

A Survey on Communication Gap between Hearing and Speech Impaired Persons and Normal Persons

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Abstract - One of the major shortcomings of society is the social barrier that is created between disabled or handicapped persons and persons who are blessed with all their human faculties in order. Communication, which is the basis of human progress, often tends to be an obstacle for those unfortunate people who are unable to articulate their thoughts. This paper illustrates the lack of proper means to overcome this communication barrier, which has led to social inequality resulting in day to day problems for deaf and mute persons to converse with normal people. The root cause of this gap is that while *deaf* and *mute* persons use sign language to communicate among themselves, normal people are either reluctant to learn it or are unable to comprehend the same. Further, the former rely on lip reading to comprehend what their counterparts have said. Consequently, in a conversation between a hearing and speech impaired person and a normal person the ease of communication and hence the comfort level is hampered. In this survey, we present research, statistics and development trends on the aforementioned subject. We provide a comparison of existing applications and research efforts to bridge the communication gap between hearing and speech impaired persons and normal persons. This survey also reports statistics on hearing and speech impaired persons in India and emphasizes the need of an effective, efficient and portable solution that can overcome the communication problem for hearing and speech impaired persons.

Keywords - *Communication, Hearing and Speech Impaired, Social Barrier, Disabled Persons*

1. Introduction

Living in the privileged galaxy of intellects and witnessing a technical revolution in everyday life it is imperative not to overlook the responsibility to utilize technology in order to contribute to the progress and development of society at large. Communication is the fundamental basis for any individual to live a normal life. As per the definitions presented by Mospi [7], a person

who cannot hear at all or can hear only loud sound is considered as *hearing impaired*. A person who is dumb or whose speech is not understood by a listener of normal comprehension and hearing is considered to have *speech disability*. A person who is unable to speak due to speech disorders is considered as *mute*. Mostly candidates who are hearing disabled are also speech disabled. In an extensive research conducted in various domains, it was found that hearing impairment and inability to verbally express oneself leads to lack of equal opportunities as well as leads to problems even in everyday communication.

According to the Mospi [7] disability statistics in 2002 by Govt. of India, 30.62 lakh people suffer from hearing disorders and 21.55 lakh people suffer from speech disorders.

Census [1] 2001 has revealed that over 21 million people in India suffer from one or the other kind of disability. This is equivalent to 2.1% of the population. Among the total disabled in the country, 12.6 million are males and 9.3 million are females. Disability in speech accounts for 7.5% while disability in hearing accounts for 5.8%.

According to JICA [8] statistics profile on disability in India, hearing disorder accounts for 8.36% and speech disorder accounts for 5.06% in India. Disability statistics provide evidence about the underlying problem itself, such as gender differences and prevalence of disability in society. Disability statistics also provide us a wealth of information about different kinds of disabilities, number of people affected by these disabilities and the obstacles they face in their life. One of the major barriers a disabled person faces in his life is inability to communicate with a normal person.

1.1 Social Effects

People who suffer from hearing and/or speech disorder can be a victim of social isolation. Hearing impaired or speech disabled persons can become targets of bullying among normal people due to their disorders. The bullying can result in lowering of self-esteem in hearing or speech impaired persons, especially among young children.

1.2 Motivation

We were motivated to perform this survey in order to enumerate and compare state-of-the-art research that endeavors to aid hearing and speech impaired persons. This study paper highlights the problems faced by deaf and mute people in communication and lack of effective, efficient, portable and usable technological support to help them express themselves. This survey can become the starting point for anyone trying to understand, evaluate and develop techniques to bridge the communication gap between hearing impaired and speech disordered people and normal people, especially in overcoming the challenges faced in Indian society by providing Indian language support.

2. Literature Survey

This section contains the description about the survey done to identify the problems faced by hearing and speech impaired persons. Further, the study about various proposed and available solutions are discussed along with their drawbacks.

2.1 Physical Site Visits

During the first phase of research, a survey was conducted at 'Aadhar Mukbadhir Shaala' (Aadhar School for Deaf) located at Bibwewadi, Pune. There we interacted with the Principal and teachers of the school discussing with them their teaching methodologies, understanding the mindset and special requirements of the disabled students and the problems faced by them in communication. We were also granted an opportunity to sit in the classrooms and observe the teaching sessions in progress. We attended the classes starting from Kindergarten and going right up to Class VII. The changes in the students were noted as well as the major problems that were faced by the teachers in teaching the students with special needs came across clearly to us. The following data was collected from the school regarding how many students own smartphones, laptops and how many can afford to buy the same.

Table 1: Statistical Data from Aadhar Deaf School

Classes	Age	Laptop	Smart-phone	Can afford to Buy	Partially Deaf
1-4	9-12	7.3%	9.75%	4.8%	31%
5-7	12-16	21%	24.24%	33.33%	15.15%

The fundamental issue that came to light was the fact that we found it extremely challenging to directly communicate with the children. Although they are accustomed to lip reading, we did experience a barrier that we wished to overcome. We observed that teachers were constantly encouraging students to speak but they were more comfortable in communicating through signs. They are adept at communicating through signs with their peers and we even witnessed a full-fledged 'conversation' between two mute girls. Though they were interacting effortlessly with each other via gestures, we as outsiders could not comprehend anything as we didn't know sign language.

Moreover, we observed that though the students were hearing and speech impaired, most of them were quite sharp and some were even intelligent and passionate towards learning. Thus, we felt that *if this communication gap could be bridged, it would lead to tremendous opportunity for hearing and speech impaired people to lead a close to normal life, overcoming the prevalent social inequality thereby leading to their individual as well as societal progress.*

We also viewed the software that was donated to the school by Rotary Club called Kompkin, which was multifaceted e-learning software that housed all the subjects and lessons in accordance with the syllabus prescribed by the Maharashtra State Board along with some interactive games, art and craft tutorials, dictionary and other features. This software was not specially designed to suit their needs. However, we were informed by the school authorities that it helped them in visual representation thereby serving as a tool in the teaching process.

2.2 Study of Existing Applications in Google Play Store

A few philanthropic developers have attempted to solve the problem faced by deaf and mute persons by developing text to audio converters, sign language interpreters and standard signs guides to name a few. However, our study of the existing solutions revealed that none of them

provided a complete solution to the problem. While one application takes input as text and produces audio as output, another simply shows the corresponding sign for the entered text. There is no integration of all the features required for a conversation in one single application. Moreover, all the existing solutions *use American Standard Sign Language which is not followed in Indian deaf schools, as per our survey.*

Table 2: Existing Applications on Google Play Store

Sr. No.	Application Name	Pros	Cons
1.	Virtual Voice [9]	-Simple interface -Uses device's native language	-Needs external software support -Requires internet connection
2.	Note Speak Listen for Deaf [11]	-Synthesized speech feature	-Slow -Only serves literate -Does not support full communication
3.	Sign Language Interpreter [10]	-Converts Text to Sign -Audio output	-Uses ASL only
4.	Sign Short Message Service [12]	-On screen sign language keypad	-No support for ISL

To meet needs of Indian society, there is a requirement of a solution that can effectively and efficiently integrate Indian languages and aid hearing and speech impaired persons to overcome the communication barrier. Existing applications available on Android market do not address this problem. *They are limited to English language and not all people in India can understand and talk in English, especially in rural areas.*

2.3 Study of Existing Research Solutions

Some research papers we studied concentrated on improving the speech capability of hearing impaired persons. Some papers suggest an approach for requirement of picture communication system that enables the deaf to communicate over long distances through telephone lines. Some papers proposed a system to aid the hearing and speech impaired for communication with normal persons. These papers provide some beneficial methods to help the hearing and speech impaired persons. But these systems had certain drawbacks like lack of

portability or were based on American Standard Sign Language.

Following are excerpts and comments on some papers that were studied:

2.3.1 Computer-Aided Interpreter for Hearing and Speech Impaired [2]

The proposed project was created with the aim of developing a system to enhance the quality of communication for hearing and speech impaired people. It seeks to establish a two-way communication by means of Human-Computer Interaction (HCI) and Computer-Human Interaction (CHI). Prashanth Suresh [2] et al. 'the proposed system is a potential human-computer and computer-human interaction for hearing and speech impaired people with normal people. The proposed device is programmed to perform two basic processes viz., a) recognizing the input voice signal and displaying the corresponding pictorial representation of the sign language gesture, and b) capturing the hand gesture and producing the corresponding voice output. This is achieved using Natural Voice processing and Digital Image Processing algorithms.

The above mentioned system makes use of the American Standard Sign Language, which as discussed earlier is not prevalent in India. Moreover, one of the major drawbacks of this system is lack of portability as it is developed for desktop. A camera and a microphone become the prerequisites for the system to convert voice into gestures and gestures to voice. Thus for the proposed system a complete setup of desktop with a microphone and camera will be required. *This implies that it cannot be used for day-to-day communication on the go.*

2.3.2 Graphical Speech Training System for Hearing Impaired [3]

Reshmi K. [3] et al. Computer aided Speech Training plays a significant role in developing speech and language skills of hearing impaired. The authors include a description of different types of hearing impairments, their causes and quantification; review global status of computer-based speech training system and address the growing need of such a system in India where the ratio of speech therapists to needy users is small, further strengthening our perspective on this issue. This paper also discusses an innovative an interactive graphical speech training system for hearing impaired persons which is cost effective and computer based to help hearing impaired children learn and practice speech skills at home

even without the presence of a speech therapist and improve kinesthetic awareness among deaf children enabling them to learn and control the muscular activities of their vocal organs to produce intelligible speech.

The proposed system concentrates on improving the speech of persons of various age groups with partial hearing loss. Consequently, it would not be of use to a completely deaf person. Also even if the person does not regularly practice, then the system will not be of much use. This system is also developed as a desktop application, thus restricting its portability.

2.3.3 Automated speech synthesizer and converter in cue symbol generation for hearing impaired [4]

According to Ibrahim Patel [4], the proposed system performs three principle functions:

- 1) Capture and parameterization of the acoustic speech input.
- 2) Signal identification via speech recognition and generates an equivalent symbol.
- 3) Generate an equivalent cue symbol based on the coded symbol obtained from the speech recognition unit.

The proposed system mainly emphasizes on conversion from normal person to hearing impaired i.e. voice to sign language. It would still be difficult for the hearing impaired person to express his thoughts.

2.3.4 Deaf speech assessment using digital processing techniques [5]

C. Jeyalakshmi [5] et al. An important contribution that auditory science can make to identify what features of the speech stimuli are relevant and what underlying time frequency analysis strategies should be undertaken in order to extract them. Such features would then form the front end of a speech recognition system, or determine the structure of a speech coder. In this paper, results of the study are based on two subjects, one deaf and one normal hearing. However, the differences observed in the two measurements are expected to occur in other deaf and normal individuals.

This paper studies and analyzes the speech of mute people so as to be useful in speech recognition system. Its conclusion follows that we cannot use the pitch and formants for deaf speech recognition since it is not common for all deaf speakers for the same word.

Although it doesn't suggest any solution to problem it at least makes a fair attempt to help in developing speech synthesizers by assessing the speech of mute persons.

3. Statistical Records

To further analyze the extent and depth of the problem, we collected some statistics to illustrate the demographic distribution of hearing and speech impaired persons in India [6].

Table 3: Area-wise distribution of deaf/mute in India (Sarvekshana)

		<i>Number of PWD</i>	<i>Hearing Impaired</i>	<i>Speech Impaired</i>
Urban	Male	4,950	339	298
	Female	3,473	330	169
	Total	8,423	7.94%	5.50%
Rural	Male	17,737	1409	942
	Female	12,628	1164	552
	Total	30,365	8.47%	4.90%

As evident from the above data, slightly higher percentage of hearing and speech impaired persons are prevalent in urban areas. This implies that they would be exposed to technology and therefore potentially can make use of technical advancements and gadgets to help them lead a normal life.

Further, we collected age-specific data of hearing and speech impaired persons in India [6].

Table 4: Age-wise distribution of deaf/mute in India (Sarvekshana)

		<i>Number of PWD</i>	<i>Hearing Impaired</i>	<i>Speech Impaired</i>
0-4	Male	17,461	1,028	1,014
	Female	9,860	597	552
5-9	Male	8,968	1,110	542
	Female	5,644	521	183
10-14	Male	8,770	669	205
	Female	4,905	504	112
15-19	Male	7,329	425	72
	Female	3,596	426	61
20-24	Male	5,409	408	99
	Female	2,423	404	68
25-29	Male	4,572	376	94
	Female	2,174	372	51
30-34	Male	4,104	452	56
	Female	2,254	451	47

35-44	Male	8,330	1,061	162
	Female	4,276	886	70
45-59	Male	12,638	2,455	385
	Female	10,650	2,219	143
60+	Male	22,729	3,312	372
	Female	2,999	3,186	180
Total	Male	100,310	11,296	3,001
	Female	48,781	10,196	1,467

4. Our Observations and Conclusion

According our study, we observed that if we want to bridge the communication gap between hearing and speech impaired people and normal people, we need to develop a technique that allows disabled persons to effectively and efficiently communicate with normal persons in Indian languages. Existing solutions lack support for Indian languages.

From the literature survey conducted, the demographical study, the study of existing applications and proposed solutions we come to the following conclusions:

- a) Hearing and speech impaired persons rely on sign language to communicate among their peers but this is not convenient to communicate with normal persons as the latter do not understand sign language.
- b) To comprehend the words spoken by a person, a deaf candidate relies on lip reading, which is an age-old but highly erratic and unreliable technique.
- c) There is a huge communication gap between hearing and speech impaired persons and normal persons which creates social divide and leads to dearth of equal opportunity for disabled people.
- d) The applications available on Google Play Store are not of any significant use to Indian disabled people as they are based in English, which only the literate are blessed to know and use American Standard Sign Language which is not followed in India.
- e) There is no single application or solution that integrates all the facets of communication and enables a disabled person to have an almost normal conversation with a normal person.
- f) The proposed methodologies are not adequate as they are not useful on-the-go. Most are desktop based solutions, which have restricted use.

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