PROJECT SANWADA

INTELLIGENT MOBILE ASSISTANT FOR HEARING IMPAIRERS TO INTERACT WITH THE SOCIETY

Project ID: 17-092

Project Final Report

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B.Sc. Special (Hons) in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology

Sri Lanka

Submitted on 04/10/2017

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GIF Compression & Extraction

Project Final Report

Dissertation submitted in partial fulfillment of the requirements for the degree of Science

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DECLARATION

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The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

……. …….

Signature of the supervisor Date

Prof. Samantha Thelijjagoda

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ABSTRACT

A language is a way of words or signs that people use to share feelings and ideas with each other. In view of the society there is an issue in communication among hearing impaired people and hearing people. Most of the hearing people have no idea about the sign languages and they are not having any desire to learn sign language. Thus, typically hearing impairers are used to be isolated. When considering about all the solutions there is an absence of a Sinhala application with Sinhala sign language. Since most of the solutions are desktop applications, hearing impairers feel so uncomfortable. In the modern era where mobile technology plays a superior role in day to day life, Project "Sanwadha" is an intelligent assistant for the hearing-impaired people for communication. The proposed application is under cross platform mobile development where users can reach the solution widely. The core of the Project "Sanwadha" is Instant Messaging (IM) chat. Here the application will get the text from the ordinary person in Sinhala and it converts to Sinhala sign language. The message will be directing to hearing impaired person in a format of GIF. 2D model can be used by the User (Hearing impaired) to grasp the idea by creating the sign as they wish. That sign would be altering in to either Text or Voice to interact with the society. Hearing people also can cooperate with the hearing impairers with the voice recognition mechanism. This solution would come up with an intelligent application where hearing impairers makes empower in the society through communication. Reaching Sri Lankan deaf community is another foremost objective of this project. This hopes to narrow digital divide that between enabled and hearing impaired users. The significance of this proposed application is that it allows hearing-impaired individuals to communicate when they are long distance apart. This application would bridge the gap between hearing impairers with the society.

Keywords: *Hearing-impairers, Instant Messaging, Mobile Application, Voice recognition, Natural Language processing, Graphic Interchange Format Introduction*

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LIST OF ABBREVIATIONS

NLP – Natural Language Processing

GIF – Graphic Interchange Format

ASR – Automatic Speech Recognition

SLU – Spoken Language Understanding

SLG – Spoken Language Generation

TTS – Text to Speech Synthesis

IM – Instant Messaging

API – Application Program Interface

1. INTRODUCTION

1.1. Background

In 2003, a research has been carried out about the number of deaf people in Brussels. The results of this study showed that about 1 on 1000 people are deaf. It wondered how Hearing-impairers deal with their situation daily and if there are difficulties with the hearing society. Different sources are referred by us and it was immediately clear that the life of a Hearing-impairer is not that much easy. Research has shown several discoveries concerning Deaf community. Most of the time Hearing-impairers discriminated and excluded by the society. It has been recognized that the hearing society has misperceptions about Hearing-impairers [1].

Problems can be found in several environments: at work, at school, in medical world, in social life etc. Due to the communication problems, Hearing-impairers face many barriers. Deafness is invisible disability which is not surprising. Because you can't see if a person is Deaf [2], [40].

Let's consider about the evolution in communication, in the last half of the 20th century the communication developed rapidly. Today this development has made communication in the day-to-day life easy. With the advancement of the technology, accessing internet has become the most imperative thing. Thus, people are more prone to use the internet as a means of communication more frequently. Using chat systems for communication has become a trend and the most popular way to connect with people all around the world. Although this is the case, today this facility is restricted only to ordinary people. Yet people who are differently-abled are isolated and denied of this facility just because of their disability. Per our knowledge and experience, most of the chat systems are based on text based chatting. Have you ever thought about, how a person with a disability uses this kind of application? Using new technologies to help people with disabilities is highly regarded and much research in this area is underway [3], [38].

The focus of this investigation goes towards the Deaf community. The technology has not sufficiently reached to the Hearing-impairs. If they want to use these kind of chat

applications, those applications should support the ways that deaf people can manage. Although visually-impaired people can communicate by using the human language. Hearing-impairers cannot use that language. They usually comfortable with the sign language. Hence, these applications should support the sign language [3], [39].

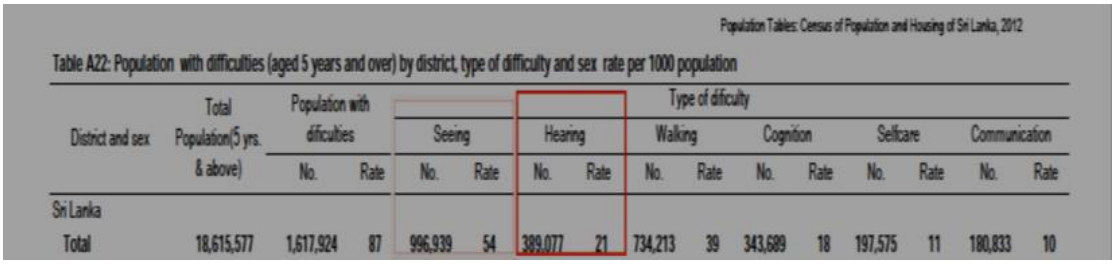
Sign languages are natural languages with their own grammar and syntax, specially formulated for the deaf people. Make use of finger spellings, body language, lip pattern and manual communication, to convey the meaning. It mainly involves the use of orientation and movement of hands. The language can be taught only by a person who is specially trained in it. Today, the 'differently-able' people can communicate to the rest of the world as easily and effectively as the able bodied. The credit goes to the sign language which was developed earlier. Most countries have their own national sign languages. Sri Lankan Deaf community also using Sinhala sign language [37].

Nowadays few different applications for people using English sign languages and other sign languages. Our main aim is to reach the Sri Lankan Deaf community who are using Sinhala sign language. Besides Sinhala is the foremost language in Sri Lanka. Today communication of Hearing-impairers with ordinary people are done by an Interpreter. Furthermore Hearing-impairers comfortable with Lip reading. Yet with the absence of an Interpreter, there is a huge gap between Hearing-impairers and Hearing people.

In the investigation towards Deaf community, Ragama School for Deaf was the most imperative place visited. Along with that the Interpreter from “Ahanna” community supports us to reach our background study very effectually. The conclusion gained was that it is equally important that hearing people should learn to deal with Hearing-impairers.

1.2. Literature Survey

Agreeing to the Census of Population and Housing – 2012 there are 389,077 hearing impaired people out of 18,615,577 people who are above 5 years old. That is roughly 21 people out of 1000 population are hearing impaired in Sri Lanka [4]. The deafness is variable. It can occur at any stage of life cycle, it may impact on the individual’s ability to function on a day-to-day basis and it may or may not be disabling.

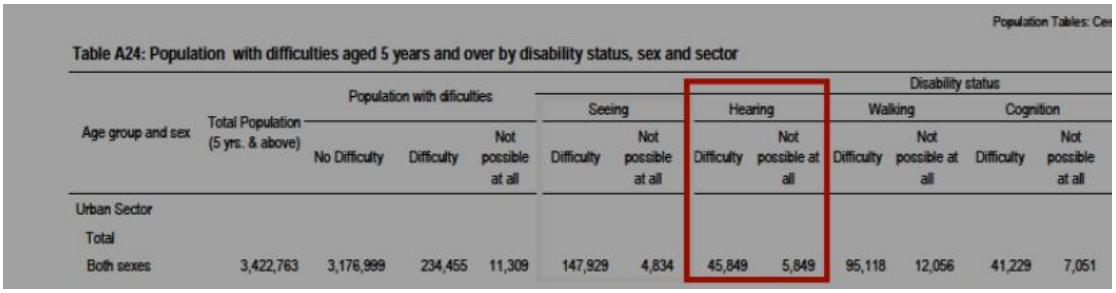


Population Tables: Census of Population and Housing of Sri Lanka, 2012

Table A22: Population with difficulties (aged 5 years and over) by district, type of difficulty and sex rate per 1000 population

District and sex	Total Population(5 yrs. & above)	Population with difficulties		Type of difficulty											
				Seeing		Hearing		Walking		Cognition		Selfcare		Communication	
		No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Sri Lanka															
Total	18,615,577	1,617,924	87	996,939	54	389,077	21	734,213	39	343,689	18	197,575	11	180,833	10

Figure 1.1: Population with difficulties rate per 1000 population



Population Tables: Ce

Table A24: Population with difficulties aged 5 years and over by disability status, sex and sector

Age group and sex	Total Population (5 yrs. & above)	Population with dificulties			Disability status							
					Seeing		Hearing		Walking		Cognition	
		No Difficulty	Difficulty	Not possible at all	Difficulty	Not possible at all	Difficulty	Not possible at all	Difficulty	Not possible at all	Difficulty	Not possible at all
Urban Sector												
Total												
Both sexes	3,422,763	3,176,999	234,455	11,309	147,929	4,834	45,849	5,849	95,118	12,056	41,229	7,051

Figure 1.2: Population with difficulties

This research is mainly focusing on these people. Hearing and hearing impaired people are having difficulties when they are communicating in day to day life. These people are using sign languages to communicate with each other." A sign language is a language which chiefly uses manual communication and body language 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 fluidly express a speaker's thoughts". There are around three hundred sign languages in the world, each sign language differs from each other by country and the language. Hand gestures in sign languages are defined for both alphabets and word phrases.

Some of the sign languages used around the world are:

- Sri Lankan Sign Language
- American Sign Language
- British Sign Language
- Italian Sign language
- French sign languages

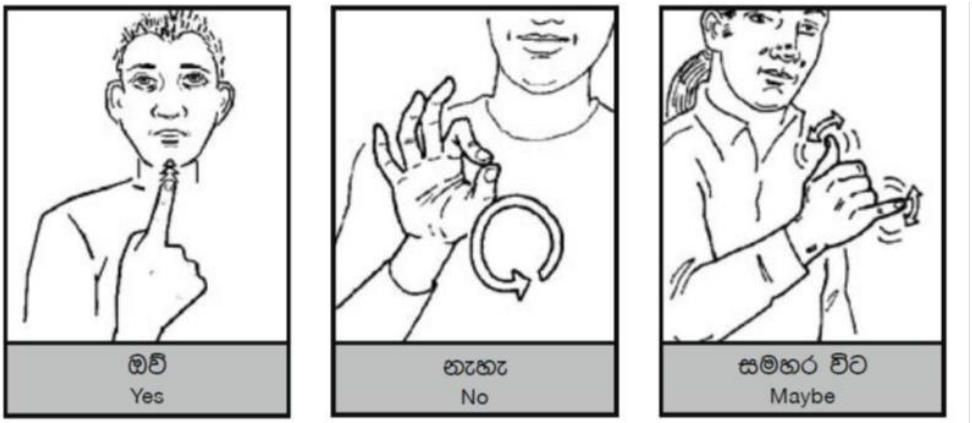


Figure 1.3: Sri Lankan sign language

There are few different applications for people using English sign languages and other sign languages. Research is mainly focusing on hearing and speech impaired people in Sri Lanka who are using Sinhala sign language and when they are communicating with Sinhala. One difficulty hearing and hearing impaired people are facing is they can only guess what a speaker is saying by lip reading, to understand totally they need someone to interpret in sign language what speaker is saying. Another difficulty is when trying to communicate something to a person who doesn't know sign language. They need interpreter to translate sign language to native speaking language. Conversational speech can be measured as having a Loudness of approximately 60 decibels (dB). Hearing is considered significantly restricted when the ear cannot interpret or process sounds of 25 dB or more [5].

The most natural way to communicate for human beings is through words. When considering about the experience of disability most of them don't have experience of expressing their thoughts with hearing people. High percentage of disabled people are Hearing-impairers. [1].

There are 75 million of deaf people use sign language as their first language. Each country has one or sometimes two or more sign languages. There are some common techniques used by deaf people to communicate with normal people. Some deaf people use speech or sign language only or a combination, some may use finger spelling or writing or body language and facial expressions. Like spoken languages, signed languages vary. Sign languages have their own accents, dialects, and idiosyncratic vocabulary. Signs may be limited to regions, schools, or even families [6].

As a help to these people so far, many applications, systems and devices have been introduced. But the main problem is to connect both non-hearing impaired with hearing impaired simultaneously. For that there are only limited number of systems are evolved. There are applications which can only turn voice to text or sign language to text separately. This research is introduced this system as a two-way communication system. These kinds of systems mainly focused on accuracy level. When working with hand gesture recognition part, many systems used image processing as the technique. It takes lots of time and lots of processing to work on. Even though it achieved, when it comes with hand gestures some rotational movements cannot be track with image processing [7].

The Bolt, Beranek and Newman System

The first computer-based speech training aid was developed around a Digital Equipment Corporation PDP-8E minicomputer. This was an experimental system, resulted directly from its development. The system consisted of 3 sensors (voice-microphone, accelerometer on the throat, and accelerometer on the nose) a preprocessor, the computer, and various output displays. The preprocessor included a pitch extractor, a spectrum analyzer, and a nasal detector [8].

Hand Gesture Recognition

This describes using RGB color spaces and models and presents, some possible ways of segmentation with algorithms. Various experiments were conducted for different gestures and results were obtained with accuracy. The algorithms were implemented in MATLAB programming language. Here it concluded Capturing the hand without the glove results in inaccurate outputs. Data base creation and testing using a GUI makes the system more user friendly. The database can be expanded with more number of hand gestures and its different possibilities to improve the performance of the system. This system consists of a basic web camera which points to the signer, MATLAB -which performs the image processing operations and an audio speaker or a display to convey the message shown by the signer. Here a colored glove is used by signer. The gloves will have red, blue, green color pattern on each finger. The intensity of the color changes with gestures. The gestures are captured by a camera. The intensity changes of the colors are detected. The gestures are detected with image processing using MATLAB [9].

Speech to Text Conversion in Real-time

This software is developed to enhance user's way of speech through correctness of pronunciation following the English phonetics. This desktop software allows one to learn, judge and recognize their pronunciation in English language. This also provide an extra add-on feature which enhance the user's communication skills by an option of text to speech conversion also. This software presents method to design a Text to Speech conversion module using Mat lab and visual studio. As a real time system, this provides a good timing (within 2-3 seconds) and less cost when compare to other voice to text converting systems. Yet this system only can be used with American accent and this is a desktop application [10].

Analysis and selection of features for gesture recognition based on a micro wearable device

This one is considering the flexibility of human finger, a device is developed which can be put it on a finger to detect the finger gestures, and 12 kinds of one-stroke finger gestures are defined per the sensing characteristic of the accelerometer. Designed a wearable device with an accelerometer to wear on finger and catch movements in 3D space. Experiment results indicate the feature subset can get satisfactory classification results of 90.08% accuracy using 12 features considering the recognition accuracy and dimension of feature set. The system is a ring shape sensing device based on a 3-trial accelerometer. To the system adopt the algorithm of feature selection, stepwise regression. This system defines great accuracy level even with the gesture combinations. But with this system only can be performed very simple set of gestures plus this is not a portable system [11].

Recognition of no manual markers in American Sign Language (ASL) using non-parametric adaptive 2D-3D face tracking

This one address the problem of automatically recognizing linguistically significant non-manual expressions in American Sign Language from video. Develop a fully automatic system that can track facial expressions and head movements, detect and recognize facial events continuously from video. The main contributions of the proposed framework are the following:

- Built a stochastic and adaptive ensemble of face trackers to address factors resulting in lost face track.
- Combine 2D and 3D deformable face models to warp input frames, thus correcting for any variation in facial appearance resulting from changes in 3D head pose.
- Use a combination of geometric features and texture features extracted from a canonical frontal representation. The proposed new framework makes it possible to detect grammatically significant non-manual expressions from continuous signing and to differentiate successfully among linguistically significant expressions that involve subtle differences in appearance [12].

Most of these systems and devices are only focused on a one side communication. But in this application, both focused on text to sign language and sign language to text. The specialty of this system is there is no such a system invented and not for Sinhala language.

Observation from the Literature Review,

- There are very less number of systems have been introduced for Sinhala language.
- The systems which are using image processing techniques are hard to implement and cannot reach the higher accuracy levels of detection when it comes to rotational of gestures.
- Some systems are high cost and technology level is not tally with our country.
- Lacks the expertise and the capacity to deal with deaf people to train them.
- Not having enough existing systems to use for the deaf users with well based manner and remains drawbacks of them.

1.3. Research Gap

There is a communication gap between Hearing-impairers and the ordinary people. Most of the time that is being filled through an Interpreter. It would be a problem when there is no Interpreter. By now, there are some solutions to cover this problem. But those solutions couldn’t reach the Sri Lankan Deaf community. Most of them are not flexible

with the Deaf users and they are not casing all the extents they need. So, by today Hearing-impairers have challenged with a huge communication gap in their day to day life. Our proposed application would be the finest solution for this gap.

1.3.1. Research gap in Creating chat application

The purpose of this project is to design and implement a multi featured chat application among ordinary people and hearing impairers. This chat application would be included by different means of communication other than the conventional text to text keyboard conversation. Things such as interpreting sign language signs to text and voice to text will be the most useful features of the system. Ordinary user could be more comfortable with Sinhala and Singlish texting. Moreover, this application can use with mobile data and if there are no mobile data, such a case user can use offline message feature.

1.3.2. Research gap in Voice Recognition

There has been a significant amount of research done in voice recognition where a system can be trained to identify a variety of accents based on various voice models which are trained to identify voice. A drawback found is the problem to recognize voice in a noisy environment. This of course cannot be eliminated 100% and specialized have been created to avoid the above-mentioned problem. But a perfect software solution has not been invented yet. Another problem unique to Sri Lankan users is because Sri Lankans have a unique accent when speaking English. Voice recognition systems fail to detect some words pronounced by Sri Lankans. Along with that there is a need to address this problem with our research. Voice recognition systems also take high processing power and the motive to reduce processing power is another area of concern.

1.3.3. Research gap in creating 2D Hand Model

This propose a real-time model-based 2D hand tracker that combines image regions 2-axis accelerometer placed on the user's hand. The accelerometer and tracker are synchronized by casting the calibration problem as one of principal component analysis. Based on the assumption that often, the number of possible hand configurations is limited by the activity the hand is engaging in. Use a multiclass pose classifier to distinguish between a few activities dependent articulated hand configurations [9].

1.3.4. Research gap in Semantic Analysis

Identifying Semantic analysis would get the meaning of a set of words and convert that meaning into a GIF. Enable the user get the core idea of the message without having nonsense words [17].

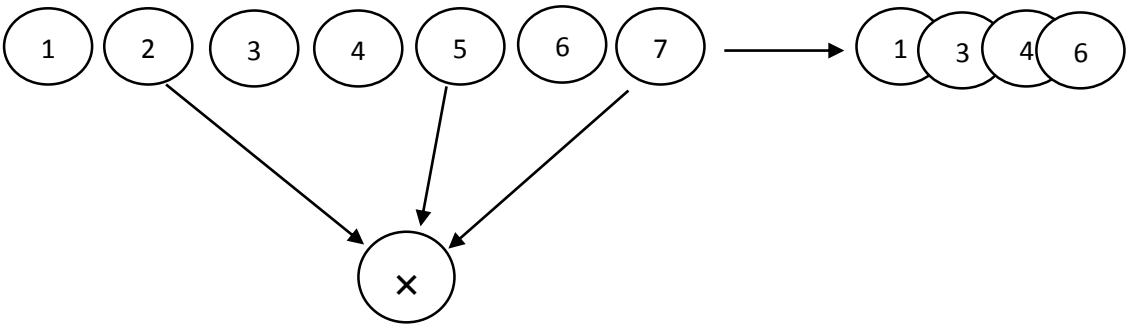


Figure 1.4: Semantic Analysis procedure

1.3.5. Drawbacks of current solutions available

Drawbacks of the solutions available today can be summarized as follows

Evaluation Study in Diverse

Deaf chat

Deaf Chat facilitates communication between Deaf and Hearing individuals. It replaces the pencil and paper that is frequently used, plus you can communicate over moderate distances.

A network connection is established between two devices (phones or tablets). The first individual can input text via voice recognition or the keyboard into his Local text area and send this to the second device. On the second device, the text will appear in the Remote text area. The second individual can respond back to the first by entering text into his Local text area, again using either voice recognition or the keyboard.

Using a network connection rather than Bluetooth allows the individuals to be near each other or separated by a large distance. The network connection will most likely be Wi-Fi, but it could be an Intranet or even a connection via the Internet [13].

Deaf - Hearing chat

DH Chat is a system for face-to-face communication between deaf and hearing people without a sign interpreter. If you are a hearing person, you can communicate with your deaf relatives, friends, clients, employees and so on. If you are a deaf person, you can make a face-to-face conversation with hearing people without sign interpreter. You can use the system everywhere: at home, at your work, at restaurants, during your education and so on [14].

NGTS

NGTS (Next Generation Text Service) is a fantastic application for helping deaf and hard of hearing people to communicate over the phone via a text relay assistant. NGTS is especially handy for using at work and can be tailored to meet your specific communication needs. User can choose from type and read, speak and read, type and hear, speak and hear options, and it's really simple to use.

Glide

Glide – Video Chat Messenger is a deaf person's favorite. The famous video messaging app allows you to send super-fast videos up to 5 minutes long, and completely hands-free. Other elements include group chats and uploading videos to social media.

BizzBook

BizzBook application lets user connect with local business using Text Messaging. User can talk to businesses. For example if user need to know their specials or hours of operation- or Group Chat. z5 Mobile is a video relay service. Whenever user need to

speak with a non-signer this is the way to go. Z5 Mobile worked over Video with translators who verbally communicate your messages to the hearing caller.

Evaluation Study in Sri Lanka

Nihanda System

This system used for children who are diagnoses with hearing impaired. Used leap motion controller to track signs and convert them to voice. They implemented game based learning system to hearing impaired children to learn sign language easily. System demonstrate how to identify individual signs and phonetics though videos and images. Mind teaser games uses to self-motivate children to improve their learning abilities. This system capture voice and gives 2D images.

Ahanna System

"Ahanna" is mainly focused on teaching the Sinhala sign language to the users who uses that system. It is web based online application.

The main intention of the "Ahanna" is to spread the pure Buddhism to the deaf community of Sri Lanka through Sri Lankan Sign Language (SLSL) while gifting many more valuable activities, innovative products & new ideas to improve the knowledge, education & quality of Sri Lankan Deaf Community [15].

KATHANA Sinhala speech recognition system

"KATHANA" is a solution for recognizing and interpreting voice. Application converts an acoustic signal which represents human speech done in Sinhala language captured by a microphone, to a set of words. Emphasis is that this acoustic wave represents a human speech done in Sinhala language. The recognized words which are the results can be used for applications as commands, data entries or could be served as the input to further linguistic processing to achieve speech understanding [16].

Table 1.1: Comparison with Available system

Features	**Deaf chat**	**Deaf hearing chat**	**Nihanda**	**Ahanna**	**Kathana**	**Sanwada**
Speech to sign translation-Sinhala	✗	✗	✗	✗	✗	✓
Text to Sign language – Sinhala & Singlish	✗	✗	✗	✗	✓	✓
Translated sign language to GIF	✗	✗	✗	✗	✗	✓
Sign language using 2D modeling	✗	✓	✗	✗	✗	✓
Stickers and animated stickers	✓	✗	✗	✗	✗	✓
Interaction with Facebook messenger	✗	✗	✗	✗	✗	✓
Mobile application	✓	✓	✗	✗	✗	✓

1.4. Research Problem

- Communication between each other is one of the most essential thing to every human being but unfortunately hearing impaired people are having difficulties in communicating with day to day life in the society.
- Subsequently it is essential to bridge the communication gap between hearing-impaired people and the ordinary people.
- Deaf people communicate visually and physically rather than audibly. Many deaf people feel awkward or become frustrated trying to communicate with ordinary people, especially when no interpreter is available.
- When consider about deaf people in distance; there's no way to share emotions and feelings unless they meet each other.
- Deaf community discourage to be social. They do not have any desire to meet each other and share ideas.
- Due to having communication problem; there are many concerns faced by deaf people in day to day travel once that person does not know how to go.
- When following the day to day scenarios; deaf people unable to get any support from ordinary people since there isn't any common communication mode.

This is the problem addressed in our research. Several researches have tried to address this issue, although none of them could not grasp the achievement successfully.

1.5. Objectives

1.5.1. Main Objectives

- The main intention of the investigation is to deliver excessive support by enabling hearing impaired people to communicate with others, share feelings and ideas, actively interact with the society and help that they require with minimum amount of effort and time. And, allowing the hearing impairs to play the role by way of ordinary people without having desertions.

- To influence the Deaf community with the highest technology evolution to make hearing-impairers more comfortable in the global world.

1.5.1. Specific Objectives

- To identify many Hearing-impairers prefer to communicate with Sign languages which leads to the communication barrier with ordinary people. Subsequently Deaf people become frustrated to interact with the society.
- To establish the pathway for investigation, research papers and documents were surveyed mostly. Furthermore, the real obligation was discovered through the interviews conducted with students of Deaf School.
- To determine the use of mobile applications for deaf people can be observed as a diligence that allows them regardless to utilize to any need of learning and communication at any time anywhere.
- To emerge the application in Sinhala language to reach the Sri Lankan deaf community in an effective way.
- To advance the text message to a Graphic Interchange Format (GIF) to get the message in sign language with more accurate and attractive manner.
- To allow the generation of own sign language using 2D model provided which makes hearing impairers more comprehend about the message they want to direct.
- To enhance Sinhala voice recognition algorithm.
- To interact with the most popular social media like Facebook Messenger.

- To verify that the product is reliable for Hearing-impaired community to lead to a sociable life.

Apart from above mentioned objectives following intentions could be identified.

- To minimize the Barriers in communication

  The main problem that the differently able people face is the communication difficulty. These barriers affect access to public information, opportunities to express oneself and access to essential services such as health, housing, transportation, education and employment. Even though we can't address all these areas, our system is an effort to minimize the barriers between differently able people and normal people in communication, by providing them a way to interact with other people and the society.

- To eliminate Barriers in education

  People with disabilities often have access to less and inferior education than people without disabilities, because of many types of barriers. This system will provide them a good opportunity to share their knowledge and experiences with other each other.

- To minimize Barriers in healthcare

  There are numerous barriers encountered in the access and delivery of health services. The major unavoidable issues in health care are physical access issues, funding, attitudinal and communication issues. Our system can address most of these areas other than funding and attitudinal as they are depending on the person. The users can connect with their doctors via system and can get the opinion.

- To minimize Barriers in developing human relationships

  Isolation of differently able people in today’s world has become a severe problem even though the modern and developed world today has failed to realize. Most of the time people who are differently able, not care for by their families, alone in places under the care of never met charity workers, are left out to be so alone. By using this system these people may able to interact with the outside world and develop good relationships with them.

- To be an outstanding team player

As a team of four dynamic individuals collaborating to achieve established goals and objectives of the CDAP project process by us. Inbuilt team-player potential to produce outstanding personage are hoped to recognize and enhance.

1.6. Research Questions

- What are the features that hearing-impaired person expects from a mobile application?
- What are the social media services that are connected?
- What are the languages that used for the input text?
- How to deliver the GIF message to the user?
- What are the technologies worked out?
- What are the techniques that can make the best performance?

2. RESEARCH METHODOLOGY

This chapter illustrates the methodology for handling the project. It's a methodical approach to the research, gathering requirements, designing and implementation to create effective solution to an existing problem an area where improvement is required.

Proposed solution presents an intelligent assistant for hearing impairers to interact with the society.

The project has a very significant research areas like, Natural Language Processing (NLP), Voice Detection, Machine learning, Artificial Intelligence, Graphic Interchange Format (GIF) conversion and Mobile platform development. Machine Learning and GIF conversion is important for the identification of individual words in each Text and converted sign language send via compressed GIF files. Research conducted further study on above mentioned research areas then the information can be used to achieve the objectives [26].

2.1. System Overview

Considering the outcome of the literature review, it is conceivable to decide the most appropriate tools, technologies and software solutions for the implementation phase. In some cases of design conclusions, study more than one possible technologies and take performance and dependencies into deliberation.

The projected solution can be divided to following key components:

- 2D Model creation
- Text Conversion Mechanism
- GIF file Compression and Extraction Mechanism
- Voice Recognition Module

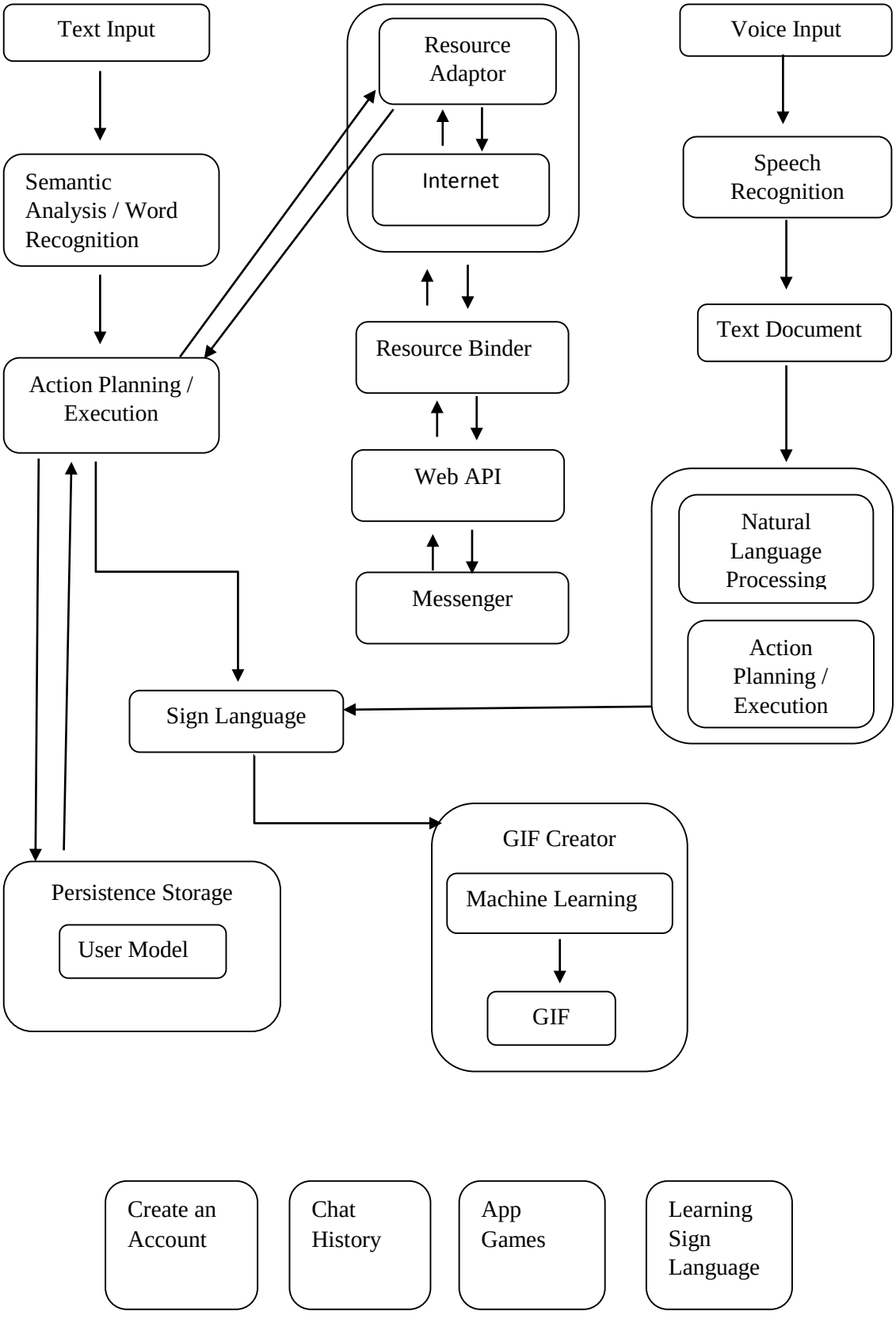


Figure 2.1: System overview of proposed solution

2.1.1. GIF file Compression and Extraction Mechanism

GZIP Compression

Figure 2.2: GZIP Compression icon

GZIP is a file format and a software application used for file compression and decompression. The program was created by Jean-loup Gailly and Mark Adler as a free software replacement for the compress program used in early UNIX systems, and intended for use by GNU (the "g" is from "GNU"). Version 0.1 was first publicly released on 31 October 1992, and version 1.0 followed in February 1993.

gzip

Filename extension	.gz
Internet media type	application/gzip[1]
Uniform Type Identifier (UTI)	org.gnu.gnu-zip-archive
Developed by	Jean-Loup Gailly and Mark Adler
Type of format	Data compression
Open format?	Yes
Website	www.gzip.org (obsolete)

Figure 2.3: GZIP details

GZIP compression is bundling (zipping) pages on a web server before the page is sent to the visitor. This saves bandwidth and therefore increases the loading speed of the page significantly. The visitors' web browser then automatically unzips the pages. This compressing and unzipping only takes a fraction of a second.

GZIP compression is recommended for all types of text files such as:

- HTML (.html) but also all types of dynamic HTML (such as extension .php, .aspx)

- Text files (extension .txt)

- CSS and JavaScript (extension .css and .js)

- Web services, such as WSDL, REST and JSON

GZIP compression is not recommended for non-text files, such as graphical files and .zip files because it hardly saves space and can therefore increase the loading time.

Importance of GZIP Compression

GZIP compression saves 50% to 80% bandwidth and will therefore significantly increase the website's loading speed.

The text files are compressed (zipped) on the web server after which the visitor's web browser will automatically unzip the files. This compressing and unzipping only takes a fraction of a second without the end user noticing.

Figure 2.4: Compression percentage

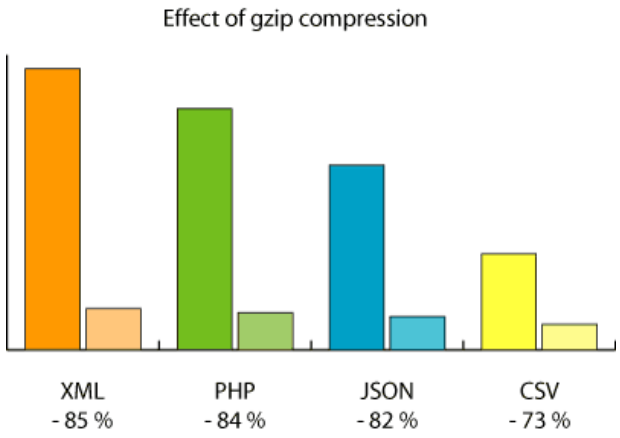


Figure 2.5: Effect of GZIP Compression

Mainly in view of GIF conversion, the string output gain through text conversion is going to be converted into GIF format in a high accuracy level. The format supports up to 8 bits per pixel for each image, allowing a single image to reference its own palette of up to 256 assorted colors chosen from the 24-bit RGB color space. It also supports animations and allows a separate palette of up to 256 colors for each frame.

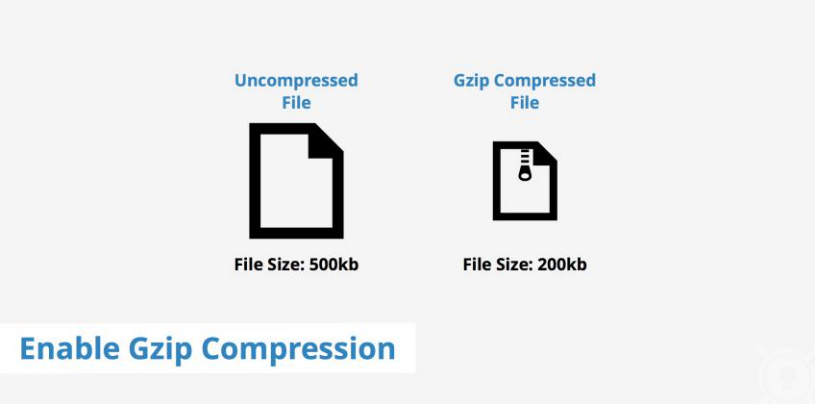


Figure 2.6: Enable GZIP compression

The capacity of a GIF file is very high. Hence it would take some time to move a GIF file to user. This can be a drawback in our application since it is an instant messaging application. As per the solution these GIF files are send through the networks by compressing to optimize the capacity. For that, the “GZIP Compression Algorithm” is used for the compression.

GZIP is a file format and a software application used for file compression and decompression.

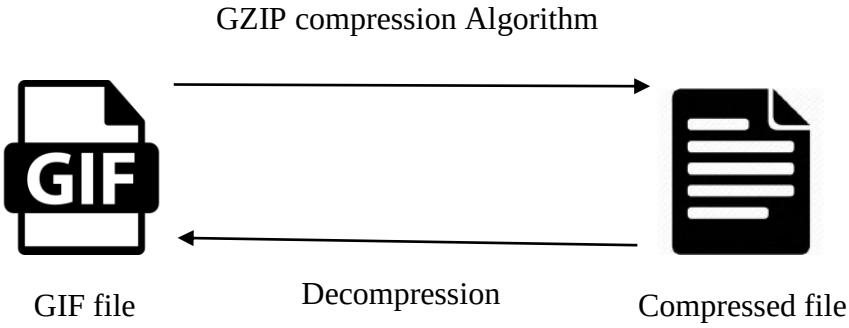


Figure 2.7: GIF Algorithm

GIF files are send through the networks by compressing. For this procedure, the "GZIP Compression Algorithm" is used where the compression can be done with less period. The compressed file can be send via proposed application "Sanwadha". The output GIF is going to be delivered under decompression.

Additionally, Compressed GIF file can be send through Facebook Messenger to the Deaf user. As Facebook Messenger has become a prevalent communication media this attempt would be more successful. Then finally the output GIF is deliver to the deaf user under decompression.

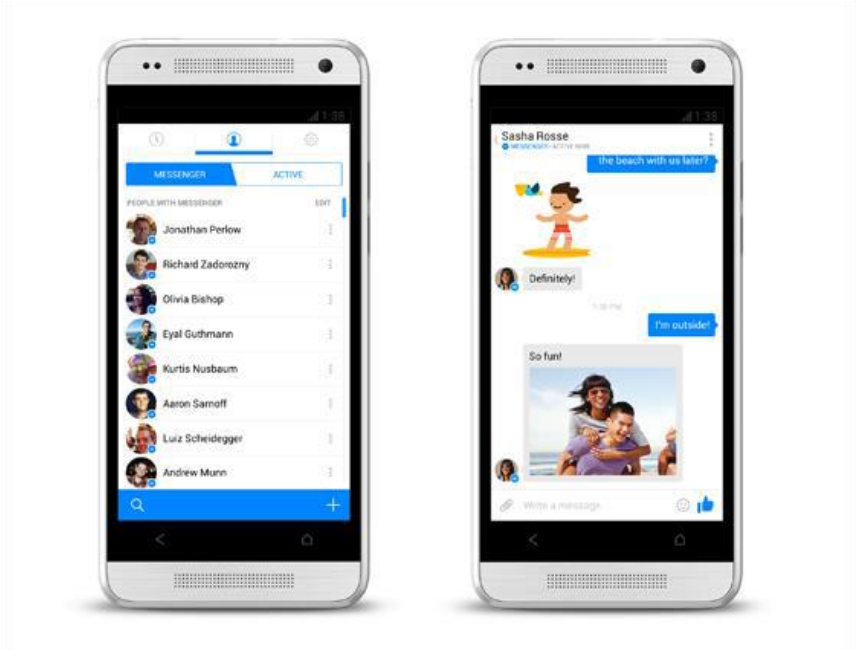


Figure 2.8: GIF delivery through Facebook messenger

There is very lesser amount of similar applications which are used around the world to support deaf people. But these systems have unresolved issues with it.

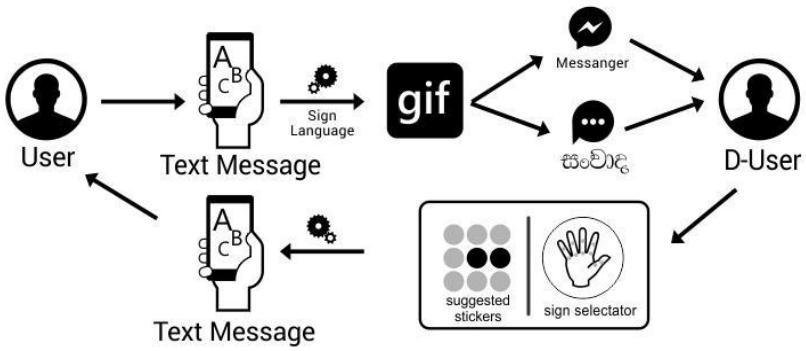


Figure 2.9: System Diagram for Text Conversion

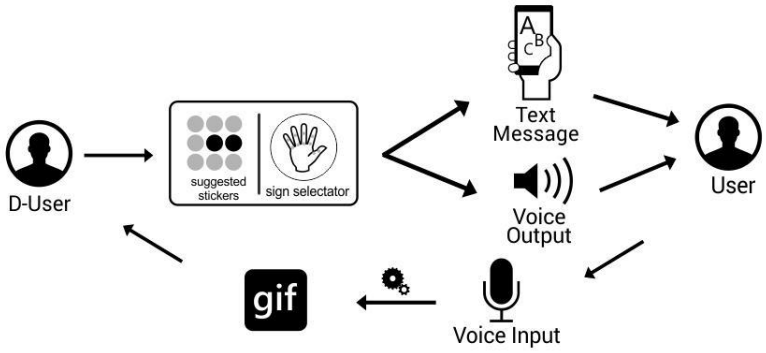


Figure 2.10: System Diagram for Voice Conversion

2.2. Resources Needed

2.2.1. Software Boundaries

- Android Studio

Application should be compatible with android devices. Android Studio is the fundamental tool used for developing the application. Since it is the official development IDE for Android development. Android Studio is mainly used for Java language to development of sound recognition part.

- Microsoft Azure

Microsoft Azure Machine learning (Azure ML) service is part of Cortana Intelligence Suite that enables predictive analytics and interaction with data using Natural language and speech through Cortana. Thus using this for progress the database in the application.

- SQLite Database
- MAYA Autodesk
- Photoshop CC
- CorelDraw X7
- Adobe Illustrator
- Rest API
- MS Office Package (2016)

2.2.2. Hardware Boundaries

Hardware requirements will need to run the developed application without having any problem. For the designing, implementation and testing purposes we have identified few hardware requirements. Suchlike,

- Mobile phones – Android

- Microphone

A good quality microphone is needed to record user input and feed into the application. A higher quality microphone will result in more accuracy.

- Speaker

A speaker is needed to provide output via the TTS module.

2.2.3. Communication Boundaries

- 4G - 3G connection of the mobile phone will be used for data transmission between the mobile app and the web server.

- Wi-Fi - If the mobile data is not available, user can connect to an available Wi-Fi router to get the internet connection in order to use the application. And this will also be used for data transmission between the mobile app and the web server.

- Required Connection bandwidth might differ time to time. Since large data load is travelling through the network, having a high bandwidth internet connection will help a lot for the users to use the application with ease.

2.2.4. Operations

System User is capable of following operations

- Create profile – User can provide user name and password in order to login to the application.
- View and edit profile – User can view the profile and update any information.
- View chat history – User can view the previous chat threads.
- Save model – User has the privilege to save the generated 2D models.
- View design history – The application save models and user can view design history.

- Add features to model – User can enhance the sign by adding Time frames, Facial expressions.
- Input text – User can input text either in Sinhala or English
- Input voice – User can feed in voice to interact with deaf people

System Administrator is capable of following operations

- Login – Admin can provide user name and password in order to login to the application.
- Manage the user details – Has the privilege to manage user details.
- Upload 2D models – Application allow admin to upload models.
- Approve relevant signs – Accept the signs created by the deaf users.

Site Adaption Requirements

- Both normal and Deaf people are the main users of the application. Hence, it is a requirement to build the application in a simple, understandable and innovative manner to make the application more users friendly.

- Internet access should be provided to the mobile.

- The voice output should be clear and accurate to the user from the beginning.

2.3. Flow of the project

2.3.1. Feasibility Study

Purpose of this phase is to recognize Limitations, Estimate & Analyze of the probable of a planned project. Govern the financial viability, operational probability, technical possibility & organizationally valued. The key constraints recognized are time & possibility of the project.

2.4. Commercialization aspects of the product

The proposed application will be highly useful for main three groups. They are Hearing impaired people, hearing people and illiterate people who cannot endure with English language. Apart from that our audience is gradually increasing. Because most of the time people loose their hearing ability when people getting old.

Accordingly many significant benefits could be found in Sanwadha application for above users.

- Help hearing impaired people to communicate themselves once they are in distance.
- Help to link hearing impaired people with ordinary people.
- To fully integrate the Hearing impaired individuals in the society.
- Avoids too much texting in chatting.
- Make message sending effective.
- Availability of offline messaging.

2.4.1. Business Pitch

In business arena why should use this application?

- Application will save the time of the user.
- As an education supportive tool. (Learning sign language)
- This application survive in the market for a far more life time.

The overall market space has no limitations for the user like age, regular or hearing impaired. They can use the application anywhere at any time.

In the discussion of earning revenue through Sanwadha application, following are the most imperative ideas.

- Government funds via special projects like MOH, Ministry of IT and ICTA

- Direct Aid Program Sri Lanka and Maldives – 2017

This program accept high quality applications that have a strong development focus and are aimed at strengthening communities in Sri Lanka and Maldives.

- Handicap International Organization
- National Secretariat for Person with Disability (NSPD)

NSPD mainly take action to rehabilitate persons with disability and enhance of making aware of the public on needs and situation of persons with disabilities.

- Endorse through Health Care exhibitions & offering trial accounts

- Charge for elementary application – Free
- Charge for Advanced features – Rs.750 per download

- Invest through Independent Software Vendors (ISV) in Private Companies

"Ahanna Foundation for Deaf" mainly cater the deaf community in every possible way. Education, Career, Spiritual, Talent Search and Life Support. Their possibilities of serving the deaf community can insert to all these categories and this is kind of a full package to a deaf life from "Ahanna (listen)".

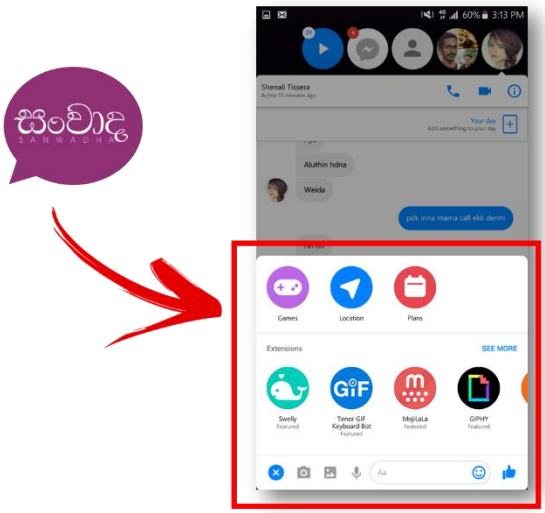
"Ahanna Foundation for Deaf" is willing to purchase the Sanwadha application for Rs.700, 000.

- Digital Marketing

- Facebook
- Twitter
- Linked In

Facebook is an American for-profit corporation and an online social media and social networking service that makes it easy for people to connect and share with their family and friends online. By now Facebook mostly target on ordinary people. As a turning point, Sanwadha application is going to be introduced as a plugin to the Facebook

Messenger in order to focus on hearing-impaired people. $8.25 will be charged per download of Sanwadha Plugin.



Sanwadha application as a plugin to Facebook

- Give a premium model and then supply additional services

Basic Suite	Plus Suite	Prime Suite
Basic chat with Animated Stickers	Basic Suite with Learning Sign language	Plus Suite with Voice Segment

- Forming partnerships with companies like Microsoft

- Through advertisements

- Google AdSense

Google AdSense is an advertising placement service by Google. The program is designed for website publishers who want to display targeted text, video or image advertisements on website pages and earn money when site visitors view or click the ads.

2.6. Testing & Implementation

Mobile application testing is both a critical and a complex component of mobile application development. It is crucial to have a clearly defined and well-developed mobile testing strategy and framework. The main components of a mobile application testing strategy include usability, performance, security and functional and nonfunctional testing across multiple platforms, devices and browsers.

A complete mobile testing strategy must also account for testing across differing network connection speeds and geographical locations, as well as address the use of Wi-Fi, 3G or 4G connections. Testing must confront such issues as screen resolution and brightness, CPU, memory and OS optimization. The mobile testing strategy must be geared to the architecture of the applications under test whether they are Web, mobile Web, native applications or hybrids. Finally, an organization must consider the test approach, primarily the use of emulators versus actual devices, or even real user monitoring.

Once it determined the team's mobile needs and developed a complete mobile testing strategy, the question becomes how to effectively execute such complex testing as a part of an on-going mobile application lifecycle strategy. Although cloud-based testing using emulators may have been sufficient of the mobile device. Effective mobile application

testing now needs to include cloud-based mobile test automation tools that use real devices. Due to the specialized skills required for testing application.

2.6.1. Mobility Testing Process

A typical end-to-end mobile testing process, should start from creating test cases of the application, performing user acceptance and finally device testing stage.

The stages in mobile application testing process are as follows.

Table 3.1: Outcome Satisfaction of the “Sanwadha”: Software Components

Test case preparation	Start by preparing test cases.
Automated script identification and modification	Identify the reusable automation scripts and modify the scripts as per the requirement.
Manual and Automated Testing	Execute both manual and automation test cases.
Usability Testing	User experience is key for applications to be accepted by end users. Check usability issues, navigation and content.
Performance Testing	Test the performance of the mobile application for its responsiveness, scalability, resource usage and stability based on standards.
Security and Compliance Testing	Ensure the application is secure by checking SQL injection, data dump and validation.
Device Testing	Execute test cases in other family of devices and testing simulation tools.

Apart from that some other testing processes are also important to our application.

Identified Types of Testing

It was a mandatory requirement that the application has to work in Android devices as the end consumers can have diverse devices. To ensure that the application worked in all the devices we selected combination of manual testing, automation testing and testing in cloud simulator – Device Anywhere.

Performance Testing

The functionality, performance (stability, responsiveness, resource usage, stability parameters as per standards) and user interface for the delivered build was thoroughly tested.

Device Testing

The application was tested across multiple OS versions/devices using the Device Anywhere simulation tool and also physically tested in our dedicated mobile application testing labs.

Maintained Test Case Sheet

During the whole process the Sanwadha team maintained the test case sheet (with all functionality implemented). The entire end-to-end mobile application testing process involved collective effort between Sanwadha team and our clients.

Generated Test Summary Report

Finally Sanwadha team created the test summary report. This is a management report which provides details of any important information uncovered by the tests conducted, includes assessments of the quality of the testing effort, the quality of the software system under test and statistics derived from incident reports. The report also records different types of testing performed and how long did it take to complete the testing. This helps to improve any future implementations. This final document indicates whether the software system under test is fit for use and has met acceptance criteria defined.

2.6.2. Implementation

A well-designed mobile application can inspire audiences and produce experiences they want to repeat and share with their community. It sounds simple, but the fact is implementing mobile application architecture that succeeds is not usual. Rely on a professional and expect to work with them through these steps in implementing a successful mobile application.

- Identify application requirements

A meeting with an industry leader in mobile design will result in the requirements needed for a successful application. Besides another meeting was take place in the form of live brainstorming with an Interpreter from “Ahanna Foundation for Deaf”.

- Strategize

Align the mobile application strategy with the business strategy and define the purpose for deployment of mobile applications and consider how it will measure success. Develop use cases and the needs definitions that are associated with users. Finally define the desired benefits that are expected as a result of developing and deploying mobile applications.

- Set the Scope

Define the initial application portfolio, and decide whether it will include B2C applications. Define the services that are deploying, and then prioritize and rank them. Mainly determine which platforms and OSs want to support with the mobile applications.

- Assess Internal Resources

Evaluate the need to integrate mobile applications with back-end systems, such as ERP or CRM systems. Define security concerns, such as the need for mobile device management solutions and mobile application management, as well as encryption and location of data assets.

- Implementation Planning

Define the elements of the mobile application architecture. Decide whether to develop mobile applications using a commercial mobile application development framework or open-source tools. Define your deployment strategy for distributing the mobile applications. Determine the life cycle management tools that will be needed for post deployment application management. Determine what analytics tools will be needed to assess the ongoing effectiveness of the mobile applications.

3. RESULTS AND DISCUSSION

To evaluate the approach, performed a survey among 100 deaf people and 50 ordinary people to understand the interest rate of using different communication methods between them. The following question helped us to clarify the objectives for the survey: "Will you intend to use this application for your communication?" The communication methods in this survey are assigned as either Texting, Sign-language or "Sanwadha" application. The survey was only conducted as questionnaires and people could choose different answers simultaneously.

The project has a very significant research areas like, Natural Language Processing (NLP), Voice Detection, Machine learning, Graphic Interchange Format (GIF) conversion and Mobile platform development. Machine Learning and GIF conversion is important for the identification of individual words in each Text and converted sign language send via compressed GIF files.

GIF Merging

Individual GIFs are merging as a single GIF according to relevant text.

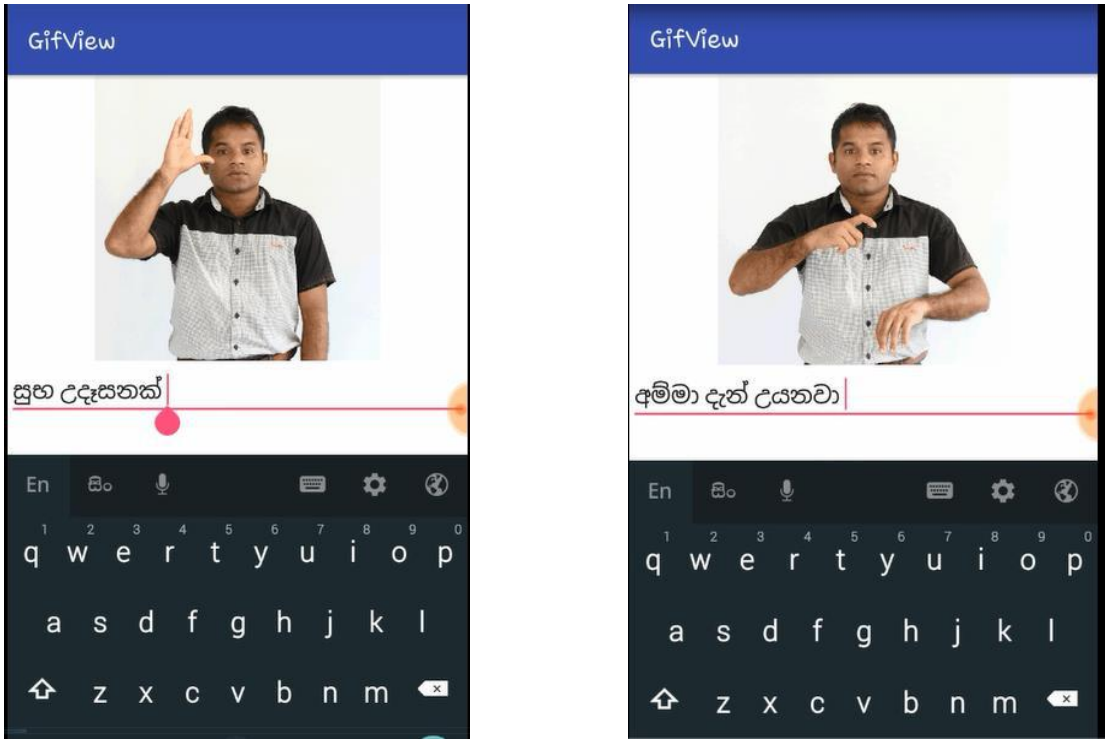


Figure 3.1: GIF merging

4. SUMMARY OF CONTRIBUTION

GROUP MEMBER – IT14114618

J.P.C.N. Jayalath

Task	Description
Sign language to Graphic Interchange Format (GIF) conversion	In creating Sign language to GIF conversion, the converted sign would be again convert into GIF. Creating GIF enables hearing impairers to identify the message more simply and effortlessly.
Semantic Analysis and Machine Learning	Identifying Semantic analysis would get the meaning of a set of words and convert that meaning into a GIF. Enable the user get the core idea of the message without having nonsense words.
Interaction with Messenger API	Enable the user to interact with Facebook Messenger in sending the GIF messages to another user with a level of high accuracy. Messenger is another most popular application by today.
Creating Stickers and GIFs	Creating basic stickers and GIFs for day to day life communication. Categorizing these stickers would be more user friendly. E.g.: - education, transport, foods, letters (Sinhala), numbers.

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APPENDICES

Appendix A

Following questionnaire is based on our survey to identify the real problems faced by Hearing-impairers. This would measure the level of requirement to ensure research.

Questions

1. What is your level of interaction with the society?

☐ Low

☐ Medium

☐ High

2. How about your willingness to use the new technologies?

☐ Low

☐ Medium

☐ High

3. How about your compatibility towards Mobile phones?

☐ Low

☐ Medium

☐ High

4. What is the way of communication with your colleague?

☐ Talking face to face using sign languages

☐ Video calling

☐ Lip reading

5. Is there any way to communicate with an ordinary person?

☐ Yes

☐ No

6. Are you using any application to have conversation with others?

☐ Yes

☐ No

7. If you are using any mobile application, in which language you would prefer?

☐ Sinhala

☐ English

8. Do you like to have any chat application rather video calling when you are communicating with others in distance?

☐ Yes

☐ No

9. What is the most uncomfortable scenario when you interact with the society?

☐ Transportation

☐ Emergency case

☐ Marketplace

☐ Hospital

10. Do you prefer to make your communication easier, using a mobile application with new technologies?

☐ Yes

☐ No

Appendix B

Compression Algorithm

```
void compress( const char *buf, int buflen )
{
  char **dictionary;
  int dictionary_ind;
  int code;
  int code_length = 9;
  char *inp = buf;

  // Create an initial dictionary with 2**9=512 entries.  When this
  // dictionary fills up, it will be expanded and the code size will
  // increase.
  dictionary = ( char ** ) malloc( sizeof( char * ) * ( 1 << code_length ) );
  memset( dictionary, 0x0, sizeof( char * ) * ( 1 << code_length ) );

  // pre-initialize the first 255 entries with their own values
  for ( dictionary_ind = 0; dictionary_ind < 256; dictionary_ind++ )
  {
    dictionary[ dictionary_ind ] = ( char * ) malloc( 2 );
    sprintf( dictionary[ dictionary_ind ], "%c", dictionary_ind );
  }

  // Compress until there's no more data
  while ( buflen-- )
  {
```

```
    // Seach the dictionary for the longest match that matches
    // inp
    for ( i = dictionary_ind - 1; i; i-- )
    {
      if ( dictionary[ i ] != NULL )
      {
        if ( !strncmp( dictionary[ i ], inp,
                       strlen( dictionary[ i ] ) ) )
        {
          code = i;
          break;
        }
}
}
    write_bits( code, out, code_length );
    inp += strlen( dictionary[ code ] );

    // Add this match, along with the next character, to the dictionary
    dictionary[ dictionary_ind ] = malloc( strlen( dictionary[ code ] ) + 2 );
    sprintf( dictionary[ dictionary_ind ], "%s%c", dictionary[ code ], *inp );
    dictionary_ind++;
    // Expand the dictionary if necessary
    if ( dictionary_ind == ( 1 << code_length ) )
    {
      code_length++;
      dictionary = realloc( dictionary,
        sizeof( unsigned char ** ) * ( 1 << code_length ) );
    }
```

```
 }
}
```

Decompression Algorithm

```
int prev = -1;
int code;
int code_length = 9;

// Create a dictionary large enough to hold "code_length" entries.
// Once the dictionary overflows, code_length increases
dictionary = ( unsigned char ** ) malloc( sizeof( unsigned char * ) *
  ( 1 << code_length ) );
memset( dictionary, sizeof( unsigned char * ) * ( 1 << code_length ), 0x0 );

// Initialize the first 256 entries of the dictionary with their
// indices.  The rest of the entries will be built up dynamically.
for ( dictionary_ind = 0; dictionary_ind < 256; dictionary_ind++ )
{
  dictionary[ dictionary_ind ] = ( unsigned char * ) malloc( 2 );
  sprintf( dictionary[ dictionary_ind ], "%c", dictionary_ind );
}

while ( ( code = read_next_code( code_length ) ) != -1 )
{
  if ( prev > -1 )
  {
    dictionary[ dictionary_ind ] = ( unsigned char * ) malloc(
      strlen( dictionary[ prev ] ) + 2 );
    sprintf( dictionary[ dictionary_ind ], "%s%c", dictionary[ prev ],
```

```
    dictionary[ code ][ 0 ] );

  dictionary_ind++;
 }

 // Expand the dictionary if necessary
 if ( dictionary_ind == ( 1 << code_length ) )
 {
  unsigned char **new_dictionary;

  code_length++;

  dictionary = ( unsigned char ** ) realloc( dictionary,
   sizeof( unsigned char * ) * ( 1 << code_length ) );
 }

 prev = code;
}
```

Diagrams

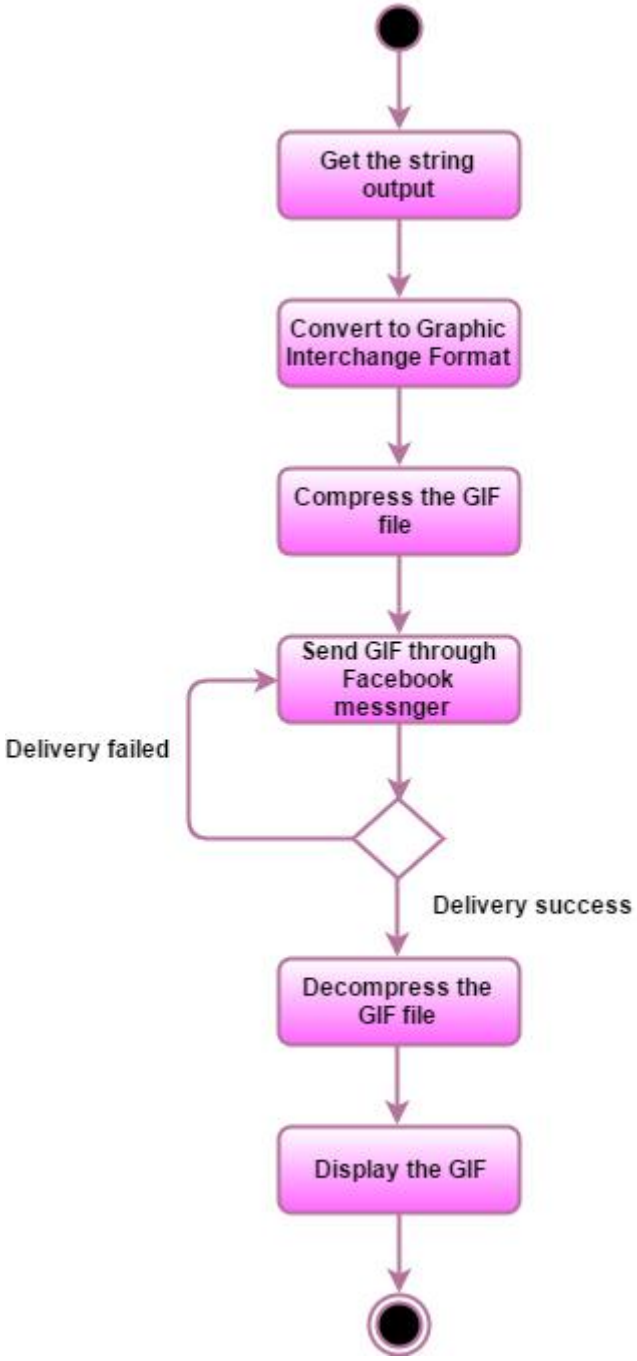

Figure: Activity diagram – GIF procedure

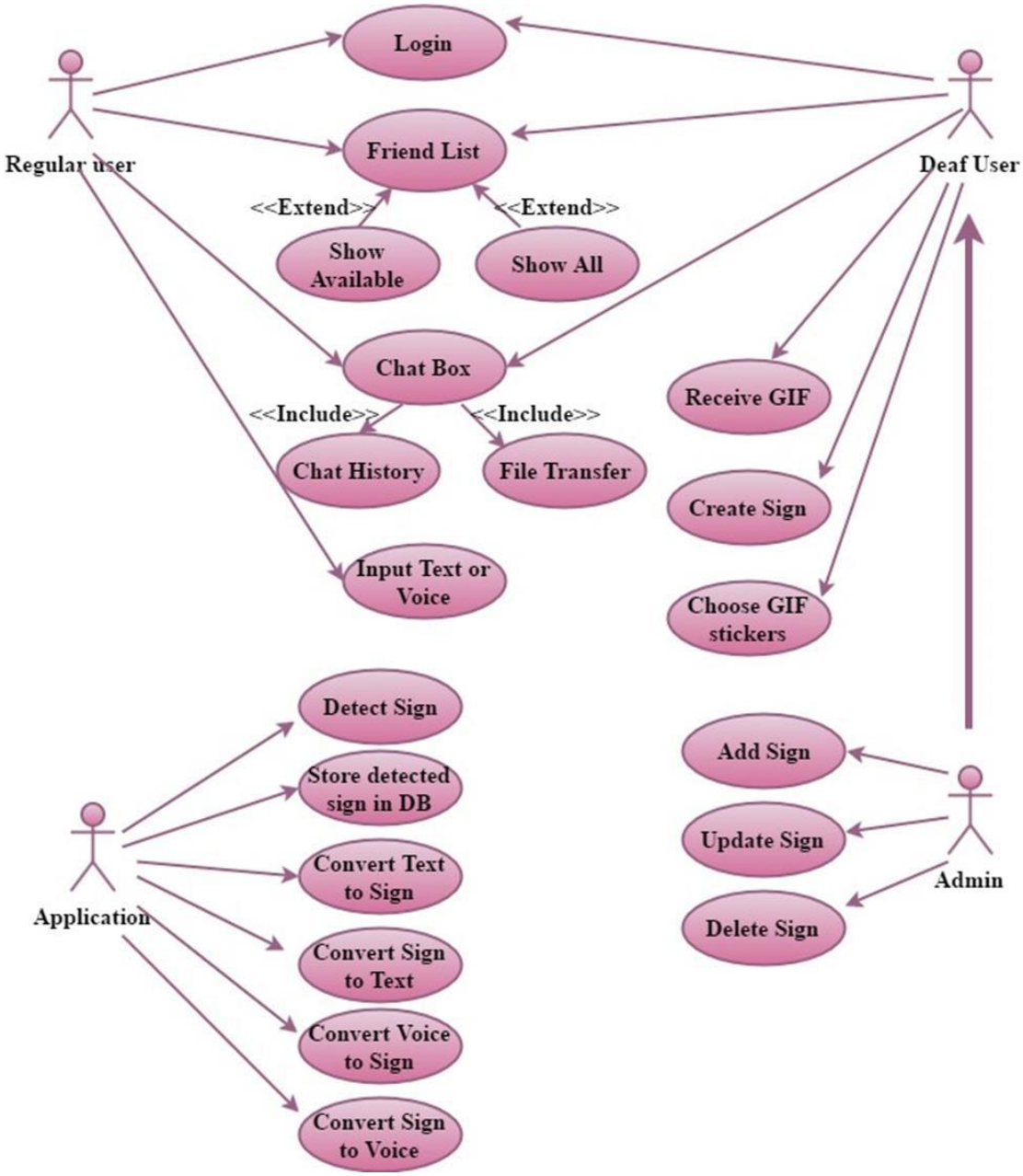

Figure: Use Case Diagram