Improving language acquisition in sensory deficit individuals with mobile application

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Abstract

This paper discusses the problems faced by hearing impaired individuals in India and the use of technology to make their interaction easier. World over sign language is used for interaction among hearing impaired people. Sign language is developed and standardized in many developed nations like United States of America, United Kingdom etc. This has resulted in American Sign Language (ASL), British Sign Language (BSL) respectively. Language acquisition is a major requirement during the initial development stage of a sensory deficit subject. The language skills help an individual’s ability to express self, aids cognitive skills and thought process. In India the pedagogy based on Indian Sign Language (ISL) is developing. Language learning using a multimedia based application is found helpful for sign language users. This paper discusses the development of a mobile application for sensory deficit people for language acquisition. An Android based learning system for hearing impaired individuals, which translates text to Indian sign language videos and images are developed.

1. Introduction

As per the census data of India 2011, almost three million of total population is speech and hearing impaired [1]. According to the resources of National Association of Deaf (NAD), the sign language interpreters for the above population are only 254[2]. The auditory impairment is found almost uniformly distributed among general
population; hence most of the affected individuals reside in rural area. The viability of giving training in advanced technology for such a remotely distributed population for their day to day interaction is a challenging task. The most prevalent electronic device that bridges urban-rural digital divide in India is the, mobile phone and tablet. The advent of mobile phones and tablets running on Android Operating System in the early 2000’s, have made great impact in all fields. Market share held by Android in India has increased from 5% to 62% from 2012 to 2015 [3]. Thus an application that runs on Android platform can reach out to a bigger audience without incurring high expenses of a personal computer and associated software. The dynamic application developing capability also helps to lower the cost.

Studies show that Bilingual approach, in which sign language is taught as a primary language and a spoken language as secondary, shows more development in cognitive, linguistic and meta-linguistic processes of hearing impaired children [4]. In Indian Schools for Deaf, students and teachers make use of cued speech for communication, rather than Indian Sign Language. Indian Ministry of Resource and Development have not accepted Indian Sign Language as a language in spite of its grammatical structure and syntax. The parents of these children consider use of sign language as a social stigma and prefer speech therapy for their children. Studies conducted by National Association of Deaf shows the importance of using Indian Sign Language as the language of learning and teaching in the education of the Hearing impaired [5]. Language development is an essential step for communication and the overall learning process in human beings. Cognitive development without a language struggles and slowly stagnates without progress. This paper discusses the intervention of technology in helping the speech and hearing impaired students to communicate. Even though there exist systems for recognizing American/British Sign Languages, one such for Indian Sign language is yet to be properly established. Owing to the popularity, cost effectiveness and other special features, Android Operating System was chosen as the platform. The work also intends to spread light on the necessity of learning Indian Sign Language and its interpretation to a spoken language, which will help the special school students or even anybody who is trying to learn the language to easily understand the mapping between the languages.

This paper is organized as follows; section II describes contemporary applications available to the hearing impaired community with a brief description of their capabilities. The emergence and importance of Indian Sign Language (ISL) is discussed in section III. The system design and implementation phase is discussed in section IV and V, respectively. The section VI discusses the scope and future expansion possibilities based on this work.

2. Literature Review

Rapid changes in technology have presented different ways to improve the language acquisition and communication among sensory deficit people. Mainly two type classifications are there. They are Technology that helps the hearing impaired community to interact with general people and Technology that helps to increase the literacy rate among speech and hearing impaired people.

Automatic gesture translator is the popular way to perform hand gesture recognition. It is glove based system, in which sensors are attached to a glove that translate finger flexion into electrical signal, to determine hand posture it has the disadvantages of less accuracy and efficiency.

Vision based analysis is the most intuitive method to program hand gesture recognition as it does not involve external parts and just needs an image capturing device. It generally involves procedures such as an edge detection, image feature extraction, and classification.

Speech to gesture converter also helps the hearing impaired community to interact with general people. There many Android based applications that do speech to gesture conversion, like List Note Speech, which is a notepad application to save voice as text. Voice Texting Pro (Android based applications) which convert speech to text and then directly send the message to email and short messaging service (SMS).

I-communicator is an application developed by Interactive solutions, Inc. (ISI) for translation of speech to sign language. It can be used as a dictionary to search for definitions. Another interesting speech to sign language software is Tessa. Here, the system simulates a clerk in a post office that can have discrete communication with a hearing impaired person, which helps him in daily transaction with a post office.
Increasing the literacy rate among speech and hearing impaired people is the challenge taken up by Copycat project. It incorporates computer assisted language learning games to improve language acquisition. The Institute of Disabilities Research and Training (IDRT) offer software that is friendly to hearing impaired people, educational software for hearing impaired is Math signer which provides 3D animated science and mathematics teaching.

3. Indian Sign language

Sign language is the most frequently used language in hearing impaired community. Indian Sign language (ISL) contains both manual and non-manual components. Parameters like shape, orientation, position and movement of hands characterize manual components whereas non-manual components are characterized by facial expressions, eye gaze, and head/body posture [7]. The gestures can be static and dynamic gestures. Gestures with no consideration of movement of body parts can be considered as static gestures and if the trajectory of movement is considered in addition to their posture and orientation with respect to time, then the gestures are referred to as dynamic gestures. The word order in ISL is different from most of the other spoken languages. It follows a participant first and predicate last rule. Temporal aspect is absent in ISL.

4. System Design

This system aims to be a communication means between sign language users and non-users, hence it consist of a two way mapping between sign language to spoken language and vice versa. Thus the knowledge of sign language will gain them fluency in a spoken language like English which will enable access to books, web and other texts based communication, thus aiding spoken language acquisition and vocabulary development among sensory deficit individuals. The public in general, who have no special training can interact with sensory deficit individuals and can be inclusive in their activities. The objective of the system is to be simple and attractive for first time users. The important sections of application are described below.

4.1 Speech to ISL

This is a word level or character level (or finger spelling) translation of English to ISL. In word level, the input can be either the speech or the word can be typed in the text box given it is programmed to play the corresponding video showing the word in ISL. Voice can also be given as input. When voice is given as input, Google’s speech recognizer is used to return the text.
Once the text corresponding to speech is obtained, it can be either be finger spelled or the corresponding video showing ISL gestures can be displayed. In world level translation the text is compared with the list in database and if a match is found, it is played. In finger spelling technique which is used for expressing noun like name or place, each character from the string is separated and compared with an array storing all the 26 letters and the picture corresponding to it is displayed. The application also provides the images of finger spelled word for better understanding. The detailed flow chart is given in Figure 2.

Figure 2: Flow chart of speech to ISL.

4.2 Emergency Mode

The emergency mode is to be used in situation that requires direct communication with non signing population. This includes provisions for playing relevant recorded messages. Figure 3 gives the detailed flow chart of this facility. The messages are linked to various icons and the icons are grouped under various activity icons. The choice of a particular activity opens up menu containing icons programmed under this activity with the linked audio messages. In emergency situation, if the user want to convey a message to people with normal hearing capacity, he/she can click on the particular icon and a audio message related to it is played through the speaker.

5. Implementation

The main feature of android application developed in this project is the character level and word level translation of English text to Indian sign language. Finger spelling is a method used to express nouns by sign language users. In character level translation, any text given as input can be finger spelled in ISL. Images of manual alphabet used in ISL gets displayed on the screen by clicking the translation button. In word level translation, ISL videos
corresponding to the entered word can be displayed.

This application is intended to improve the communication between signers and non-signers. It is also helpful for people who want to learn ISL at a very basic level. Impaired individuals who are very good in ISL can make use of this feature to improve their spoken language acquisition.

![Figure 4: Screen shots of the application developed](image)

According to Paden and Ramsey [6] relation between sign language competence and reading does not develop naturally but must be cultivated. Translation process like chaining, where a spoken language word is finger spelled in sign language and is made clear using pictorial support. The application that is developed employs this idea in mobile platform in a different manner.

The developed application also includes a simple technique to improve the articulation of hearing impaired students by checking the pronunciation of the words in an interactive game. When the game starts picture of a letter appears on the screen with a provision for voice input. The user is asked to read the letter aloud, if the pronunciation is correct then the user will be awarded with a point and next picture appears on the screen. If the user fails, he/she is given the opportunity to repeat the task or quit. This is intended to help hearing impaired students to develop better pronunciation.

6. Conclusion

The importance of sign language as the primary language in a bilingual approach for the overall cognitive development of speech and hearing impaired individuals was the focus of the paper. The implementation of multimedia application on Android platform was carried out for a limited set of vocabulary and transactions. Further expansions in the area of vocabulary development, large scale adaptation of speech and hearing impaired subjects to this platform are to be achieved.

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References


[6] Paddon, Carol PhD; Ramsey, Claire PhD, “Reading Ability in Signing Deaf Children”, Topics in Language Disorders, August 1998.