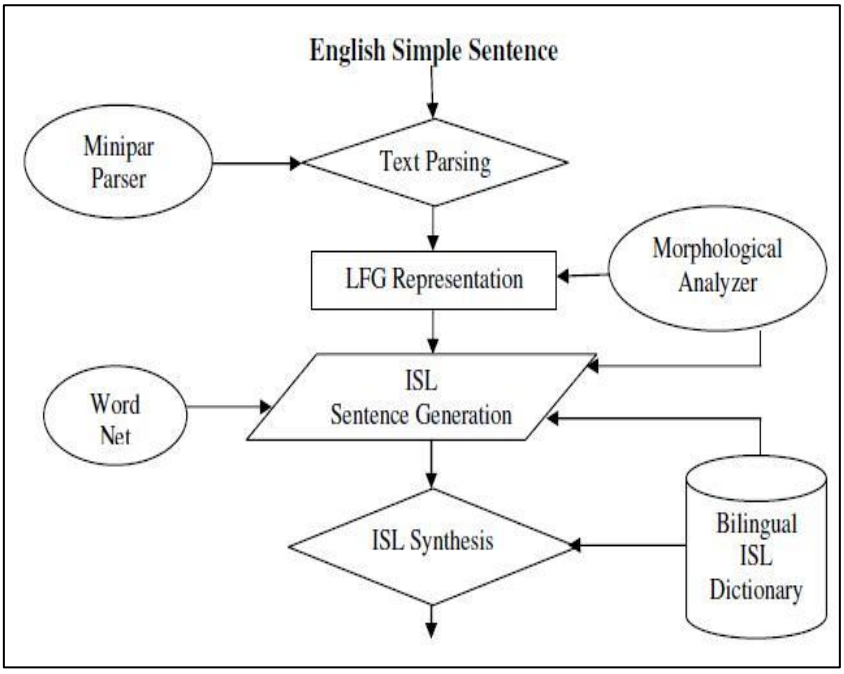


Figure 2.6: Architecture of Text-To-ISL Translator [16]

2.1.7 Dicta-Sign Project

Efthimiou *et al.* (2009) had described Dicta-Sign project for providing technologies for the development of sign language based web applications. The project provides a platform for recognition, modeling and animation of signs. The project is developed for Greek, British, German and French sign language. It is implemented for the improvement of web-based applications which are developed for easy communication among hearing impaired people. The users input the signs by using webcams, which are identified by sign language recognition component. These signs are translated into a linguistic internal representation which is animated by signing avatar. The signs are animated in the language selected by user from all the four given languages. The system also translates the generated sign into the other three sign languages along with the language selected by the user. Dicta-Sign varies from other

projects in the way it integrates together various modules for sign recognition, animation and machine translation [20].

The Dicta-Sign project is aimed for the development of corpora for four different sign languages. It is used for implementation of sign language recognition and animation systems. It can also be used for the development of a sign language-to-sign language translator. The visual tracking and feature extraction is done by using various statistical functions and geometrical characterizations body parts of the signer's [21]. These calculations are used for object-oriented morphological filtering, which is used for extracting the position of face and hands of the signer. Hidden Markov model (HMM) adaptation methods are used to ensure that the recognition system works in a signer-independent way. The system services a interface like dictation-style in which user is provided with the nearest-matching solutions if a symbol is not identified exactly. Sign language synthesis and animation is done by using virtual avatar by the conformation of symbol phonology components. The recognized sign language sequences are written in SiGML form, which is used for execution by an avatar on the computer screen in Greek, British, German and French sign language [22]. The Dicta Sign system is also available online and can be found at the given URL http://vh.cmp.uea.ac.uk/index.php/Dicta-Sign .

2.1.8 Spanish to Spanish Sign Language translation

Segundo *et al.* (2010) had developed a system for translation from Spanish speech to Spanish Sign Language (SSL). It is developed to focus on words uttered by an authorized when serving people who are applying for Identity Document (ID) and Driver's License (DL). It is used for translating the officer's instructions into sign language for hearing-impaired people. It has two modules; one is for Spanish speech to SSL translation and other is for Spanish generation from LSE [23].

The LSE translation system has a translator, a speech recognizer and a 3-D virtual avatar module. For identifying the spoken language utterances, a speak recognizer is used. A sequence of words is generated from the recognized speech. The translator is used for converting the generated sequence of words into a set of gestures that belong to the sign language. For playing sign language gestures, animation avatar is used [24].

In this way, the words spoken by an officer are converted to signs. The Spanish generator from SSL has a visual interface and language translator. The visual interface is used for providing a pattern of signs in sign-writing. For producing a sequence of words in Spanish,

a language translator is used. The corpus developed for this system has a collection of more than 4,000 sentences, which are commonly pronounced by the officers and users. The sign database of the system uses eSIGN Editor and stores the signs in the form of HamNoSys. There are three techniques that are used by the system for translation from spoken words to sign language. Figure 2.7 shows Architecture of Spanish Sign Language Translation System. These techniques are example-based technique, rule-based translation and statistical conversion. An example-based technique is used while translating the given words. If the distance of the given sentence and the nearest example in the database is lower than a threshold value, then the translation output is same as the nearest example.

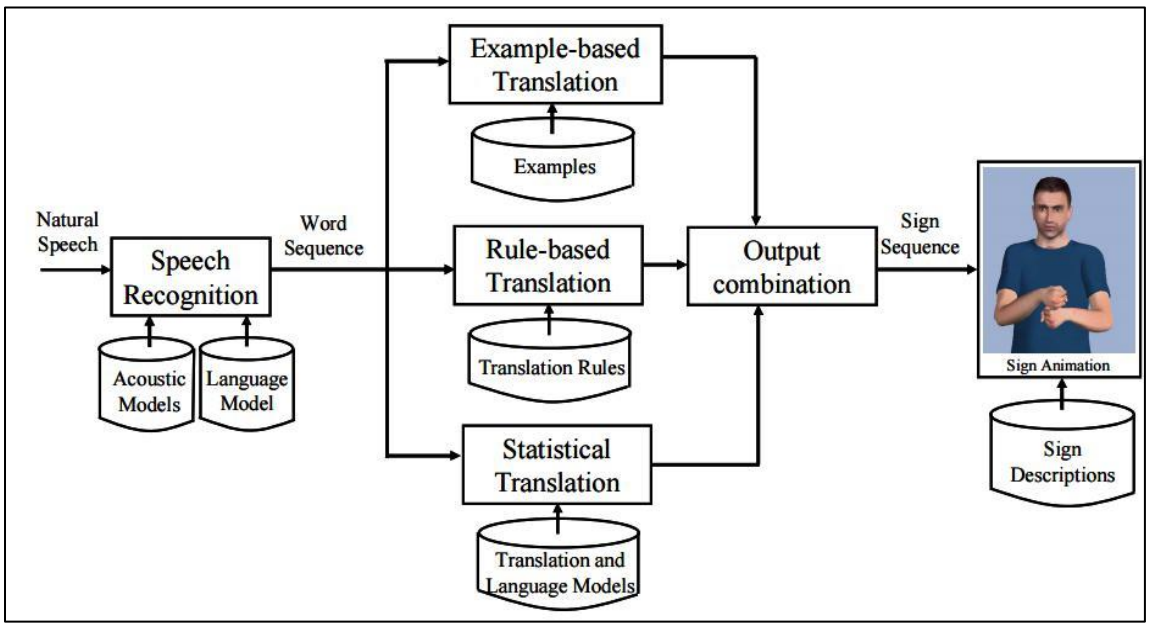


Figure 2.7: Architecture of Spanish Sign Language Translation System [23]

The rule-based and statistical techniques are used for translating the word sequence, if the distance is higher. The output sign is animated by using the eSIGN 3-D animation avatar [23].

2.1.9 LSESpeak: A spoken language generator for Deaf people

Verónica *et al.* (2013) had expanded a system LSESpeak based on Language Translator, For Deaf people a spoken Spanish generator is designed. This system consists of two main tools: a SL into speech translation system and an SMS (Short Message Service) into speech translation system. The first tool consists of three units: a progressive visual interface (to specify a sequence of signs by a deaf person), a language translator (where the sequence of words in Spanish is generated), and finally, an emotional text to speech (TTS) converter in

order to generate spoken Spanish language. The visual interface permits a sequence of signs to be defined using various utilities. The module diagram is described in Figure:2.8.

On basis of Hidden Semi-Markov Models (HSMMs), the emotional TTS converter is generated allowing voice gender, an emotion type, and strength of emotions to be controlled. The second tool includes a language translator, an SMS message editor and the same expressive text to speech converter. The translation tools make a use of phrase-based conversion technique where target language models are provided training from the corpora in parallel. The phrase model has been provided the training beginning from a word alignment calculated using GIZA++ [31]. In these experiments so carried out to assess the conversion performance, the sign language-speech conversion system has reported a 96.45 BLEU and the SMS-speech system a 44.36 BLEU in the specified domain [18].

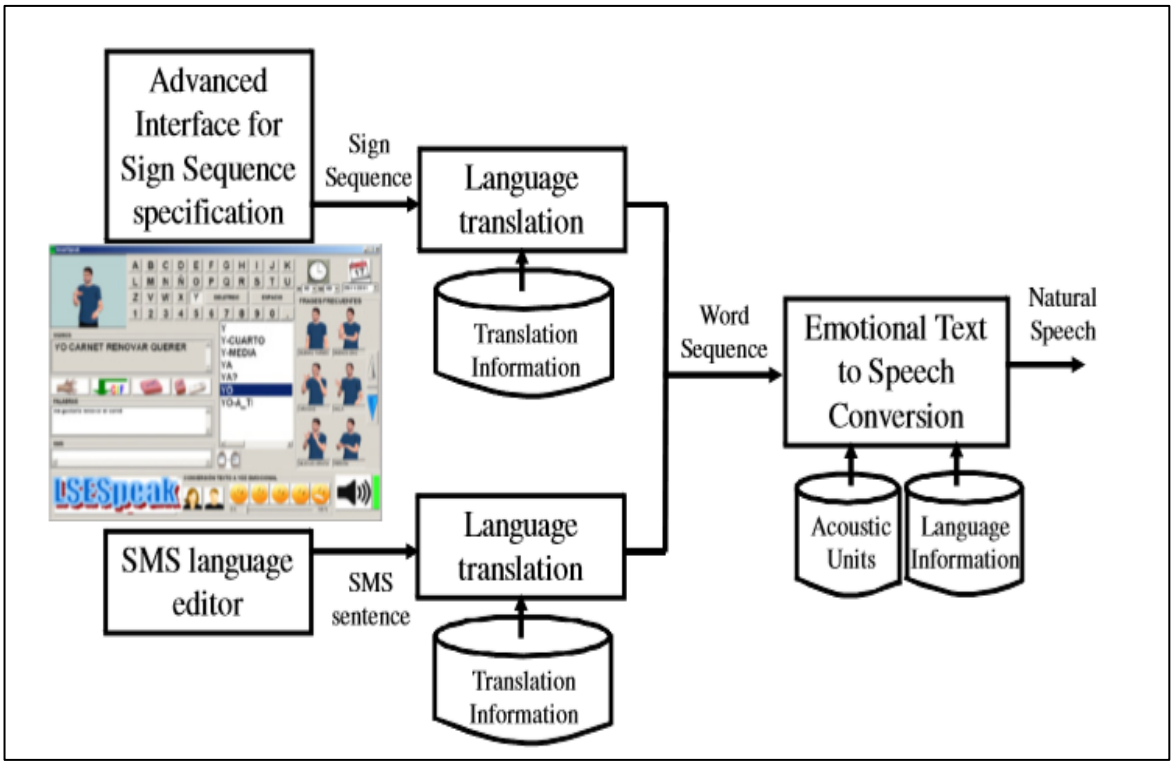


Figure 2.8: Module diagram of LSESpeak [18]

2.2 Comparison of Various Sign Language Automation Systems

The various existing systems for automatic generation and animation of sign language content are compared on the basis of their main features, year of development and the sign language for which they are developed. The comparison of various systems is shown in Table 2.1.

Table 2.1: Comparison of various Sign Language Automation System

Sr.	Name of System	Year	Sign Language	Main Features
1.	Sign Language Recognition by using Hidden Markov Model (HMM)	1996	Taiwanese Sign Language (TSL)	The system recognizes Sign Language gestures and postures by HMM. The probabilities generated from gestures and sentence level match are used to produce output for the real time gestures of the inputted sign.
2.	Zardoz System	1998	American Sign Language(ASL)	The system uses blackboard structure to generate signs from given text. It has eight panels that convert the input string into stream of tokens, which are animated by using Doll Control Language(DCL).
3.	ViSiCAST System	2001	British Sign Language (BSL)	The system parses the input sentence and generates semantic string which is used for animating signs for the inputted text.
4.	The ASL Workbench	2001	American Sign language	The system is Writing to ASL Machine Translation System. It analyses the input written text up to LFG-style f-structure.
4.	TESSA	2002	British Sign Language (BSL)	The system is used by post office officials for interacting with deaf people.

				The system takes voice as input and animates the sign.
5.	English Text-to-Indian Sign Language Translator	2008	Indian Sign Language (ISL)	The system takes English sentence as input and uses Minipar parser, Morphological analyser and WordNet to convert the sentence in ISL format. The pre-recorded video streams are used to produce output.
6.	Dicta-Sign Project	2009	Greek, British, German and French Sign Language	The users input the signs by using webcams, which are recognized by using Sign Language recognizer. The signs are animated in sign language selected by user.
7.	Spanish to Spanish sign Language translator	2010	Spanish Sign Language (SSL)	The system takes speech as an input and uses speech recognizer to generate a sequence of words which are converted into set of sign language gestures are then animated by virtual avatar.
8.	LSESpeak: A spoken language generator for deaf people.	2013	Spanish Sign language (SSL)	The system is used by deaf as well as normal people for interacting with each other in order to remove communication barriers.

2.3 Existing Tools for Sign Language generation and automation

Sign Language is different from other spoken and written languages, so there is need of creation of dictionaries for storing signs and relating the spoken language words with the stored signs. Sign language differs in various countries and regions due to which there are a number of different sign language dictionaries. It is difficult to manually create and manage the sign language dictionaries, due to which there is a need of automation tools for sign language. Some of the tools available for creating, storing and automating the sign language content are discussed below.

2.3.1 ESIGN Editor

ESIGN editor is a tool designed for creating signs easily by the users. The signs that are created can be represented for signing by an animated ESIGN agent. The URL for the current release of ESIGN Editor is http://vh.cmp.uea.ac.uk/index.php/SiGML_Tools#eSIGN_Editor. The ESIGN Editor interface is shown in Figure 2.9.

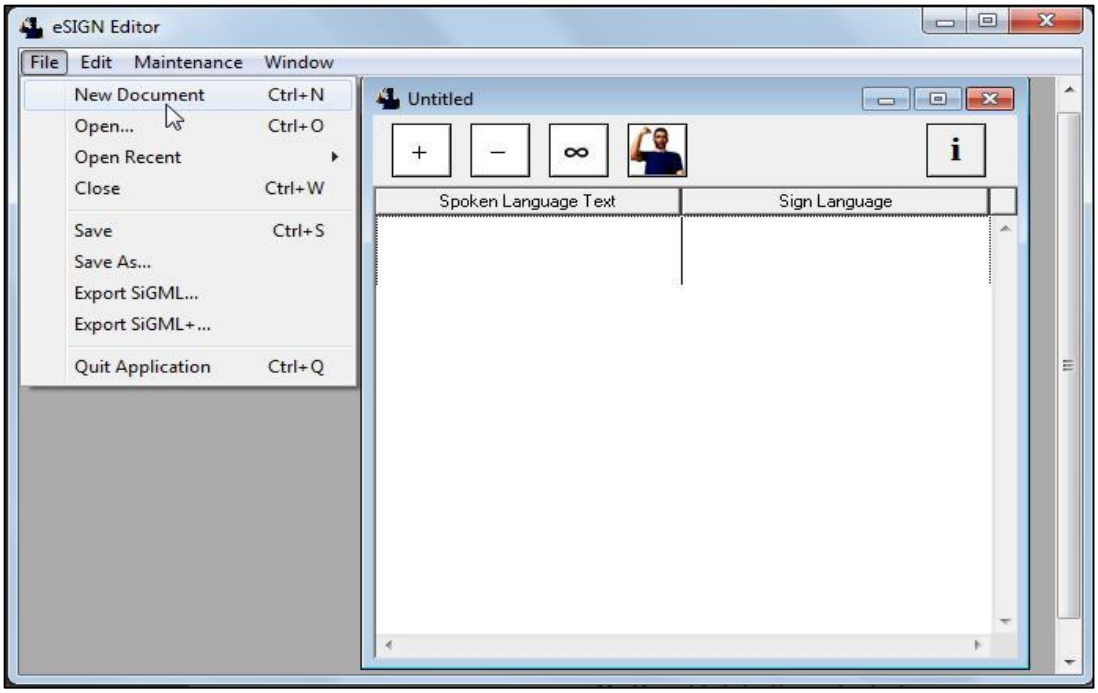


Figure 2.9: ESIGN Editor Interface

The ESIGN editor interface shows the editor window divided in two columns, one to represent an expression in natural language and other for its translation in sign language. The left column is for providing a phrase for the sign while the right is for its description in sign language. The document window is divided into rows where each row contains the description

for a sign or a phrase [27]. The ESIGN editor contains a database of signs in which the signs are stored with the sign gloss and their respective HamNoSys notation.

The words in the editor can be searched by providing the sign gloss and HamNoSys can be retrieved from the editor. The ESIGN editor also provides the non-manual features for a given sign. After selecting the word from the database, the users can choose mouth gestures, hand shapes, limbs postures and face expressions for a given sign [27].

The signs stored with the sign gloss and their respective HamNoSys notation as shown in Figure 2.10.

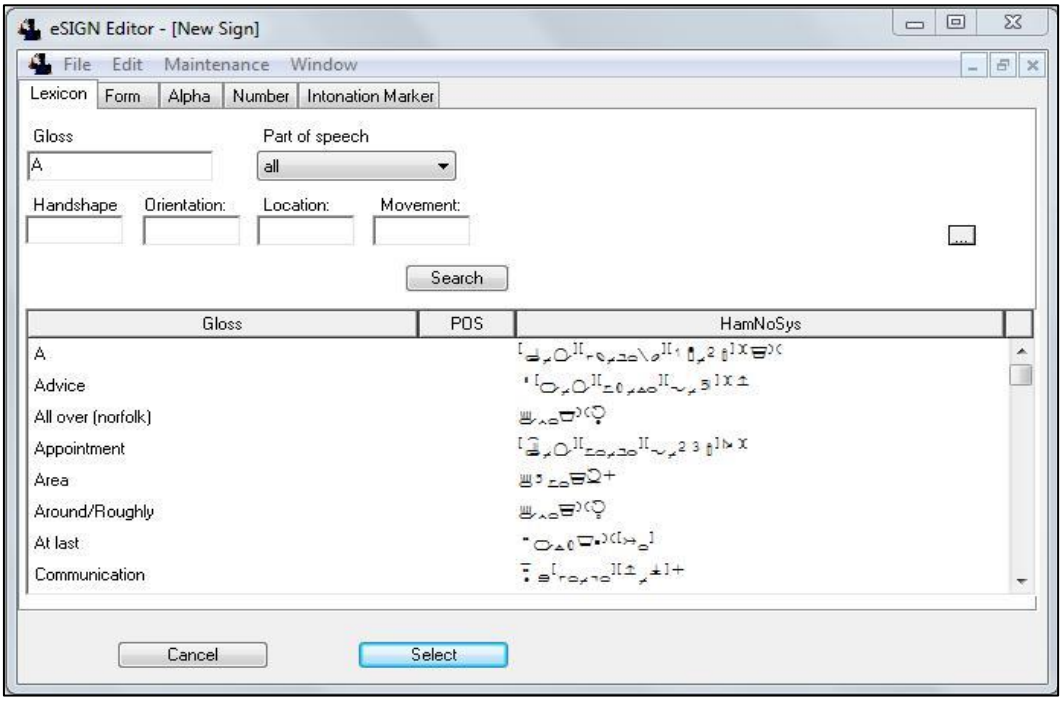


Figure 2.10: List of words in ESIGN Editor

2.3.2 HamNoSys Editor

HamNoSys2HPSG v. 2.1 is an editor for generating HamNoSys of the given signs. The interface of HamNoSys editor is shown in Figure 2.11. In the Interface of HamNoSys editor, arrow pointing upwards is used for typing the HamNoSys characters for a given sign. When the user clicks on the arrow pointing upwards, a HamNoSys input system is shown to the users. It contains various tabs for hand-shape (Hsh), hand-orientation (Ori), hand-location (Loc), straight (Mov1) and curved (Mov2) movement of hand and symbols used for two-handed (2hd) operations. The HamNoSys symbols are shown as button caption and the HamNoSys string appears in the text field when the button is clicked [28]. The URL for the

current release of HamNoSys Editor is http://vh.cmp.uea.ac.uk/index.php/SiGML_Tools#Ham2HPSG_Tool.

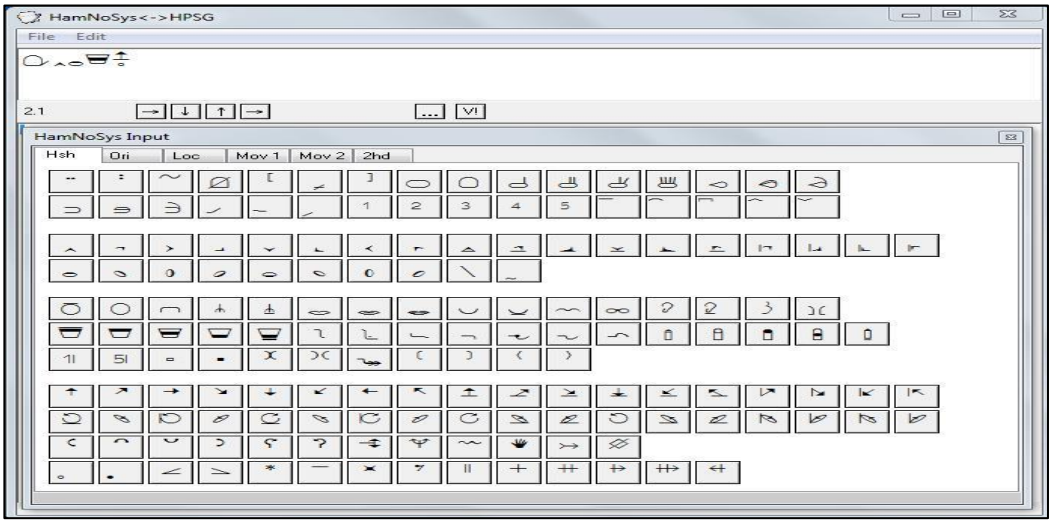


Figure 2.11: HamNoSys Input System

By clicking on the arrow pointing downwards, the user will get the textual representation of the entered HamNoSys notation as shown in Figure 2.12. Alternatively, the user can also manipulate a textual representation and then click the upwards arrow button to get its respective HamNoSys string.

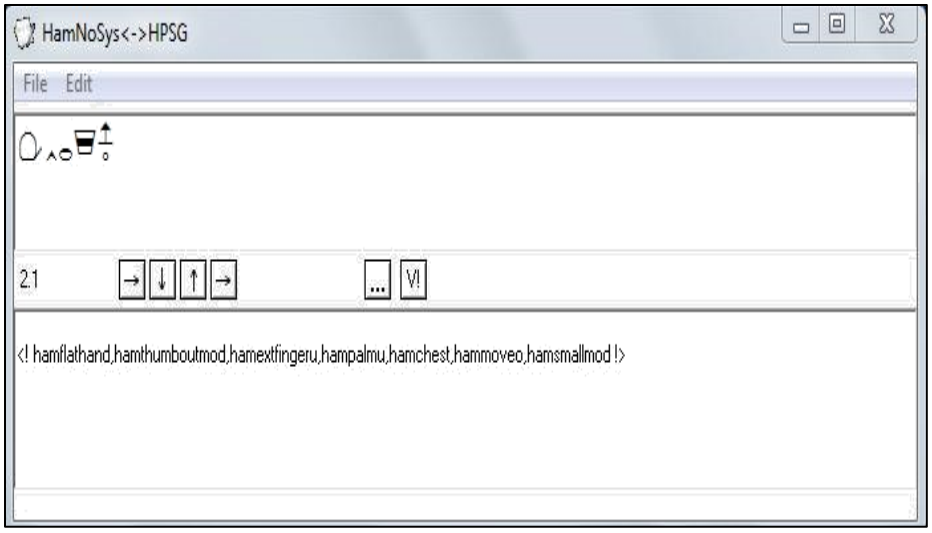


Figure 2.12: HamNoSys Editor showing textual representation of HamNoSys

2.3.3 Search-By-Example Tool

Dasgupta *et al.* (2008) had developed a tool for building sign language dictionary using multiple languages. It is used to produce signs for a given word or a phrase. The system also transcribes the signs in the form of HamNoSys notation. The transcribed HamNoSys string is

used for automating signs by using animation avatars. The system architecture of ISL dictionary tool is shown in Figure 2.13.

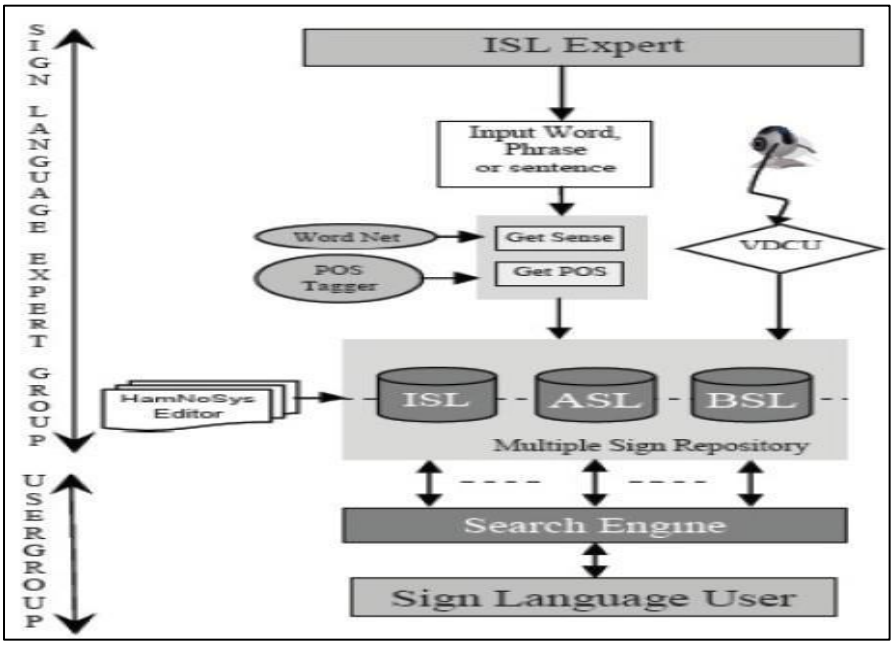


Figure 2.13: System Architecture of ISL dictionary [16]

The interface of the system is divided into Expert and User Module. The expert module is further divided into three units. These units are for processing input text, capturing visual data and for storing signs. In the Input Text Processing Unit, a Sign Language expert selects the spoken language such as English or Hindi. Then after selecting the desired language, the input text is provided by the expert. The language for generating signs is also selected such as ISL or ASL. The input text may be in the form a sentence, phrase or word. The Visual Data Capture Unit (VDCU) is used for capturing the gestural features of the words signed by the users. The VDCU has a number of webcams attached to it. These are placed at various angular positions with respect to the signer.

The input text, linguistic specifications and the video clip of the sign are expressed in the form of HamNoSys and are stored in a database. The HamNoSys is then converted into SiGML type form. The input text is entered in the search engine of the system in English or Hindi. The system parses the entered sentence or phrase. After parsing, the system searches the root words, from the inputted text, in the sign language dictionary. If root words are matched with the words stored in the dictionary, then the signs corresponding to the selected words are displayed [16].

2.3.4 Indian Sign Language Dictionary Tool

Elliott *et al.* (2011) had developed Search-by-Example tool for four national sign languages. These are Greek, German, French and British Sign Languages. The system has a sign gloss, HamNoSys notation and a video clip for each sign. It has a component for recognizing signs, which makes use of Kinect device for synthesizing signs in real-time. It also uses an animation avatar to show the generated signs to the users. In this system, user signs in front of the Kinect device, which acts as an input to it. The user selects the language, out of the four languages, in which he wants the sign to be animated. As an output, the system shows animations of signs recognized as similar to the signs inputted by the user. Along with the selected sign language, the sign animation is also available in other three languages. and extraction of two main features for a given sign, i.e., hand motion and location. The HamNoSys notation is written for the extracted features to express the sign in a more precise way. The basic architecture of the system allows recognition he HamNoSys notation is converted to h-SiGML, which maps the corresponding HamNoSys symbols into XML elements. This textual representation describes the sign gestures in the sequence in which they take place. The h-SiGML form is then converted by JA Signing into corresponding g-SiGML. The g-SiGML form contains additional information about timing and space. It is also providing the syntactic representation of the gestural description, corresponding to the phonetic composition of the given sign. The JA Signing application converts g-SiGML signs into a string of skeleton poses and morph values. These values are used to provide signing information to the animation avatar in the form of subsequent gestural frames. For a given sign selected by user, the system will show four active instances of the animation avatar. Each avatar will show the signs for the corresponding word gloss in all the four languages [29].

2.3.5 Translating Bus Information into Sign Language for Deaf People

This framework characterizes the language translation application innovations used for creating the bus info in Spanish Sign Language (LSE: Lengua de Signos Española). For this task, mainly two systems have been established: one for translation of the messages in form of text from information sheets, and the another one for interpreting the spoken Spanish into natural talks at the info point of the bus company. These two systems consist of a translator of natural language (which is used to convert a word sentence written by user into an arrangement of LSE signs), and a 3D animation module avatar in order to play the signs. For the natural language interpreter, two technical methods have been analysed and unified: an

example-based strategy, and a statistical interpreter. For this interface, while translating the spoken sounds, it is also essential to integrate a speech recognizer for the purpose of decoding the spoken word into words sequence, preceding to the language translation component. It includes a detailed explanation for the evaluation of field permitted out in this domain. The evaluation has been approved out at the client information office in Madrid concerning both real company of bus workers and hearing-impaired people too. The evaluation also comprises another objective extent from the information and system from questionnaires. In the evaluation of field, the whole translation presents an BLEU greater than 90% and SER (Sign Error Rate) of less than 10%.

They concern signs creation as main problems, which is the time essential for modelling. Disregarding the improvement of new procedures to encourage the movement of virtual characters, (for example, converse kinematics controls and key represents), the user may spend in the vicinity of 15 and 30 minutes setting another sign. Recall that each sign must be made just once and because of the plan of the representation module, this depiction of the development can be reused in various 3D avatars. On account of the huge amount of the time required, this stage might be viewed as the fundamental bottleneck in the project.

Figure 2.14. Sign editor based on the use of predefined static poses for hand shape and orientations [32]

A sign editor module (Figure 2.14) has been created to facilitate the development of the sign word reference.

In this application, the user picks fundamental designs of shape and introductions of the two hands (active and passive). Figure 8 introduces the interface of the introduction board and the portrayal of the 5th stance [32].

In the present framework, 86 hand shapes (23 fundamental shapes and 63 gotten from the essential designs) were characterized. On account of the utilization of this sign manager, the time required to indicate another sign diminished by 90% with comparative quality outcomes. A few illustrations can be downloaded from http://www.esi.uclm.es/www/cglez/ConSignos/listadoSignos/ .

2.3.6 Automatic Generation of Sign Language from Hindi Text for Communication and Education of Hearing Impaired People

A DST sponsored research project (2017) being carried out at Thapar University, Patiala to develop Text to Indian Sign Language conversion tool, i.e., Indian Sign Language generation system from natural language input Hindi text. The major objectives of this project are as follows:

- To build online multilingual multimedia Indian Sign Language dictionary and develop a parser to parse input language Hindi text for its ISL processing.
- To develop HamNoSys generation system to create HamNoSys notation for ISL to express sign language phonological features.
- To generate Indian Sign Language with avatar to animate ISL corresponding to input text using HamNoSys notation.

For the proposed system input Hindi sentence will be processed by shallow parser to identify the higher syntactic and functional information of the sentence. It is a syntactic representation of a sign to facilitate computer processing. The root words of input sentence will be mapped with HamNoSys notations with eSIGNEditor tool. eSIGNEditor will be used to pick signed sentences sign by sign from the lexicon and apply morphological changes to individual signs or strings of signs where necessary. The visual interface of the proposed system has been given in below Figure.

Figure 2.15: Visual Interface of Text to Indian Sign Language System

After writing signs in HamNoSys, it will be converted into Signing Gesture Mark-up Language (SiGML). SiGML is a form of XML which defines a set of XML tags for each phonetic symbol in HamNoSys. Generated SiGML file will finally be processed by Signing Avatar like "JA SiGML URL APP", which will play sign animation for the input text. The URL for this proposed system is: http://www.islfromtext.in/.

2.4 Comparison of Various Sign Language Generation and Automation Tools

Table 2.2: Comparison of various Sign Language Generation and Automation tools

Sr.	Name of Tool	Year	Main Features
1.	ESIGN Editor	2003	The ESIGN editor contains a database of signs in which the signs are stored with the sign gloss and their respective HamNoSys notation. The words in the editor can be searched by providing the sign

			gloss and HamNoSys can be retrieved from the editor and also provides the non-manual features for a given sign.
2.	HamNoSys Editor	2005	A tool which contains various tabs for hand-shape (Hsh), hand-orientation (Ori), hand-location (Loc), straight (Mov1) and curved (Mov2) movement of hand and symbols used for two-handed (2hd) operations. The HamNoSys symbols are shown as button caption and the HamNoSys string appears in the text field when the button is clicked.
3.	Indian Sign Language Dictionary	2008	Search-by-Example tool for four national sign languages, i.e., Greek, German, French and British Sign Languages. The system has a sign gloss, HamNoSys notation and a video clip for each sign.
4.	Search-By-Example	2008	A tool used to produce signs for a given word or a phrase. The system also transcribes the signs in the form of HamNoSys notation. The transcribed HamNoSys string is used for automating signs by using animation avatars.
5.	Translating Bus Information into Sign Language	2013	It consists of a translator of natural language and a 3D avatar animation module in order to play the signs. Two technical methods have been analysed and unified: an example-based strategy, and a statistical interpreter.
6.	Text to Indian Sign Language conversion	2017	A tool which build an automation system to generate signs corresponding to the ISL words which are used while communicating with deaf people with signing avatars from SiGML.

Chapter Summary

This chapter summarizes the various systems and tools that are available for sign language automation. The various systems include ASL benchmark, Text-To-Indian Sign Language Translation system, ViSiCAST translator, Zardoz system, TESSA. The Dicta-Sign Project is used for sign recognition for four European Sign Languages and can also be used for sign language translation. The various systems using hidden Markov model for recognizing signs have also been discussed. The Spanish Speech to Language conversion and the model named LSESpeak use Example-based and Rule-based translation methods for converting speech to sign language gestures. The different tools for sign language automation which have evolved over time are ESIGN Editor, HamNoSys Editor, Search-By-Example tool for Multilingual Sign Language Databases and Multilingual Multimedia Indian Sign Language Dictionary Tool and Automatic Generation of Sign Language from Hindi Text for Communication and Education of Hearing Impaired People. Besides all these available systems to work with sign language in various languages there was a need of an SMS generator in Indian Sign Language via which the hearing-impaired people could send a short message to their near and dear ones in case of emergency or for communication purposes. This has been inspired from LSESpeak and the Translating Bus information system which have achieved this objective in Spanish sign language. A text-to-speech service has also been added as an improved functionality through which the English sentence generated from ISL words can be converted to a voice message.

Chapter 3

Problem Statement

According to All India Federation of the Deaf (AIFD), near about 4 million deaf and around 10 million hard of hearing people are present in India. Indian Sign Language is a mode of communication for more than 1 million deaf adults and around 0.5 million deaf children [32]. Many people who take birth in deaf families or are born deaf, they learn sign language as their first language. Written form of sign language doesn't exist so writing or reading becomes less preferred modes of communication for such people. They have difficult issues to express themselves or understand printed texts, verb tenses, gender, number and also issues while making an image of abstract thoughts in mind and are also unable to access the information which the people who can hear do very easily like television content, multimedia on the web and individual public speeches. They prefer to access information in form of sign language on Internet rather than in the form of written content. But very few sites offer content in the form of sign language. That content is available in form of video clips and can be accessed by reading the text. Making the content available on Internet using video approach is very expensive.

This demands for the need of a platform which acts as the intermediate between the hearing-impaired person and a normal person even if he is not acquainted with the use of internet or any other kind of browsing. A platform was needed where the disabled person can send his thoughts and emergency messages through an offline mode which could have been in the form of SMS. This should be accompanied with the voice feature so that the disabled person can communicate even with the person who does not avail the mobile service for the receiver of SMS or in in bad network area.

3.1 Objectives

The main goal of this research study is to develop Sign Language based SMS generator for hearing impaired people along with the automation of signs. For completion of this task, the following objectives have been framed.

i) To perform extensive analysis of existing Sign Language generator and techniques used all over the world.

ii) To propose a framework for the development of Sign Language based SMS Generator for hearing impaired people.

iii) To implement Sign language based SMS Generator for hearing impaired people.

iv) To test and validate the proposed system for its effectiveness.

3.2 Methodology

To achieve the objectives given in section 3.1 following methodologies have been adopted.

- The Literature survey has been carried out to learn Sign Language and to understand various types of tools and techniques used for automatic generation of sign language to achieve the first objective by comparing the various existing systems and tools for automation of Sign Language.
- The framework of the system to be generated has been grounded on the database of ISL words which are the most frequently used words by the deaf people in their daily routine. On the basis of these words, the platform so formed generates an English sentence by the use of the ISL word so selected from the database. The architecture has been formulated around the invoking of an SMS and voice message corresponding to the sentence so formed by the application.
- For implementation of Sign Language based SMS generator, the web portal is designed by using Java Servlets and Java Server Pages (JSP). The various steps taken for implementation is described as:

  i) An input system has been developed in Java. The alphanumeric keyboard input system has a user-friendly and easy to use interface, where list of suggested words is represented as an icons and caption is also provided on the buttons in the virtual alphanumeric keyboard. The parameters needed to represent signs in Indian Sign Language including hand shape, orientation, location and movement are verified and taken from url: http://www.islfromtext.in/avatar.php. Thus, the users having little or no knowledge of sign language can use the system to create signs of the words in ISL.

  ii) The ISL words stores signs in the form of images with their respective sign phrase or gloss. The stored signs are transcribed by using HamNoSys notation are retrieved from ISL Dictionary and are converted into their SiGML form for animation are taken. The 3-D animation avatar takes SiGML as input and animates the signs and hence the animated signs are stored to their corresponding ISL words.

  iii) This Java application has animation avatars in the form of GIF files corresponding to each sign defined in the database which are developed for the automated representation of signs. Gif file is created using url: http://gifcreator.me/. It

makes use of Java applet technology for the animation avatar to run on the local server. The ISL words selected for the sign representation match with their corresponding ISL sign from the database consisting of both words and their respective signs. Hence, the users can easily retrieve the signs of the words corresponding to the letters selected from the alphanumeric keyboard without the knowledge of Sign Language.

iv) For conversion of Indian Sign Language to SMS language used by hearing people, rules have been predefined in java. In order to depict an SMS sentence, a window known as the "SMS Window" has been added to the platform in which ISL sentence is converted into English which is displayed as a message.

v) The developed system also includes the provision to send SMS to a specific number for better communication or to reach someone in the case of emergency using a cost effective End-to-End Enterprise Mobile Messaging Service with high service level availability by mVaayoo. It is an SMS Gateway which equips any website, application, or information system with high-speed, secure, 2-way SMS capabilities. This Gateway can be integrated using mVaayoo's APIs, which are offered in a wide array of connection options. Comprehensive API integration guides are provided, covering the entire integration process. The url used to send sms is: http://api.mVaayoo.com/mvaayooapi/MessageCompose?user=basrarubal94@gmail.com:onkar456&senderID=TEST SMS&receipientno=9872513556&dcs=0&msgtxt=This is Test message&state=4 .

vi) The system has a translator written in Java, for converting text to speech using eSpeech. It is an open source speech convertor which includes various JavaScript's like speakClient.js, speakWorker.js, speakGenerator.js. Speak-js is a 100% clientside JavaScript + HTML5 for text-to-speech conversion on the web. User can change the amplitude, pitch, speed, voice and wordgap. It is a port of the eSpeak speech synthesizer from C++ to JavaScript using Emscripten.speakClient.js is the file that user interact with. It defines speak(), and will load speakWorker.js in a web worker. speakWorker wraps around speakGenerator.js, which does the actual work of converting a string into a WAV file. The WAV data is returned to speak(), which then plays it in an HTML Audio element.

- The effectiveness of the system generated has been evaluated on the basis of ratings given by various users to the sentences formulated and sent as SMS by the platform. The sentences have been rated on a scale of 1 to 5 where the sentence with the highest frequency of use has been given a rating of 5 and vice versa. The average score has been calculated to find the efficiency of the system.

Chapter Summary

In this chapter, the problem statement, various objectives to eradicate the social relations barriers between hard of hearing people and society bestowed with hearing and methodology used to implement Sign Language based SMS generator for hearing impaired people system are discussed.

Chapter 4

Implementation

4.1 Technology used for Sign Language based SMS Generator for Hearing Impaired People

The technologies so used in the construction of this SMS generator are Java Server pages**,** Java Script, bootstrap, CSS, HTML, IDE, Server and Database. These have been explained in detail as follows:

4.1.1 JAVASERVER Pages (JSP)

JSP technology enables us to effortlessly make Web content that has both static and dynamic components. JSP technology lets offered all the dynamic availabilities of Java Servlet innovation but yet gives a more common way to deal with making static content.

The primary Components of JSP innovation are as per the following:

- Performance is fundamentally better because JSP permits implanting Dynamic Components in HTML Pages itself as opposed to having a different CGI documents.
- JSP are always compiled before it's prepared by the server not at all like CGI/Perl which needs the server to load an interpreter and the objective script each time the page is demanded for.
- Java Server Pages are based over the Java Servlets Programming interface, so like Servlets, JSP additionally approaches all the effective undertaking Java APIs, including JDBC, JNDI, EJB, JAXP and so on.
- JSP pages can be utilized as a combination with servlets that handle the business logic, the model upheld by template engines Java servlet.

The life cycle of a JSP page has been explained as follows in the form of stages it goes through:

- JSP Page translation and JSP Page compilation
- Classloading (classloader loads the class file)
- Instantiation (Generated Servlet object is created).
- Initialization (container invokes the jspInit() method).

- Reqeust processing (container invokes the _jspService() method).
- Destroy (container invokes the jspDestroy() method).

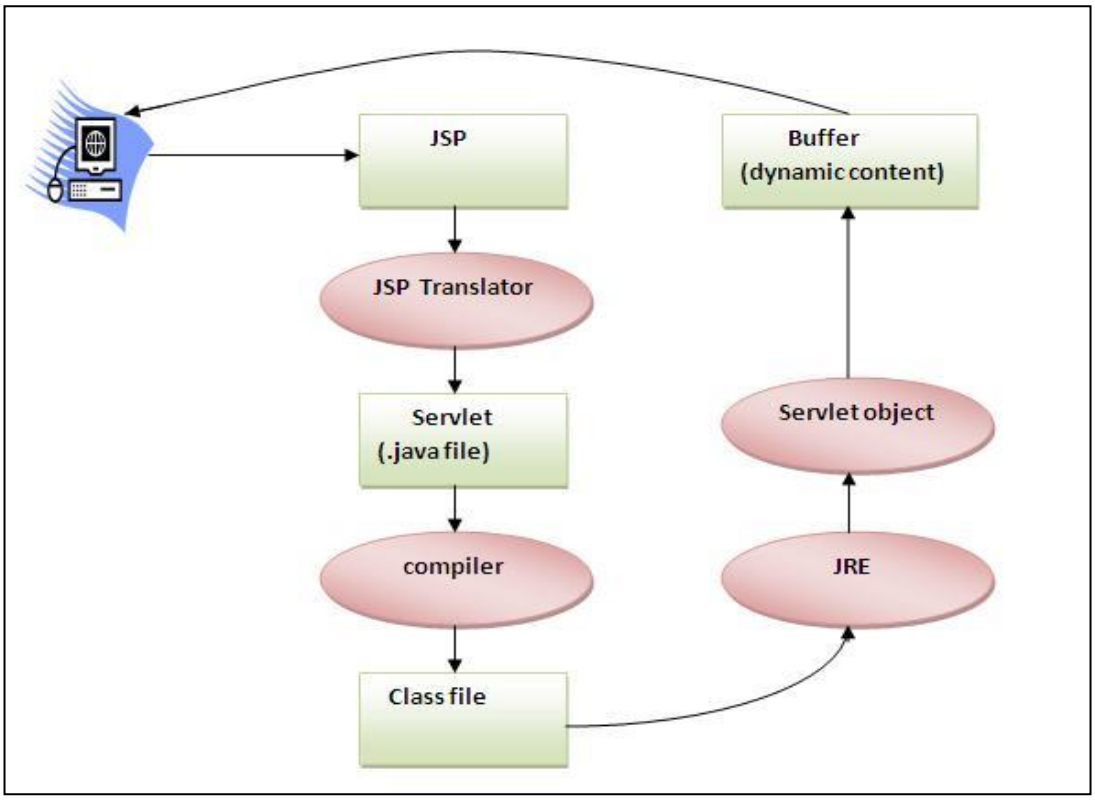


Figure 4.1: Life Cycle of JSP [33]

4.1.2 JavaScript

JavaScript is a dynamic PC programming language. It is lightweight and most frequently used as a web pages parts, whose executions allow client-side script to interrelate with the user and create dynamic pages. It is an interpreted programming language with object-oriented abilities. The general-purpose core of the language has been entrenched in Internet Explorer, Netscape and other web browsers. A standard version of the core JavaScript language can also be defined as:

- JavaScript is a lightweight, interpreted programming language.
- Designed for making system driven applications.
- Complementary to and incorporated with Java.
- Complementary to and incorporated with HTML.
- Open and cross-stage.

4.1.3 Bootstrap

Bootstrap is the most prevalent HTML, CSS and JavaScript system for building up a responsive and portable inviting site and completely allowed to download and utilize. It is a front-end framework utilized for simpler and speedier web advancement. It incorporates HTML and CSS based plan layouts for shapes, typography, catches, navigation, tables, modals, picture carousels and numerous others. It can likewise utilize JavaScript plug-ins. It encourages you to make responsive designs.

4.1.4 CSS and HTML

CSS is an acronym stands for Cascading Style Sheets. It is a template dialect which is utilized to depict the look and designing of an archive written in mark-up language. It gives an extra element to HTML. It is by and large utilized with HTML to change the style of pages and UIs. It can likewise be utilized with any sort of XML reports including plain XML, SVG and XUL. CSS is utilized alongside HTML and JavaScript in many sites to make UIs for web applications and UIs for some portable applications.

4.1.5 Server

A server module is a NetBeans module that encourages combination with a web server or a Java EE server, including beginning/ceasing the server, sending, troubleshooting, UI for server enlistment and essential organization, taking care of server-particular information and different assignments.

Glassfish is an open-source application server extend begun by Sun Microsystems for the JavaEE stage and now supported by Prophet Organization. The supported adaptation is called Prophet Glassfish Server. Glassfish is free programming, double authorized under two free programming licenses: The Basic Advancement and Appropriation Permit (CDDL) and the GNU Overall Population Permit (GPL) with the classpath special case. Glassfish is the reference usage of JavaEE and all things considered backings Venture JavaBeans, JPA, RMI, JavaServer Pages, servlets and so forth. This enables engineers to make endeavor applications that are versatile and adaptable, and the incorporate with inheritance advancements. Discretionary segments can likewise be introduced for extra administrations. Expand on a measured bit controlled by OSGi, Glassfish runs straight over the Apache Felix execution. Glassfish depends on source code discharged by Sun and Prophet Organization's TopLink tirelessness framework. It utilizes a subsidiary of Apache Tomcat as the servlet compartment

for serving web content, with an additional part called Grizzly which utilizes Java New I/O (NIO) for versatility and speed.

Sun Microsysytems propelled the GlassFish extend on 6 June 2005. On 4 May 2006, Venture GlassFish discharged the main form that backings the JAVA EE 5 particular. On 4 November 2013, Prophet reported the future guide for JAVAEE and glassfish server, with a 4.1 open-source version arranged and proceeding with open-sources updates to GlassFish however with a conclusion to business Prophet bolster. Open source Glassfish is intended to proceed at any rate through adaptation 5, and will be delivered from GlassFish Server OpenSource Version 5. This reproduces what has been done in past JAVA EE and GlassFish server release.

4.1.6 IDEs Used

NetBeans IDE - The Smarter and Speedier Approach to CodeNetBeans IDE lets you rapidly and effortlessly create Java desktop, portable, and web applications, and additionally HTML5 applications with HTML, JavaScript, and CSS. The IDE additionally gives an awesome arrangement of tools for developers of PHP and C/C++.

It is free and open source and has a substantial group of clients and users far and wide. Best Help for Most recent Java Advances, NetBeans IDE is the authority IDE for Java 8. With its editors, code analysers, and converters, you can rapidly and easily overhaul your applications to utilize new Java 8 dialect builds, for example, practical operations, lambdas and strategy references. Clump analysers and converters are given to seek through numerous applications in the meantime, coordinating examples for transformation to new Java 8 dialect develops.

With its continually enhancing Java Editorial manager, numerous rich components and a broad scope of instruments, formats and tests, NetBeans IDE sets the standard for creating with front line innovations out of the crate. Recordings and more data Quick and Brilliant Code Altering an IDE is a great deal more than a word processor. The NetBeans Proof-reader indents lines, matches words and sections, and highlights source code grammatically and semantically.

It lets you effectively refactor code, with a scope of helpful and intense apparatuses, while it likewise gives code layouts, coding tips, and code generators. The supervisor bolsters numerous dialects from Java, C/C++, XML and HTML, to PHP, Awesome, Javadoc, JavaScript and JSP.

Since the proof-reader is extensible, you can connect to help for some different dialects. More data on Altering and Refactoring, more data on Code Help, simple and Productive Venture Administration, keeping a reasonable diagram of vast applications with a great many organizers and records, and a great many lines of code is adaunting errand. NetBeans IDE gives diverse perspectives of your information, from different venture windows to supportive instruments for setting zup your applications and overseeing them productively, giving you a chance to penetrate down into your information rapidly and easily. When new designers join your venture, they can comprehend the structure of your application in light of the fact that your code is efficient. Fast UI Improvement, Outline GUIs for Java SE, HTML5, Java EE, PHP, C/C++, and Java ME applications rapidly and easily by utilizing editors and intuitive instruments in the IDE. For Java SE applications, the NetBeans GUI Developer consequently deals with adjust dispersing and arrangement, while supporting in-pace altering, too. The GUI developer is so natural to utilize and instinctive that it has been utilized to prototype GUIs live at client presentations.

4.1.7 Database

MySQL, the most prominent Open Source SQL database administration framework, is created, disseminated, and upheld by Prophet Company. The MySQL Site (http://www.mysql.com/) gives the most recent data about MySQL programming.

MySQL as back end a description

The back-end involves the parts that procedure the yield from the front-end. Back-end is avoided the client. A back-end database is a database that is gotten to by clients by implication through an outer application as opposed to by application programming put away inside the database itself or by low level control of the information (e.g. through SQL commands).

MySQL is the world's most fit relational database. It is anything but difficult to introduce, simple to oversee, and simple to create with. With this, we utilize a natural, program based interface, to:

- Administer the database.
- Create tables, see and other database objects.
- Import, fare and view table Information.
- Run queries and SQL scripts
- Generate reports.

4.2 Features of the Proposed System

The effectivity of a system depends upon the variety of features it offers which make the system more scalable, robust and user friendly. The features of this SMS generator have been explained in detail which increase the advantage of the system used manifolds.

i) Searching of Indian Sign Language Symbols for Sign Language Automations

The system has a virtual keyboard in order to display corresponding sign for the word so selected from the suggested words. The users can search sign for a given word in suggested words in order to display sign representation of selected word. The ISL words has been stored in dictionary along with its Sign representation. The stored word and its sign representation can be retrieved from the suggested words of ISL dictionary corresponding to any alphabet letter when required by the users. The Indian Sign Language to English translator, i.e., text to speech translator is used to convert that retrieved ISL to English. The Frequent Signs are displayed on basis of most of ISL words searched by the user. The ISL sentence is given as an input for automation of the sign of the word selected from ISL dictionary in order to show through GIF file so that animated gifs can show ISL sentences in a much better way than it would normally do.

ii) Use of Sign Language based SMS generator for Hearing Impaired People

The system for creation of Sign Language based SMS Generator for Hearing Impaired People is implemented through a web based portal developed in Java. In this system, various tools are developed and collaborated together for sign language generation and automation.

Figure 4.2: Avatar showing sign for word “HELP”

This system, has been deployed into four modular functionalities: the first one includes advanced visual interface for a deaf person to indicate sign sequence or enter ISL sentence

which is to be converted into English with the use of a language translator, second one sends that English sentence as an SMS to the deaf person or normal person , third module converts the English sentence into speech using text-to-speech translation system, the fourth module is an animation module for playing the sign actions through the GIF file corresponding to the ISL sentence. The graphic interface permits a sequence of signs to be characterized by means of various services such as a GIF file is created corresponding to every English sentence so generated by the platform. Thus, in this way the proposed system is extremely beneficial for interacting face to face with deaf people as well as the people who can hear but are unaware about the Indian Sign Language.

In this way, to convey messages between hard of hearing people and normal persons, Sign language is essential. It has been also used in providing education to deaf, for boosting up self-possession and increasing their communication skills, for gaining information of non-verbal communication, helps in keeping peaceful atmosphere at religious places and workplaces and delivers another direction to manifest yourself with inspiration.

4.3 Architecture of Sign Language based SMS Generator for Hearing Impaired People

The following depicts the basic architecture of the system where with respect to the selected letter from the alphanumeric keyboard a word is chosen from the suggested words library and corresponding to that word a sign representation and a GIF representation is loaded. The proper layout of the architecture is shown in Figure 4.3.

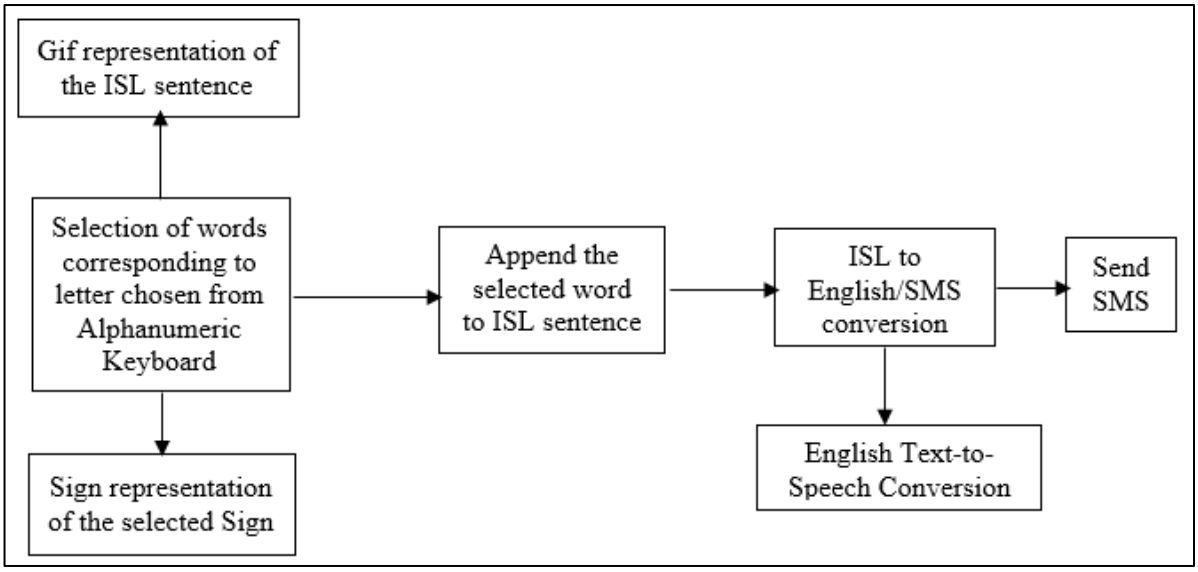


Figure 4.3: Architecture of Sign Language based SMS Generator for Hearing Impaired People

The chosen English word is appended in the ISL words tab and an English sentence corresponding to the words present in the ISL tab is generated with the use of and ISL-to-English conversion system. The English sentence so generated can be sent and SMS or can be taken as output in the form of a voice message.

4.4 Design and Workflow of the System

The modular diagram of SMS generator is depicted in Figure 4.4. It has been shown that the SMS generator consists of three basic utilities. The first and foremost is a new kind of an ISL to English conversion system defined in Message window, and secondly there is sending of messages to people, since Indian hearing-impaired community is well-versed with SMS languages. Both these tools are a three-modular structure. The first module is made up of an advance level interface in which we specify an ISL sequence which undergoes language translation into English language also known as the SMS to be sent and this all takes place under the second module. The Translation Information module specifies the language to which the ISL has to be converted here, English.

The third module which is the Text to Speech converter converts the SMS or more broadly speaking the English text generated into speech with the use of acoustic units and the Language Information tells the text to speech converter the language to which it has to convert the text. The fourth module which is the GIF file creator creates the GIF (Graphic Interchange Format) corresponding to the ISL word or Sentence in the ISL tab. Each module fulfils its allotted work as the interface has been connected to the ISL dictionary which acts as the database from which the sentences corresponding to the ISL word get displayed in the ISL sentence window.

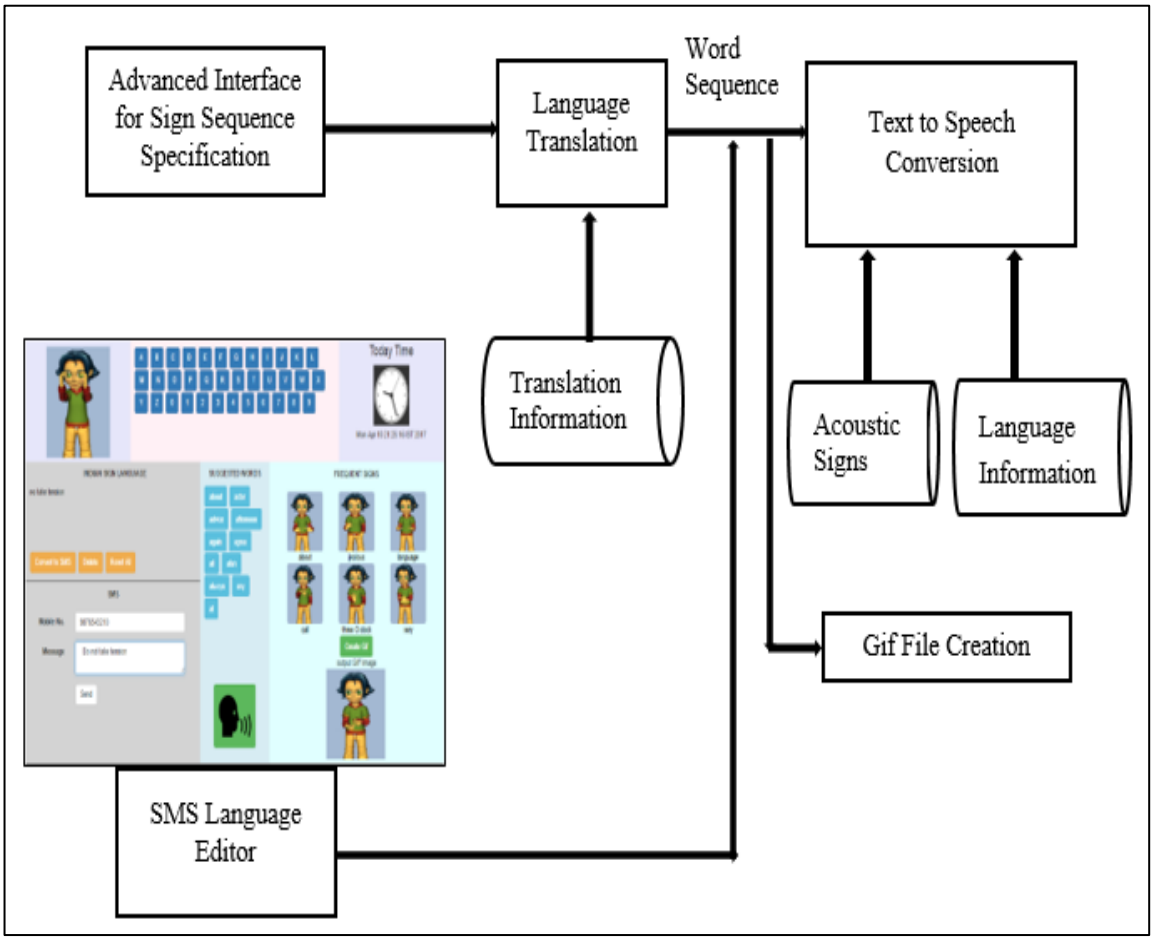


Figure 4.4: Module Diagram of SMS generator

4.4.1 SMS Generator Visual Interface

The graphically visual interface is the outcome of an extensive design procedure divided into three main stages. Figure 4.5 depicts the main services included in the SMS generator interface.

The description of the various tabs is:

a) Alphabetic selection of Signs: It comprises of choosing a letter from virtual keyboard to display the words related to selected letter.

b) Suggested words: The list of suggested words starting with the selected letter are shown in this tab in alphabetical order.

c) Sign representation of selected words: In this tab, a corresponding sign is displayed in the "Sign Representation" WINDOW of the interface for the word so selected from the suggested words.

d) ISL words: The selected words from the suggested words will be written to ISL words tab.

e) Convert ISL to English(SMS): The convert button is used to convert Indian Sign Language to English language.

f) SMS language: In order to send message by clicking send button, message will be displayed in this tab.

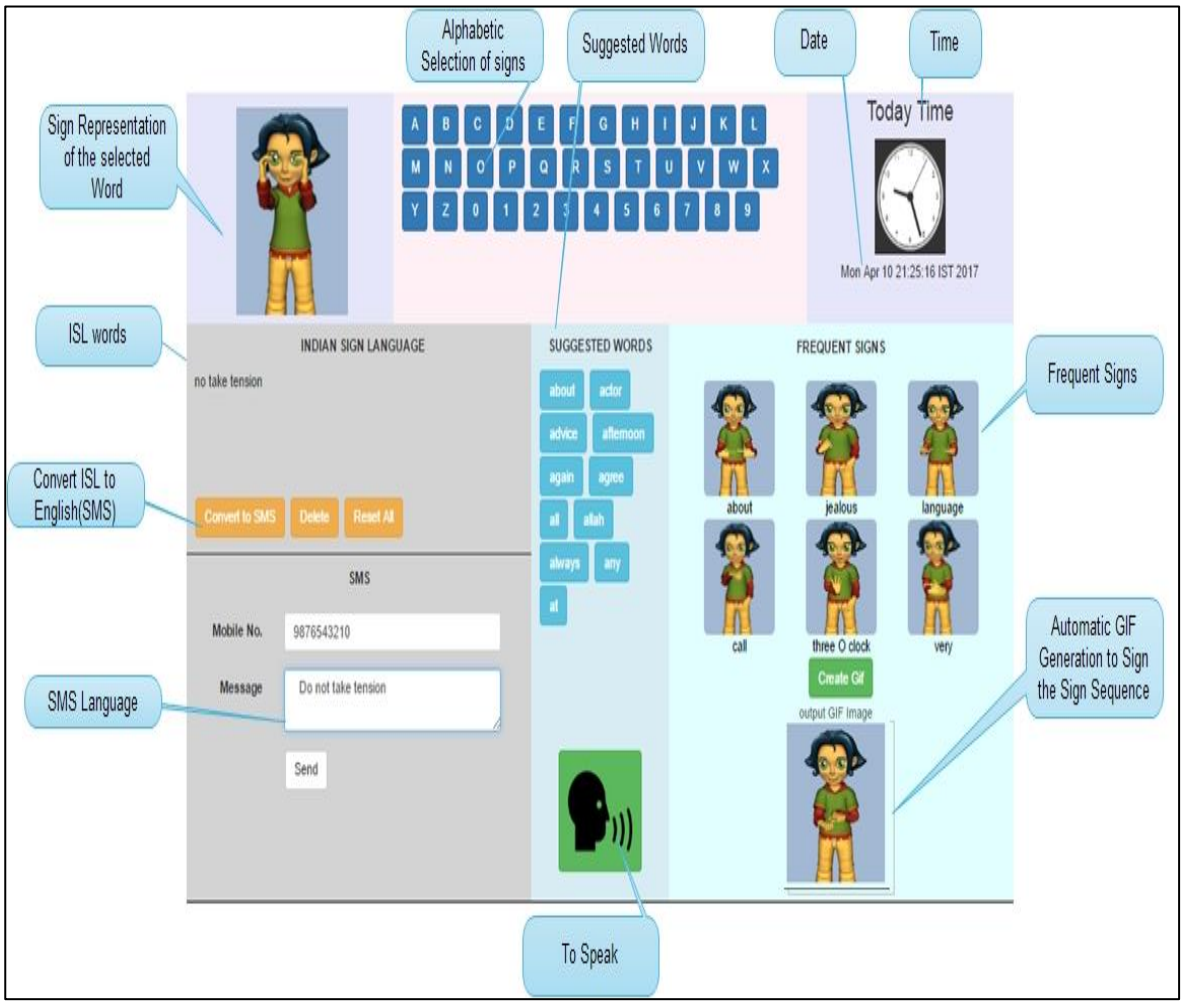


Figure 4.5: SMS generator interface consisting of all the functionalities for ISL or Message Specification

g) To Speak: This tab is used to speak English written in SMS language tab.

h) Date and Time: These tab is used to display current date, day and time.

i) Frequent Signs: This tab inculcates a list of the most frequently used sequences of sign used by users.

j) Automatic GIF generation to Sign the Sign Sequence: This tab is used to display the sign sequence of sentence written in ISL tab.

4.4.2 The ISL to English translation module ISL

ISL to English conversion is done by the use of the already described sign sequences in the database. Here, the words and their corresponding SMS inputs (ISL to ENGLISH) are calculated and aligned bi-directionally.

In this arrangement, the simultaneous matching is based on the words(tokens) in the ISL tab and every word is aligned with an English word. But it may happen that some words may stay unaligned which accounts as the only shortcoming of this platform to be resolved in the future. But the combination of sign sequences so selected from the corpus are written in the syntactically correct format in the message dialog box to be sent as the SMS to the user on the other end or we can say to the person interacting with the deaf user.

4.4.3 Working of the Interface

The primary function of the interface comprises of choosing a letter (from the alphanumeric keyboard available on the interface as in Figure 4.4) and a list of suggested words starting with the selected letter are shown in the tab below in alphabetical order. A corresponding sign is displayed in the "Sign Representation" WINDOW in the top-left corner of the interface for the word so selected from the suggested words.

At any moment of time, a person can perform the necessary actions: to delete the last word as well as the sign corresponding to it 

button can be used and to clear the whole sequence 

button can be used. Every time the sequence is changed, the language conversion module is implemented and as a result the sequence of words is depicted in the ISL window. The speech button () applies the TTS converter on the series of words entered in the "Send SMS" window.

By pressing the "RESET ALL" button, the system gets into the initial mode where no data has still been entered. This service is very innovative for depicting a new word by again selecting a letter from the alphanumeric keyboard. When the new sign has to be shown, the availability of the signs in the sign directory is carried out at the backend of the interface.

Another useful functionality allows the frequently used signs to be added into the signs database so that it could be proposed in future. For a new sign, click on words displayed in SUGGESTED WORDS window (Figure 4.6).

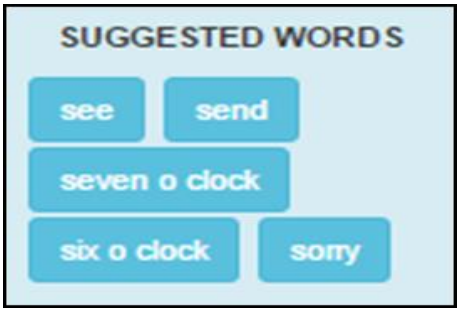


Figure 4.6: Suggested Words Tab

To add a date and time, this platform provides the date in the calendar format and the time on an analogy clock digitally (Figure 4.7). To add the current date and time to the ISL tab directly, the user just has to press the DATE and TIME ( ) buttons.

Figure 4.7: Selected date is 11April,2017 and selected Time is 10:57

To display current date and time, The java.util.Date class is used in java in order to represent a specific instant in time, with millisecond precision. It provides constructors and methods to deal with date and time in java.The java.util.Date class implements Serializable, Cloneable and Comparable<Date> interface. It is inherited by java.sql.Date, java.sql.Time and java.sql.Timestamp interfaces.

At the end, the visual interface inculcates a list of the most frequently used sequences of sign (about, jealous, language etc.). With the selection of any of the sequences from this list, the sign representation is replaced by the image of the selected word, and the ISL window is also updated (Figure 4.8).

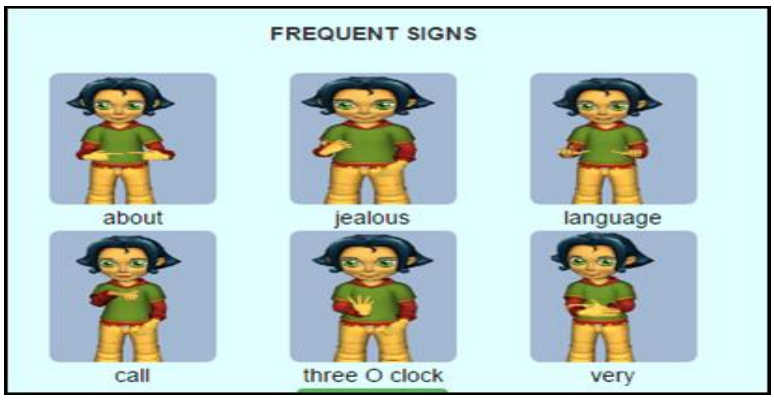


Figure 4.8: Options available from the frequently used sign sequences

These frequently used sign sequences are represented in the form of GIF images which are shown on the right-hand side of the platform terminal. The frequent signs are defined using HashCode and Equals method in Java object. Java.lang.Object has methods called hasCode() and equals()methods playing a significant role in the real time application. The default implementation of hashCode() is provided by Object , which is derived by mapping the memory address to an integer value and **equals()** method is used to make equal comparison between two objects(signs).The graphic interface permits a sequence of signs to be characterized by means of various services. An animation module has been added for playing the sign actions through the GIF file. The GIF button (Create Gif) creates a GIF file in the "OUTPUT GIF IMAGE" window displaying the important features from the words specified in the ISL tab (Figure 4.9).

Figure 4.9: Output GIF of ISL sentence

Finally, so as to depict an SMS sentence, a window known as the "SMS Window" has been added to the platform (Figure 4.10) in which ISL is converted into English and is displayed

as a message. The send button (Send) is to send SMS to specific number defined in Mobile No. window. Some examples of ISL and their corresponding SMS sentences are shown in Table 4.1.

TABLE 4.1: EXAMPLES OF INDIAN SIGN LANGUAGE AND SMS

Indian Sign Language	**SMS**
All best	All the best
No jealous	Do not jealous
Where your mother?	Where is your mother?
No worry	Do not worry
No take tension	Do not take tension
What your language	What is your language
How you?	How are you?

The above examples show the Indian Sign Language and their corresponding SMS or English sentence.

Figure 4.10: Example of send SMS

4.5 Description of the Proposed System for sentence "I am busy in meeting" as an example

The steps given below show the automation of the signs using ISL words, beginning from words selection to sign animation. The following steps will take the example of ISL sentence

— “I am busy in meeting” to explain the process of sign automation and message sending.

Step 1: Providing Words to a Concept

By choosing a letter I (from the alphanumeric keyboard available on the interface) and a list of suggested words starting with the selected letter are shown in the tab below in alphabetical order. After choosing a word “I”, corresponding sign is displayed in the “Sign Representation” WINDOW for the word so selected from the suggested words and I is written in Indian Sign Language tab. Similarly, by selecting “busy” and “in” words, corresponding sign is displayed and is written in Indian Sign Language tab. The figure below shows the word concept entered for word “I”, “in” and “busy” and selecting word “meeting”.

Figure 4.11: Concept for input sentence “I am busy in meeting” in ISL

Step 2: Retrieving the sign from ISL Dictionary words

The Sign Concept is the exact name of the sign or the part of it, which will be used for referring the words from the ISL Dictionary words. After choosing a word “I”, corresponding sign is displayed in the “Sign Representation” WINDOW. The figure below shows the sign concept entered for word – I

Figure 4.12: Word selected “I”

Step 3: Avatar Playing Sign for ISL sentence “I busy in meeting”

An animation module has been added for playing the sign actions through the GIF file. The GIF button is used for creating a GIF file in the “OUTPUT GIF IMAGE” window displaying

the important features from the words specified “I busy in meeting” in the ISL tab. The figure below shows the animated GIF of entered ISL sentence “I busy in meeting”.

Figure 4.13: Playing Sign for ISL sentence “I busy in meeting”

Step 4: Frequent Signs Explanation

The visual interface inculcates a list of the most frequently used sequences of sign (e.g. about, jealous, language etc.). User can select any of the sequences from this list, the sign representation is replaced by the image of the selected word, and the ISL window is also updated by word of selected sign. The figure below shows by selecting frequent sign-, their corresponding words will be shown in ISL window.

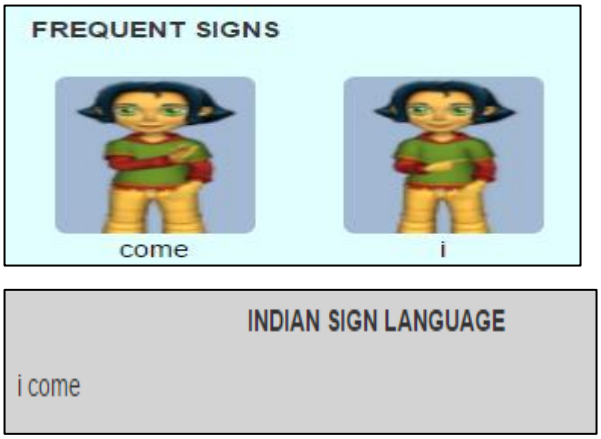


Figure 4.14: (a) Selecting frequent signs “I” and “come” (b) their corresponding words in ISL window.

Step 5: Conversion of ISL sentence to SMS(English)

The words and their corresponding SMS inputs (ISL to ENGLISH) are calculated and aligned bi-directionally. The user can write ISL sentence and then by clicking on “convert to SMS” button, the output will be displayed and can be easily understood by any user. Figure below show the ISL sentence “I busy in meeting” and its output “I am busy in meeting” in English.

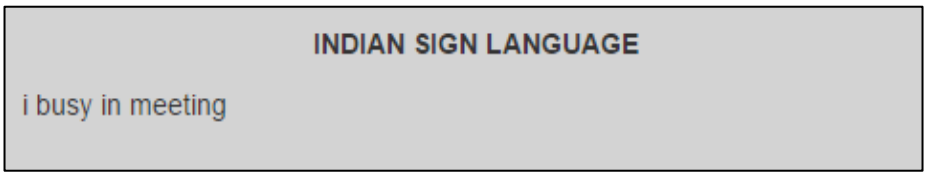


Figure 4.15: (a) ISL sentence

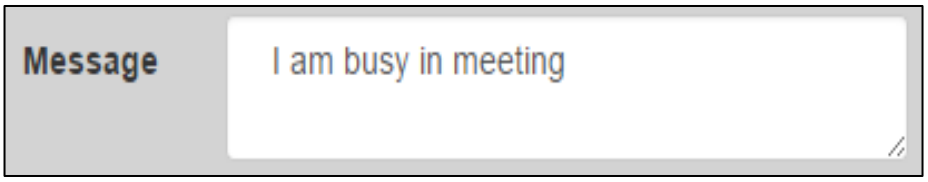


Figure 4.15: (b) SMS or English sentence

Step 6: Send Message

By using this interface, any hearing-impaired person can send SMS to specific number defined in Mobile No. window. Hence, a new platform for assisting hard of hearing part of society to communicate with us is designed. It takes the proceed of message communication (popularly taken in use by the hearing impaired for SMS communications) to boost the efficiency of face to face interaction with normal people or in case of emergency. If message is sent successfully, “message sent successfully” will be displayed. Figure below shows the sending of message and receiving that message to specified number.

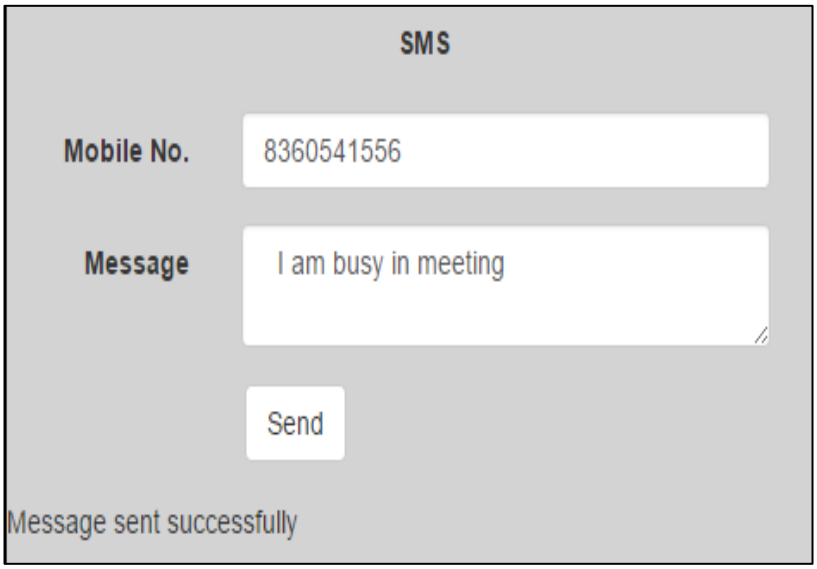


Figure 4.16: (a) Sent message

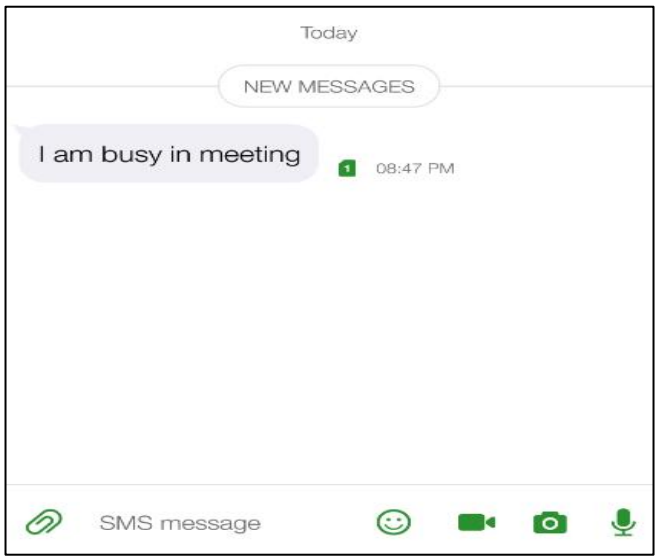


Figure 4.16: (b) Received message

One of the main parameter is state which specifies the response type's state description.

a) State=0 - User can add a custom message of his/her choice, e.g. "Thanks for submitting your response".
b) State=1 - User can send sms to multiple numbers (9810028310, 9837371812,), and a unique transaction id are generated for each mobile number on successful submission.
c) State=2 - On sending messages to multiple numbers, this will return a unique Job ID for the campaign.
d) State=3 - On sending messages to multiple numbers, this will return a unique Job ID for the campaign along with multiple Transaction id.
e) State=4 - User can send messages to a single mobile number; on successful submission, a unique Transaction id is generated.
f) Also, in case of customized message (state =0) user has to pass the response message (e.g. Thank You for your response).

Step 7: Text to Speech Conversion

By clicking on speech button (), user can apply the TTS converter on the series of words entered in the "Send SMS" window. In this way text to speech conversion is beneficial for People with learning disabilities – Some people have difficulty reading of text due to dyslexia and other learning disabilities. People who speak the language but do not read it. Text to speech can be a very useful tool for the mild or moderately visually impaired. Even for people with the visual capability to read, the process can often cause too much strain to be

of any use or enjoyment. With text to speech, people with visual impairment can take in all manner of content in comfort instead of strain. In this way, offering them an easier option for experiencing website content is a great way to engage them.

Chapter Summary

In this chapter, technologies used for SMS Generator have been explained including searching of Indian Sign Language Symbols for Sign Language Automation and sending message. The features and architecture of the proposed system for creation of Sign Language based SMS generator for hearing impaired people and its working procedure is discussed. The steps for Description of Proposed System for ISL sentence are also described.

Chapter 5

Results and Discussions

SMS generator system has been tested for simple signs which make use of manual components. The system has been tested on 250 sentences which include basic hand-shapes, commonly used words in day-to-day communication and also the sentences used in daily routine and in basic behaviour norms. The signs for all the words have been taken from the books on Indian Sign Language, which are published by Bhagat Puran Singh School for Deaf, Pingalwara, Amritsar for hearing impaired persons.

The system has been used and tested by 12 hearing-impaired people and by the use of ratings given by them the calculation of average score and efficiency has been carried out which are the measures to evaluate the performance of the system so generated. The signs shown have been evaluated by the sign language experts of the same organization, the results are really very encouraging and are worth to be used for easy communication with deaf people. Hence, deaf people can also be helpful in unexpected or serious situations and can perform jobs like sending SMSs to others, passing on urgent information through messages, interacting with the visually challenged people by the help of TTS utility and also guiding other hearing-impaired people break their communication barriers.

5.1 Testing of Sign Language Based SMS Generation System

The system has undergone manual testing where each sentence was rated on a scale of 1 to 5 by different users on the basis of the fact that how efficient the sentence-making was from the basic ISL words and that how frequently a particular sentence is used for communication purposes. The user has given the rating of 5 which stands for the ‘excellent’ grade to the sentence which he/she considers to be both syntactically and grammatically correct and vice versa. The system has been tested on various sentences which use ISL words as their foundation to be used in day-to-day communication, to be used in basic behaviour norms and to be sent as messages in case of emergency or for communication purposes. The rating used for grading the sentences have been explained in table 5.1

Table 5.1 Average Score with their respective description

Average Score	Description
5	Excellent

4	Good
3	Average
2	Below Average
1	Poor

The sign representation of each sentence has been done accurately by using the signs corresponding to each work in the ISL sentence. Some examples of ISL to SMS Generator System and their Sign representation with their respective rating given by 10 hearing impaired people who were experts in the use of English and ISL words is described in table 5.2.

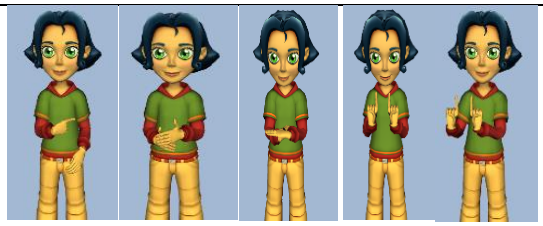
Table 5.2 Examples used for Testing ISL to SMS Generator System and Testing Animated Sign

Sr. No.	Indian Sign Language	SMS	Animation	Average Score
1.	All best	All the best	 all best	4
2.	Where your family?	Where is your family?	 Where your family	3
3.	How you?	How are you?	 How you	4
4.	I sorry	I am sorry	 I sorry	5

5.	Now time 3	Now time is 3 O'clock	 Now time three	4
6.	See you later	See you later	 See you later	4
7.	Please come in	Please, Come in	 Please come in	4
8.	what your name?	what is your name?	 What your name	5
9.	When we go	When we will go?	 When we go	3
10.	Give me pen	Give me a pen	 Give-me pen	4

11.	What your problem	What is your problem?	 What your problem	4
12.	Help me please	Help me, please	 Help-me please	4
13.	No jealous	Do not be jealous	 No jealous	3
14.	I welcome you all	I welcome all of you.	 I welcome you all	4
15.	Where keys	Where is the keys?	 Where key	3
16.	Will you call me	Will you call me?		3

			Will you call me	
17.	Remind me later	Remind me later	 Remind me later	4
18.	How your mother?	How is your mother?	 How your mother	3
19.	Meet me in office	Meet me in office	 Meet me in office	4
20.	Cannot talk now	Cannot talk now	 Cannot talk now	4
21.	God with you	God is with you	 God with you	3

22.	Time is seven o clock	Time is seven o' clock	 Time seven O'clock	2
23.	Call ambulance	Call the ambulance	 Call ambulance	3
25.	I busy in meeting	I am busy in a meeting	 I busy in meeting	4
26.	We will meet again	We will meet again	 We will meet again	4
27.	Good bye	Good bye	 Good bye	5
28.	How your family	How is your family?		4

			How your family	
29.	Good evening	Good evening	 Good evening	4
30.	Time three o clock	Time is three o clock	 Time 3'O clock	3

On the basis of score given to all the sentences the system evaluation has been done by the calculation of average score and thus the efficiency which is based on the average score so calculated. The average score of all the sentences is evaluated by the formula:

$$Average\ Score = Sum\ of\ all\ the\ ratings\ /\ No.of\ sentences\ tested \quad (1)$$

The average score in this study comes out to be 3.6 which accounts for 72% efficiency of the system so proposed. The efficiency of the system depicts the accountability and scalability of the system. Higher the efficiency, more robust the system is.

Chapter Summary

Thus, the system has been tested by 10-15 experts and hearing-impaired people and only on the basis of efficiency so calculated has the system been proposed to the general public for use. The efficiency can further be increased by the use of better techniques else than those explained above and the database can further be expanded to add more ISL words so that the creation of the English sentence can be more perfectly attained.

Chapter 6
Conclusion and Future Scope

6.1 Conclusion

There are very few sources in India that can impart knowledge about sign language among the deaf communities thus resulting in poor literacy level and language skills among deaf people. So, a system for creation of Sign Language based SMS Generator for hearing impaired People is developed for automation of sign language and also for improving communication skills among deaf community. Message communication can be utilized as a part of unexpected or serious situations to send messages to both normal or deaf people, to send SMSs to visually challenged people or, in this scenario, to help the hard of hearing people to be in communication with normal people. This interface is extremely beneficial for interacting face to face with the people who can hear but are unaware about the Indian Sign Language.

There was earlier no way to message communication for deaf community, but the system also provides a SMS communication for hearing impaired to boost the efficiency of face to face interaction with normal people or in case of emergency through a web portal. Thus, the system can be used by a person who has little or no knowledge about sign language.

An innovated platform for the assistance of hard of hearing people has been proposed to generate verbal English. It comprises of two primary functionalities: the foremost being the improved version of a verbal English generator from ISL. It contains a graphical interface where the hearing impaired can input a sentence in ISL. The sentence so specified is converted to English and can also be given as an input to a TTS converter which will thus generate the verbal English for it. In this version, new conveniences have been added like representing frequently used sentences, automated generation of gifs of the text written in ISL and a far better module of language translation. The second utility added here is an ISL to verbal English conversion system which is composed of an SMS window for the SMS specification and options to send it to the person with the mobile number specified in the "Mobile No." tab.

6.2 Limitations

The system no matter how advantageous it is always having some loopholes and shortcomings in its working and function delivery. In this case, the shortcomings have been categorized as the limitations of the system and have been explained as follows:

- The ISL dictionary currently has an entry only for 250 ISL words and hence there is need to make ISL dictionary which includes all the words used by deaf as well as normal people.
- It is web-based interface not a mobile application. There is need to develop a Mobile App as mobile application offers better personalization.
- The users need to have prior knowledge about Indian Sign Language for entering the ISL sentence and for generating GIF of any given ISL sentence, but the quality of a GIF image is often blocky and blurred which can also slow down the system while making a jerky appearance.

6.3 Future Scope

Since there is always a scope of improvement and innovation of the system thus the future scope of the system has been explained in the following points where each prospect can add to the versatility of the system manifolds.

- An innovative downloadable mobile application can be developed for hearing impaired people with numerous features to assist them ease their communication with normal people.
- As this interface is on the basis of Indian Sign language, large number of another languages like-Italian Sign Language, Japanese Sign language, American Sign language and many more can be provided for the use of this interface.
- The ISL dictionary currently has an entry for 250 ISL words. It can be extended further for storing all ISL words and the entire Indian sign language content.
- Avatars can be added as Player for making the signs corresponding to the inputted text.
- This system can be extended to sending e-mails or WhatsApp messages directly from the interface to the person to whom the hearing-impaired person wants to send the message and a Multimedia option can be attached to interface so that the user can send images and videos to the person he wants to communicate with.
- The provision of broadcast can be added to the platform where a disabled person can send a message to multiple receivers in a single go and the application can be connected to the list of contacts already available in the mobile or tablet which is acting as the platform for the run of this application.

- A list of customised messages can be added so that the disabled person need not go through the entire process of message creation and may save his time in case of emergency.

In this way, we can say that the system so proposed is extremely advantageous for interacting with deaf people and is also beneficial for hearing impaired in communicating through SMS even with the people who are unaware about the Indian Sign Language. The system so proposed can be further enhanced by the addition of many features as explained above so that the ease of communication for deaf persons can be upgraded.

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List of Publications

Research Paper Accepted

- Rubaljit Kaur and Parteek Kumar, Sign Language based SMS Generator for Hearing Impaired People *in IEEE Technically sponsored International conference on "Computational Intelligence on Data Science" (ICCIDS-2017)*, Chennai, Tamilnadu, India.

Video URL

A video has been uploaded on YouTube to describe the working of the system named "Sign Language based SMS Generator for Hearing Impaired People". The URL of the video is as follows:

https://www.youtube.com/watch?v=f45KKH1mOiA

Sign Language based SMS Generator for Hearing Impaired People

ORIGINALITY REPORT

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SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	LÃ³pez-LudeÃ±a, VerÃ³nica, RubÃ©n San-Segundo, Carlos GonzÃ¡lez Morcillo, Juan Carlos LÃ³pez, and JosÃ© M. Pardo MuÃ±oz. "Increasing adaptability of a speech into sign language translation system", Expert Systems with Applications, 2013. Publication	%1
2	oa.upm.es Internet Source	%1
3	en.pcfavour.info Internet Source	%1
4	simple4all.org Internet Source	%1
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