

Communication between Deaf-Dumb People and Normal People: Chat Assist

L. Jayatilake, C. Darshana, G. Indrajith, A. Madhuwantha and N. Ellepola

Abstract- Chat applications have become a powerful media that assist people to communicate in different languages with each other. There are lots of chat applications that are used different people in different languages but there are not such a chat application that has facilitate to communicate with sign languages. Sign languages are used by deaf and dumb people to communicate among them but those Sign languages vary from nation to nation as American Sign Language, British Sign language, Japanese Sign language etc. The developed system has based on Sinhala Sign language. The system has included four main components as text messages are converted to sign messages, voice messages are converted to sign messages, sign messages are converted to text messages and sign messages are converted to voice messages. Google voice recognition API has used to develop speech character recognition for voice messages. The system has trained for the speech and text patterns by using some text parameters and Signs of Sinhala Sign language is displayed by emoji. Those emoji and signs that are included in this system will pave a new way for the normal people to be more close to hearing disable people and also hearing disable people to be more close to normal people.

Index Terms- Sinhala Sign Language, Google voice recognition API, Gifs, Text parameters, Deaf dumb people

I. INTRODUCTION

For years scientists have worked to find a way to make it easier for deaf and dumb people to communicate. Researchers have used image recognition to translate sign language into 'readable language' and the tool could one day be used on smartphones. There were some researches about translation of sign language to human readable language. This research was also about finding a proper method to translate sign language to human readable language but in this research, the research team expected to develop a chat application that translates human voice and texts to sign language. This is an android based chatting application that can use anytime anywhere with assist of internet.

A sign language is a language which chiefly uses manual communication to convey meaning, as opposed to acoustically conveyed sound patterns. This can involve simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to express a speaker's thoughts. Sign languages share many similarities with spoken languages (sometimes called "oral languages"), which depend primarily on sound, and linguists consider both to be types of natural language. Although there are some significant differences between signed and spoken languages, such as how they use space grammatically, sign languages show the same linguistic

properties and use the same language faculty as do spoken languages.

Sign languages are different according to the country and nations. The system has developed for Sinhala sign language. The Sinhala Sign Language contains different set of signs and those signs were studied by group member. Voice has translated to the text and then translate to the sign language is another component of this project. That component has added for make more efficient real time face to face chatting feature to this system.

This research not only translates voice and text to the sign language. Totally this research scope was expanded up to four main areas. Those main areas were translating voice to the sign language, translating sign to the voice, translating text to the sign language and translating sign language to the text.

Another important aspect of this research was performance and accuracy. The system has focused on voice and text and it was needed to clarify whether voice to sign translation consumes more time. If it does not consume more time, then we needed to research about accuracy of translated sentences and utterances.

The main research problem was lacking of any communication media between hard of hearing people and normal people. Accordingly, the identified research questions were how to identify the signs in Sinhala Sign Language, how to design a localized sign language keyboard? How to convert voice or text to the sign language and vice versa. The main objective of this application was, reduce the communication gap between normal people and deaf-dumb people by giving some help to deaf-dumb people to do their works at their convenient and also allowing them to chat with ease by using this tool.

The project team searched and found some applications that support some of the functionalities as listed. Examples are Signspeak, V2S, Sign Mobile and Hand Talk. They all were designed for some kind of communication and learning process. There was no chat application to communicate with deaf-dumb people and normal people. Thus, our group has developed an application that can cover the application of all the area of deaf-dumb people.

II. LITERATURE REVIEW

There are many research have begun carried out in this research area.

Oi Mean Foong et al has discussed about sign language translation system using Speech and Image processing technique in "V2S: Voice to Sign Language Translation System for Malaysian Deaf People"[1]. The Advantage is Voice (English Language) to sign language of Malaysia. Main disadvantage is System first needs to be trained with speech pattern based on some generic spectral parameter set.

Jonathan Gatti et al have authored “Voice-Controlled Artificial Handspeak System”

[2]. Methodology was Prototype. Advantages of this paper robotic hand designed with openSCAD and manufactured with a low-cost 3D printer used, core automation comprises an Arduino UNO controller by a raspberry Pi computer and uses open source speech recognition engine Julius. One and only main disadvantage of this research was robotic hand has its limitations and possible future developments.

Tirthankar Dasgupta et al has proposed an application that can be used as an educational tool to learn ISL[3]. This research has used prototype methodology. The system was not only improve information access, but it can also get as main advantage and disadvantages of this research. It was not translate Indian sign language in to the text, system takes only simple English sentences as input, sign synthesis module using an animated avatar has not been developed, and some grammar rules cannot be applied to translate English to ISL, not given clear idea about how system works properly.

“Sign Speak: American Sign Language Translation through Sensory Glove.” authored by JanFizza Bukhara, Maryam Rahman, Samna Ishtar Malik, Awaits M. Kamboh, Ahmad Salman [4]. Methodology was to design a glove that would enable deaf and mute people to communicate by translating their sign language gestures into speech according to the American Sign Language, different modules were: glove design, data acquisition system, feature extraction, feature matching, wireless link and android application. There were main two advantages has this research. Those were focused the translation of gestures of the alphabets and also the words, gestures were classified very efficiently and accurately. And also there were many disadvantages. Those were required the user to wear clothes with full sleeves to cover arms. Plus, lighting effects could adversely affect this method, no communication happens between two people, more hardware used (flex sensors, Accelerometer, Contact sensors), only supported Android OS.

Dalia Nashat et al has discussed an android application in “An Android Application to Aid Uneducated Deaf-Dumb People”[5]. Main advantages were, support uneducated Deaf-Dumb people who could not read and write Arabic languages to communicate with others, to learn and to entertain, represent quizzes and games for training deaf and dumb people/kids to identify Arabic and English words, introduce Sign language keyboard. Main disadvantage was, only Support Android OS, no face to face communication happens, educational tool rather than Real world tool, use one sign for the one alphabet.

Dr. Sami M.Halawani et al have authored “Arabic Sign Language Translation System on Mobile Device” authored by [6]. Advantages were 3D Animated characters gave more attraction & realistic to the system users, application could work with online & offline. There were more disadvantages. System had not translated sign language in to text, no option of face to face communication, need more database space (Arabic Sign, applications for translating text to sign animation, other external systems or library).

Noor Saliza Mohd Salleh et al has proposed “Sign Language to Voice Recognition: Hand Detection Techniques for Vision-Based Approach” [7]. Advantages were, more flexible

and useful than prior approach, fast processing. Main disadvantage was video analysis problems.

“Sign Language to Speech Translation System Using PIC Microcontroller” authored by Gunasekaran and Manikandan. R [8]. Advantages were, system offered high reliability and fast response, more precised on hand movement, different languages could be installed without altering the code and main disadvantage was high manufacture cost.

Sachin Bhat et al has proposed an application on “Translating Indian Sign Language to text and voice messages using flex sensors [9]. Main advantages were, user independent, portable system to convert the sign language to text message form which consumes less power because of the low ultra-power AT89S52 microcontroller was designed, used the simple mobile application and also main disadvantage was higher cost.

A. Sujith Kumar et al has discussed mobile chat application on “Sign Mobiles (An android app for especially able People)” [10]. Advantages are enable sign language finger spelling communication, briefly allowed to use mobile communication with face to face chatting, automatic translation and speech recognition. Main disadvantages were large size database was needed to store video clips, mismatch of voice with video clips cannot be handle, it took time to comparing a video clip and voice rather than matching text with signs.

A. E. E. El Alf et al has proposed Arabic sign language mobile chat application on “Intelligent Arabic text to Arabic Sign Language Translation for Easy Deaf Communication [11]. Advantages were this knowledge based system has solved number of Arabic language problem such as synonyms, inflectional, derivational, diacritical and plural, allowed finger spelling translation and disadvantages were this system had not allowed to video processing, this system had not translated Arabic language text to Arabic sign language, it was difficult to match grammar rules of Arabic language with Arabic sign language.

III. METHODOLOGY

The research is developed according to the prototype methodology. There was a necessity to run many iterations of the system phases. Therefore prototype methodology was selected to implement this system. Research team identified the research problem firstly. Then the research team gathered requirements about android chat application structures, hardware resources and software resources that were used for develop a chat applications. Then develop the time frame for the system to complete within one year. The initiative states of the system, the research team divided the whole research component into four sub research components. Then the research team researched about Sinhala sign language signs and how those signs were created etc. Then the Gantt chart created that has indicated tasks and allocated time for each task. Then feasibility analysis was done for clarify that this system is feasible for develop to research team. The research group had gone through around twenty research papers and analyzed the details of the similar systems. The research team met a sign language teacher and had an interview. The information about Sign language words that were gathered in that interview was analyzed. Then research team decided to design emoticons for those signs. The research team needed to observe the idea of normal people about this android chat application.

Then had a survey by creating questionnaires. Around three hundred participants were participate to this survey. 90.9% participants' parentage has given positive response for this project. Therefore the research team was confident to build this application.

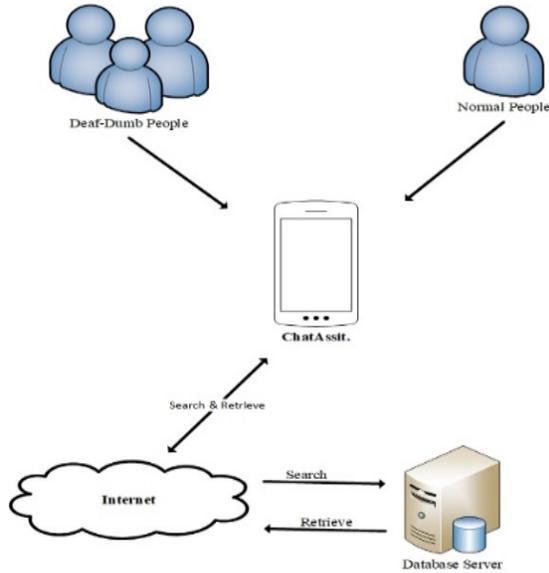


Figure 1 : Framework of the application

Figure 1 shows the framework of the application. It shows the interaction between the software or hardware devices and people. There are two users mainly involved in this system as deaf dumb user and normal user. The system is installed in the smart phones. Internet is a must to run this application as indicated in the diagram and the system has been included the firebase database to store user details and messages that are sent in chat sessions.

Designing of the system was done as similar chat application like WhatsApp, Viber etc. The main difference of the project was the Sinhala sign language signs. Those signs displayed as animated emoticons. Sinhala sign language signs were designed according to the way of deaf and dumb people used to express their ideas in day today life. Those signs were designed using Adobe Photoshop, Illustrator software. The designing part of emoticons was done as step by step. If we considered a sign like "Good morning". It was designed under three steps as follow.

සුභ උදෑසනක්



Figure 2: "Good" word in sign language
designed the signs for "morning" word.

Then



Figure 3: "Morning" word in sign language



Figure 4: "Good Morning" word in sign language

After that the signs were merged as a one sign that depicted "Good morning" sign. The emoticons could not cover up all the possible sentences in the chat. Therefore research team decided to develop a keyboard that has signs and those signs converted when the receiver received the message into normal language such as English language.

After that designed interface and move to the implementation phase. In implementation phase project team had to code and develop the system. Features of system divided into four parts then each group member contributed to implement the android application. After completed whole system, it was forwarded to the testing phase. Implementation of this system was done under four main categories. Those categories were

- Converting text messages to sign language signs
- Converting voice messages to sign language signs
- Converting sign messages to text messages
- Converting sign messages to voice messages.

Signs that were designed in designing phase was used for develop this application. The voice recognition part of the system was done using Google voice recognition API. The Google voice recognition API was embedded in this system and the user voice should be trained for the system for recognize the voice messages. Text patterns were analyzed word by word and the developed a text message converting to sign messages part as well.

The system should be tested that ensured the high system performance and reliability. Unit by unit of this chat application was tested in development process under unit testing. Then those units were merged and tested under integrated testing. Then research team used white box testing and black box testing methods. In white box testing research team tested the android application coding errors in line by line. In black box testing whole application distributed amount few android users to get their feedback to improve the application performance. After all the whole system was tested under system testing and finalize the whole testing process.

IV. RESULT & DISCUSSION

Screenshots of interface of various components of ChatAssist results are included as evidence.

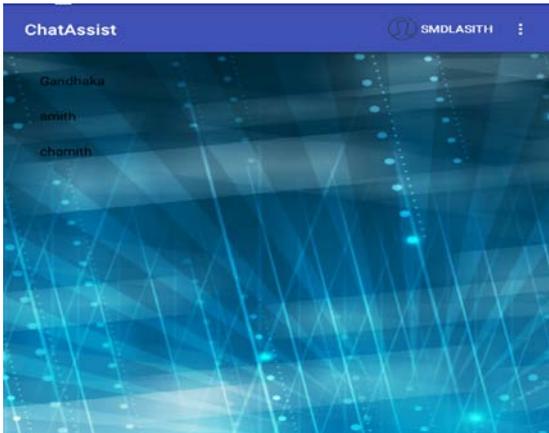


Figure 5: Home interface of the ChatAssist Application

The Figure 5 shows the screenshot of the home interface. User can select the user that he want in the list then he can click the relevant user for chat. In the left top of the interface show the user menu. It has “Change Background Wallpaper”, “Profile”, “About Us” and “Logout” button.



Figure 6: Chat interface with customized sign keyboard

Figure 6 shows the screenshot of chat interface of the application. In this interface user can input using sign letters from A – Z from the sign keyboard.

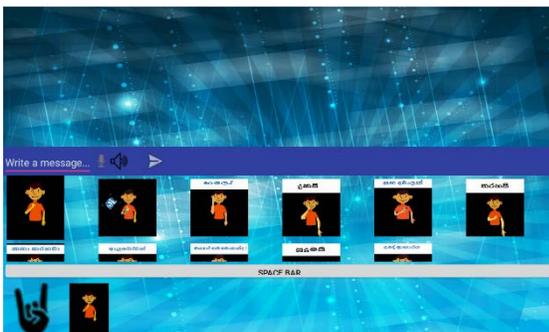


Figure 7: Chat interface with emoticons

Figure 7 shows the screenshot of chat interface of the application. In this interface user can select and send emoticons from the emoji list.

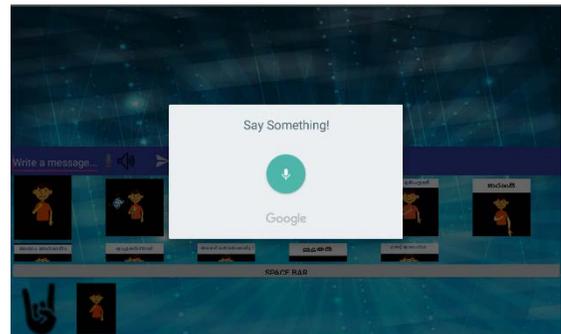


Figure 8: Voice input from the chat interface

Figure 8 shows the voice input from the user and send to another user feature.

“ChatAssist” contains functioning components such as text to sign, sign to text, voice to sign, sign to voice through android mobile application. The system that has been implemented for sending and translation of voice or text to sign language and retrieve from the database and then give the result. Already there were many researches about chat applications but very less of it in sign chat. Because of that the research team decided to complete our research of sign chat. After having meetings with our supervisor and lecturer, the idea of creating android application that goes along with our chat technology was proposed. Tasks of the android application was not easy since the team could not find and information source regarding how to create an android application that is gone along with chat communication technology. Finally after all the discussions with our supervisor and related lecturers project team decided the sign chat communication research component for the application. After doing further research on this idea the team managed ourselves to create the schema and retrieve the information from the Ceylon School for the Deaf & Blind. After discussed with Ceylon School about the Deaf & Blind project, Research team found relevant information regarding the Sinhala sign language. The system was built based on the details the research team gathered.

The reliability of the system was measured by considering maturity, fault tolerance and recoverability attributes. Those reliability attributes were checked with in a given time period. Then the accuracy level of functionalities, accuracy of messages was also checked and clarified because this was an android chat application. Level by level the system was designed and implemented under four categories. Iteration wise and the designing, implementation, development parts were repeated until the system reached to the final level.

Table 1: Brief summary of test cases of emoji

Component	Total Tested result			Tested result as percentage
	Emoji testing			
	Iteration no			
	1	2	3	

Text to sign	17/21	19/21	21/21	90.47%
Text to voice	18/21	19/21	21/21	92.06%
Sign to text	18/21	20/21	21/21	93.65%
Sign to voice	16/21	18/21	21/21	87.30%

The research team needed to cover up all the signs but it was not a better idea therefore a sign keyboard embedded to the system. Signs were included to the system as emoji. Technically less amount of errors.

Table 2: Brief summary of test cases of sign keyboard

component	Total tested result			Total (result as percentage)
	Letter result			
	Iteration no			
	1	2	3	
Text to sign	21/26	23/26	26/26	89.74%
Text to voice	21/26	25/26	26/26	92.30%
Sign to text	22/26	24/26	26/26	92.30%
Sign to voice	21/26	24/26	26/26	91.02%

Research team had to face for a technical issue. That was trained the user sound to the system. Technically the system had not found out a system. Text patterns also analyzed in the system codes user message was sent. The research group has covered the system parts and upgraded but it continued until the system become the perfect.

V. CONCLUSION

The main objective of this research was to implement an android based application for deaf and dumb people to communicate with normal people. One of the area with the greatest potential impact was in the contribution that mobile application can reduce the communication gap between deaf and dumb people with normal people. Recently, communication through mobile phone is considered very important in enhancing better understand in social situation.

Even though there are many similar applications are available in the world, most of them do not meet the basic requirements. Some are very much complex, not user friendly and it's difficult for both side understand the application. Most of them don't provide the exact outcome what user wants.

The project "ChatAssist" has better solution, it is a simple and understandable chat application, which really suits the deaf people, hearing impaired people and normal people to communicate with each other. The ChatAssist system has four components integrated into a single system, which are Translating voice to the sign Language, Translating sign Language to the voice, Translating text to the sign Language and Translating sign Language to the text. User can choose any chat type to chat with other person.

VI. LIMITATIONS

Even though team "ChatAssist" went through a good process in the research project, the team had to deal with so many difficulties when completing the system. Most of problems were taken care by the team to complete, though some still exists. Some of the difficulties are listed down as followed,

- If the Internet connection is down, cannot send messages.
- Designing sign for selected few words.

VII. FUTURE WORKS

"ChatAssist" system can be developed in several ways since the concept is applicable to this kind of situation.

- Designing signs for more words.
- Designing application for support iOS.

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