Bachelor of Science in Computer Science & Engineering

An Android Based Communication System between Hearing Disabled Person and General Person

by

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in Computer Science & Engineering

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Abstract

Communication is one of the important needs of human. There are many deaf people in our society. They can not understand our language and we are also unable to understand the sign language. So it creates a communication gap between us. So we want to reduce this gap by using the technology. To achieve this goal we want to develop a communication medium that will bridge the communication gap between the general people and deaf people. To do this task, we have decided to use smart phone device as our communication medium.

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Chapter 1

Introduction

1.1 Introduction

Communication plays an important role in human life. General people can communicate with each other without having any problem but people who have hearing impairments cannot communicate with us normally. Deaf people need a different medium to communicate. They use signs to communicate that are known as sign language. Sign language uses different body movements for communication. There are many kinds of sign languages used around all over the world. Sign language decreases the communication gap between general people and deaf people like hearing-impaired persons. Hearing disability is one of the biggest problems that deaf people have. Very few general people know sign language, so that makes it difficult to communicate between normal people and deaf people. So there is a need to have a medium that makes it easy to communicate between them. So we develop a friendly medium in Bangla to bridge the communication gap between general people and deaf people. We hope it will make easy the communication among people.

1.1.1 Problem statement

A huge number of normal people do not know sign language. So it is very difficult to communicate between normal people and deaf people. There are some works based on detecting sing image to build a communication medium for hearing impaired person. But there are very few works in Bangla language to perform this task. Few works have been done by some people from India, in which they build a medium to convert Bangla text to sign language. In this procedure, they build a dictionary that contains about 900words. Bangle words that match the text are fetched using unique id and video clips are joined one by one in sequential order that shows the sing output [1].

Another work is done [2] where text input is broke down and analyzed into the morphological level. In the first step, characters are filtered that are useless are removed by syntactic analysis. And texts are placed in sequence according to Bangla grammar rules by morphological analysis. A two-way communication system is built using a mobile platform that performs communication between deaf and normal people. In that process, a speech recognition system called CMU Shphinx converts Bangla speech to sign language. Sphinx convert the speech input in phonetic text. Sentences are stored in Bangla model file and audios files are saved as Bangla acoustic file and using those files, the process is begun that breaks out a recorded speech file into phonetic text [3]. Another work is done where deaf people have to write text using a keyboard and by using the google translator it will be converted in speech [4]. A Bangla swipe keyboard layout is designed and described the essential keyboard structure [5]. Android application is developed in a different platform that can be communicated by some methods [6]. Android based application is easy to use and can be used to communicate through different people. The communication between inter-app can be established by predefined intent, which is built into a java package. By using 'WebSign', teaching assistants that are animation-based can be performed. It converts natural language to real-time sing animation. a sign is played from a dictionary for each word [7]

1.1.2 Objective

Our aim is to develop an android based communication system to bridge the gap between hearing disabled people and normal people. The system will provide the following features:

- Easy to use interface

- Convert voice to sign language

- Show output for Bagnla input text

1.2 Framework/Design Overview

The design of whole process is consisting some steps. Also, we have to create cor-
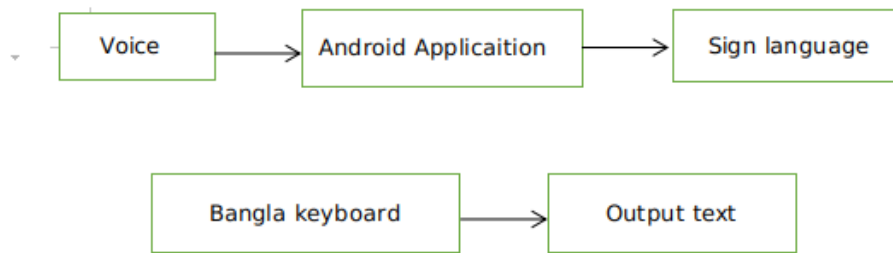
Figure 1.1: Design of sign language conversion

responding sign language animation for many words. But the general design is given below.

1.3 Difficulties

There are some difficulties to develop this application. The first one is to collect different signs for different words. As the sign language covers the regular language, we have to collect body movements against the Bangla word. Another difficulty is to create animations for those body movements. It is a time-consuming process. And finally, we have to implement the whole process that shows the sign language against the Bangla voice given by the user of this application.

1.4 Applications

This application is intended to bridge the gap between deaf people and general people. By using this application normal people can easily communicate with deaf people who are hearing impaired. This application provides a user-friendly communication process as anyone can easily use this without any technical difficulties. We hope this system will help people to communicate with deaf people.

1.5 Motivation

There are a lot of deaf people in our country. They can not communicate with us normally. And another problem is, the general people also do not know the Sing language that deaf people can understand. We need a communication medium as normal people

and deaf people can communicate with each other without having any difficulties. We want to overcome this problem.

1.6   Contribution of the thesis

The goal of this project is to develop a system that can convert Bangla speech to sign language so that normal people and deaf people can communicate with each other easily. The conversion of Bangla speech to Bangla text is done by the google speech api recognition system which converts Bangla speech to Bangla text in a good way. And the next step is to show animation for corresponding Bangla words. Our system covers more than 200 Bangla words. The animations are also shown correctly against the Bangla words.

1.7   Thesis Organization

This report is divided into 5 chapters. Chapter 1 gives an overview and the goal of this project. Chapter 2 covers the literature review and technologies used to complete this project and related works. Chapter 3 shows the methodology and working process of this project. Chapter 4 describes the experimental results and evaluation of this project. And Chapter 5 gives a conclusion of this project and give an outline for future work for this project

1.8   Conclusion

At the end of this chapter, we have a clear understanding of our project goal and objectives Also we have known the difficulties to implement this project.

Chapter 2

Literature Review

2.1   Introduction

This chapter represents the technologies used to develop this project. Discussion of Related previous works is also described in this chapter.

2.2   Android OS

Android is the most popular mobile operating system around the world. Android is free and open-source software. It is based on the Linux kernel. It is developed by Google and also used in touchscreen devices such as smart tv, smart-watch etc. The user interface is based on direct manipulation, using touch input that loosely corresponds to actions like tapping, swiping, pinching along with a virtual keyboard. Full-size keyboards are supported via usb and bluetooth. The source code has been used to develop game consoles, portable media players, digital cameras, PCs etc. Software that runs on android uses the apk file format that is available in the google play store. As of May 2017, there are two billion active monthly users of android. As of February 2021, there are about 3 million android applications in the google play store.

Figure 2.1: Android logo

2.3 Linux Kernel

The android operating system runs on Linux kernel. It is the core software of android. It is a free, open-source, multitasking, modular, unix-like operating system. It was first developed by Linus Torvalds in 1991. It is not only used in the smartphone but also it is being used by various embedded devices. It has a modular design. Advance memory management along with virtual memory makes its memory management easier. Linux kernel provides security features to android.

2.4 Java

Java is an object-oriented, high-level programming language that is widely used all around the world. Java is mostly used in enterprise-level applications. Java is a general-purpose programming language intended to write code in a single place and run everywhere. It is platform-independent. Compiled Java code can run on all platforms where a java virtual machine (JVM) is installed. Although java is a high-level programming language, it provides some low-level language features. Dynamic capabilities such as runtime code compilation are provided by java which is not available in a traditional programming language. Java was first released in 1995 by Sun Microsystems. As of March 2021, Java 16 is the latest java version. To run java on our machine, we need to install the Java development kit (JDK) in our machine. JDK provided the Java runtime environment.

Figure 2.2: Java logo

2.5   Android Services

There are three kind of android services. Such as:

1. Foreground

2. Background

3. Bound

The service which is viewed by the user is known as foreground services. And the service that is running in the background but does not visible by the user is known as background service. A background service can be performed without affecting the foreground services. If a component binds a service by calling the bindService() function then it is called the bound service. A service can handle network activities, playing audio and video, perform I/O operations, handling content providers etc.

2.6   Broadcast Receivers

Another core feature of the Android operating system is broadcast receivers. Broadcast messages are sent and received by using this feature. When an event occurs, broadcast receivers can send messages. A specific broadcast can be registered. A router works to notify the subscribers who already subscribed in the broadcast. It is very useful for messaging applications. There are two types of broadcast. One is a normal broadcast and another is the ordered broadcast. Normal broadcast does not maintain any order. It is asynchronous in nature. Ordered broadcast is sent one at a time.

2.7   Media Player

Any audio and video files are played by the media player. It supports most of the common media file types. There are several classes used to play media files. Such as MediaPlayer and AudioManager.

2.8 Adobe Photoshop

Adobe Photoshop is the most popular photo editing software around the world. It is a raster graphics editor. Adobe Inc has developed this software. Adobe Photoshop was developed in 1988. There are many versions of adobe photoshop. Photoshop can create and edit different types of images. Photoshop maintains multiple layers for editing purposes. The default file format of photoshop is .psd. Photoshop offers various color models like RGB, CMYK etc. Photoshop provides various editing tools in its sidebar. Some of them are listed below:

- **Move tool** : We can move any layered element in photoshop with the help of the move tool. It is very helpful for editing images.

- **Rectangular marquee tool** : We can select any rectangular shape with the help of this tool.

- **Elliptical marquee tool** : We can draw any elliptical shape by using this tool.

- **Pen tool** : the Random path can be selected by using this tool. It uses anchors to track the path created by selecting any area..

- **Selection tool** : With the help of this tool, we can select any part of a picture for editing purposes.

- **Magic wand tool** : This tool helps us to select any specific area of an image. It also helps a lot when someone needs to select any complex parts in a layered image.

- **Pencil tool** : We can draw any kind of shpaes by using this tool. It is a very basic and useful tool of photoshop.

- **Eraser** : If someone makes a mistake when drawing or painting an object then he can easily erase the unwanted part by using this tool.

- **Paint bucket tool** : This tool is used to paint any specific layer with a custom color of an image.

- **Lasso tool** : Users can select an arbitrary area by using this tool. Lasso tool

provides three types of selection options. These are - polygonal, regular, magnetic. The Polygonal Lasso tool helps to create straight lines of any image. By the regular lasso tool, users can select any random area on an image. And magnetic lasso tool can do the same work as the other two can do. In addition, it can detect the edge of an image.

- **Background eraser tool** : With the help of this tool, one can erase the image background easily. It makes background removal easy.

- **Text tool** : Another basic and important tool is the text tool. By using this tool, users can write text on images.
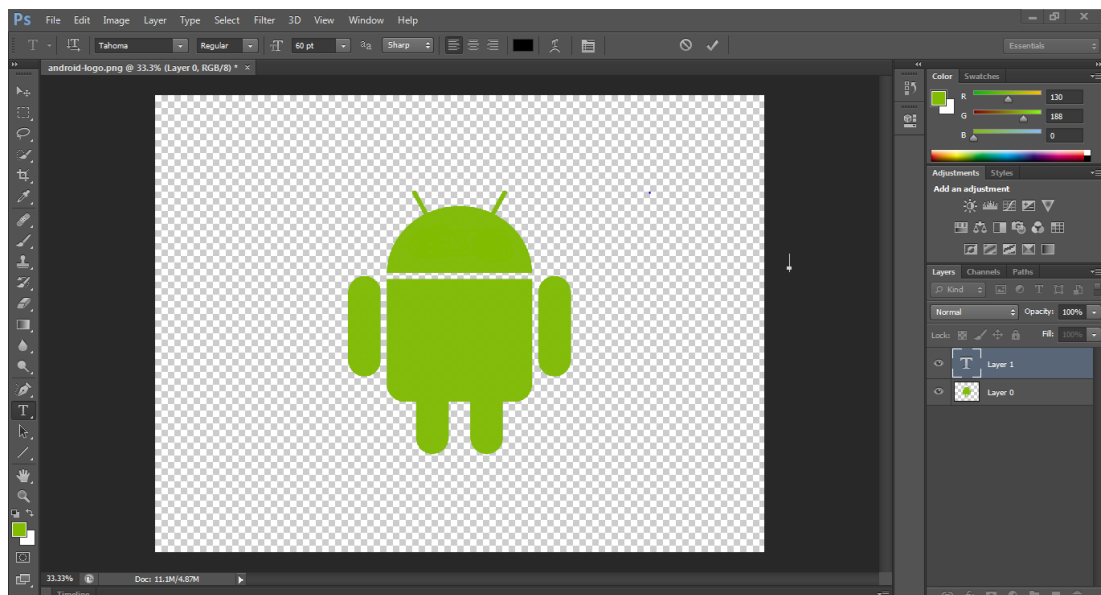
Figure 2.3: Adobe Photoshop

2.9 Adobe Character Animator

Adobe character animator is automatically installed along with adobe photoshop. For making animation, the layered images have to be uploaded first in character animator. It is a desktop application. By this software, the captured image is combined with multi-track recording to create a 2D layered image. The image is placed on a scenario. The final output is a series of images file that is supported by the Adobe media encoder.

2.10   Adobe Media Encoder

Files that are created by Adobe Character animator are very large in size. We compress those big files by adobe media encoder to make our application size small. It helps to play animation files smoothly on any device. The compression process uses various kinds of algorithms depends on the file. It ensures the quality of the video file that it will play around any device smoothly.

2.10.1   Implementation Challenges

There are some implementation challenges of our system. We have to ensure that the animation files properly show all the movements accurately. Another important fact is the application size. We have to limit our application size as it can smoothly play in any device regardless of the processor speed, ram etc. Another challenge is to convert the voice to sing language properly as our algorithm can split the sentence in the right manner and fetch the corresponding animation file.

Chapter 3

Methodology

3.1 Introduction

In this chapter, we will show the entire process to develop our android based communication system in detail.

3.2 Diagram/Overview of Framework

Our main task is to build a communication system that will bridge the gap between deaf people and normal people. Our application provides a list of Bangla words for normal people that will be converted to sing language. For deaf people, there is a button to pick up a keyboard to write Bangla words. There is a built-in speech recognition system in android devices that use google api to recognize voice speech and translate it to an expected language.
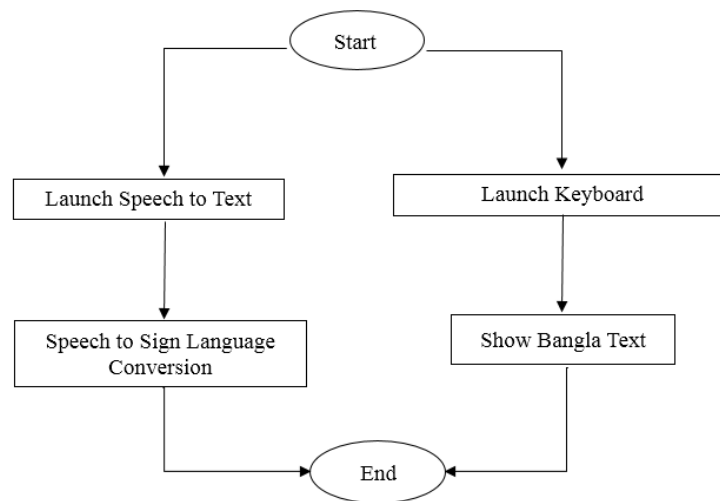
Figure 3.1: System overview

With the help of the virtual agent, we will convert the text to sing language. Deaf people can select a keyboard and write Bangla words. We have provided an output box to show the output of the Bangla word. The whole process is shown below via a block diagram.

3.3 Detailed Explanation

3.3.0.1 Drawing image

We have to create images to show animation. For performing this task we will use Adobe photoshop. There are few steps to create the image. These are described below:

1. Create a new file and select background color.

2. Using ellipse tool, line tool, rectangle tool, custom shape tool drawing the body.

3. Using Paint Brush tool to color the image.

4. Placing all the body parts in a sequence of layers..

5. Save the file as .pdf format.

3.3.0.2 Create animation file in Adobe Animator

We have to import the designed animated files into Adobe Animator. The following steps are required to create an animation:

1. Import the image into Adobe Animator

2. To fix the individual parts add Handle tool

3. For arms add the stick tool.

4. For movable parts add the Dragger tool.

5. Set the duration of each frame.

6. For recording the scene press the record button

3.3.0.3 Speech to text conversion

For performing the speech-to-text conversion we have used the android build in Google api speech recognition system. To use this system we have to write the following code:

```
Intent ob=new Intent(RecognizerIntent.ACTION_RECOGNIZE_SPEECH);

ob.putExtra(RecognizerIntent.EXTRA_LANGUAGE_MODEL,RecognizerIntent.LANGUAGE_MODEL_FREE_FORM);

ob.putExtra(RecognizerIntent.EXTRA_LANGUAGE, "bn");

ob.putExtra(RecognizerIntent.EXTRA_PROMPT);

try{
    startActivityForResult(ob,100);

}catch (ActivityNotFoundException e){

    Toast.makeText(getApplicationContext(),"sorry your device doesn't support speech
    language",Toast.LENGTH_LONG).show();

}

Intent detailsIntent =  new Intent(RecognizerIntent.ACTION_GET_LANGUAGE_DETAILS);

sendOrderedBroadcast(detailsIntent, null, new LanguageDetailsChecker(), null,
Activity.RESULT_OK, null, null);
```

Figure 3.2: Code for calling google api

3.3.0.4 Show signs

Animation files are saved in the Android studio folder. Bangla text converted by google api is checked against the saved words. If there is a match, MediaPlayer() plays the animation file for the corresponding word.
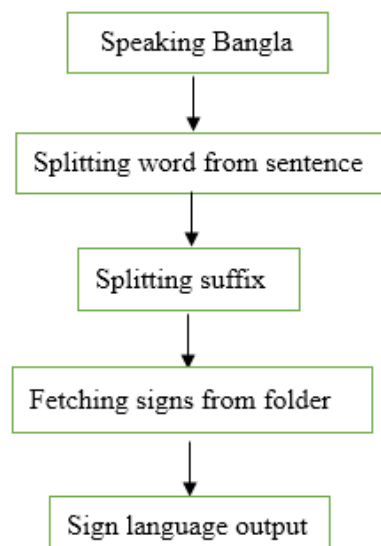

Figure 3.3: Showing signs

Splitting of words has been done by a for loop whether any space is found. An array is used to store words. Suffixes are removed by a recursive function. And the final output is shown by MediaPlayer(). Available Bangla words are listed below :

এখন, এখানে, মাত্র, অথবা, মে, মিনিট, সমতল, বর্ষাকাল, সমর্থন, লম্বা, শব্দ, অক্ষর, ড্রাইভার, চালক, স্টুডেন্ট, ছাত্র, বর্ষা, চাউল, আমেরিকা, শূন্য, লাল, আকাশী, রং, এপ্রিল, এলাকা, আগস্ট, অগাস্ট, শরৎকাল, শরৎ, বাংলাদেশ, আগে, কাল, কালো, রাজধানী, চট্টগ্রাম, শহর, কলেজ, মহাদেশ, গণনা, দেশ, গরু, রোজ, দিন, ডিসেম্বর, বল, গাছ, গাছের কাঁটা, ডাব, তরমুজ, ডিম, আট, আঠারো, আশি, এগারো, ইউরোপ, চারিদিক, দ্রুত, ফেব্রুয়ারি, কিছু, পনের, পঞ্চাশ, আগুন, পাঁচ, পতাকা, খাদ্য, খাওয়া, খাও, খাব, খাবে, খেয়েছ, শুক্রবার, দাও, দেওয়া, কেমন, কিভাবে, হেমন্ত, অনেকদিন, মার্চ, জন্য, পক্ষকাল, চল্লিশ, চার, চৌদ, সোমবার, মাস, সকাল, জাতি, কখনোনা, রাত, নয়, উনিশ, নব্বই, দুপুর, উত্তর, নভেম্বর, অক্টোবর, এক হাজার, ভাত, সালাম, শনিবার, সেপ্টেম্বর, সাত, সতের, বিদায়, যদি, বহু, অনেক, সমস্যা, রিজার্ভ, সত্তর, অসুস্থ, ছয়, ষোল, ষাট, আকাশ, দক্ষিণ, বসন্তকাল, বসন্ত, গ্রীষ্ম, গ্রীষ্মকাল, রবিবার, দশ, তিন, বৃহস্পতিবার, আজ, আগামীকাল, কালকে, মঙ্গলবার, বারো, বিশ, দুই, বিশ্ববিদ্যালয়, পানি, ঢাকা, রোগ, জেলা, বিভাগ, পৃথিবী, পূর্ব, রাস্তা, বুধবার, সপ্তাহ, পশ্চিম, কি, কোথায়, কখন, কেন, শীতকাল, শীত, বছর, গতকাল, স্বাগত, স্বাগতম, সহজ, সোজা, আমি, আমার, নরমাল, সাধারণ, মামুলি, স্থায়ী, স্বয়ং, নিজে, নিজ, আমরা, আমাদের, তুমি, তোমাদের, সাপোর্ট, মধ্যে, বেকার, উপর, উচ্চ, উপরিভাগ, পরে, বিকাল, সমান, শক্তি, শক্তিশালী, আসো, আসবে, এসেছো, এসেছিলে, আরম্ভ, শুরু, কারফিউ, দল, আলাদা, আলাপ, কথা, জয়, খেলা, খেলছে, খেলোয়াড়, কাঁঠাল, পেঁপে, শাপলা, ফুল, চানাচুর, জিলাপি, প্রশ্ন, সবসময়, সময়

3.3.0.5 Output Bangla word

We provide a button to select a keyboard for typing Bangla word to display it on the screen. In this way, deaf people can type Bangla words as they can communicate with a normal person. The procedure is shown below:

3.4 Implementation

We have to develop an android based software for communication purpose

3.4.1 Development tools

1. Android Studio (IDE)

2. Android Phone (Smart phone)
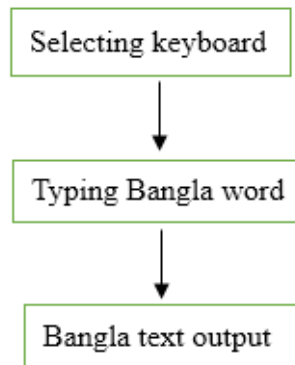
Figure 3.4: Showing text output

3.4.2 Welcome screen

At first, when a user launches the application a home screen will be displayed. On this screen, users can see two types of buttons. One for the deaf people and another for the normal people. Normal people can select the button for converting the voice to sing language. Deaf people can select the button for writing Bangla text.

3.4.3 Speech to sign language

When pressing the speech to sing language conversion button, a view will open that contains the list of Bangla words that can be converted to sign language. Users can scroll up and down to see the list of words available for conversion. A tap to voice button will be shown on this page. Users can press this button and speak the Bangla language. After speaking Bangla, a tap to convert button will appear. When users tap this button, google api will convert the Bangla speech to Bangla text. After that, our algorithm splitting the Bangla sentence and removing suffixes and search for a match from the array where the words are stored which can be converted to sign language. If a match is found, then MediaPlayer() will display the corresponding sign to the user.
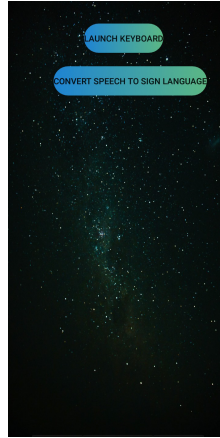
Figure 3.5: Home screen
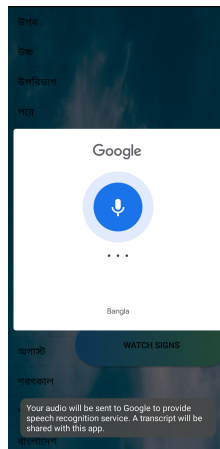
Figure 3.6: Voice recognition system

Figure 3.7: Showing animation

3.4.4 Output Bangla text

For deaf people, we are providing a second button for opening a keyboard. Users have their choice to select their desired keyboard from settings. When pressing

that button, a keyboard will pop up and deaf people can write Bangla sentences and it will be displayed on the screen. So normal people can easily read the senteces from the screen.
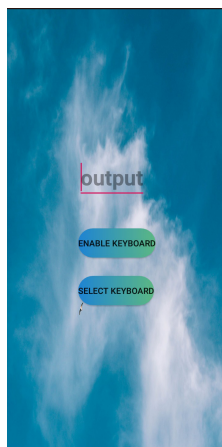
Figure 3.8: Keyboard selection screen
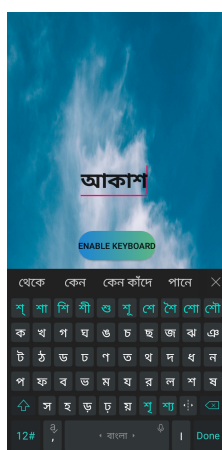
Figure 3.9: Output Bangla text

Chapter 4

Results and Discussions

4.1 Introduction

Testing is performed properly for this application. We will show how the data sets are collected and the performance of this system.

4.2 Dataset Description

We perform an inquiry to ask people to know the difficulties of communication between deaf and normal people. And we have collected various information about this problem. People are facing various types of problems in communication with deaf people. We have visited a deaf school called "Mute and deaf school, Muradpur, Chittagong" and ask them the difficulties of communication. We also gather the experience from them. We try to know their needs. We see they are expecting some features to facilitate the communication between deaf and normal people. These are:

1. Speech to sing language conversion

2. Easy to use interface

3. Playing animation against speech

4. Bangla writing keyboard

5. Good user interface

4.3 Impact Analysis

Impact means how this application affects our daily life. We have seen that our system provides a positive impact to bridge the communication gap between deaf people and normal people.

4.3.1 Social and Environmental Impact

There are good social and environmental impacts of our application. A Major number of normal people do not know sign language. So they can not communicate with deaf people easily. Our system has solved this problem. By using our system, the general people do not have to know sign language to communicate with deaf people. Their speech will convert into sign language which is recognized by deaf people. And the other hand, a huge number of deaf people can not talk. Our system provides a keyboard to write Bangla words on the keyboard. it will be displayed on the screen and normal people can easily read it. So our system makes communication easy in our society.

4.3.2 Ethical Impact

Our application also has a good ethical impact. As it makes communication easy so people are happy using this application for easy communication.

4.4 Evaluation of Framework

Evaluation of framework means whether our system fulfills the specified goal or not. It also includes the performance, errors, efficiency, risks of our system. It focuses on what was required and what is delivered. In this perspective, we have successfully completed all the requirements. We make communication easy between the deaf and normal people. It also judges the risk analysis. We also analyzed the following factors for risk analysis of our system:

1. Ensure quality product

2. Reduce bugs from our system

3. Product reliability

4. Fulfill all requirements

5. Good user interface

6. Provide easy to use interface

7. Scalable application

There are different methods to test an application. We have performed testing for our application. White box testing needs the knowledge of technical details. But black-box testing does not require any technical details. Black box testing means a normal user will interact with the application and try to understand whether the application behaves well or not. Below is the test cases of black-box testing of our application:

Table 4.1: Black box testing.

Activity	Expected behaviour	Result
Start application	Application runs in smartphone	yes
Button press	Show views	yes
Speech to text	Convert speech to bangla text	yes
Text to sing	Convert bangla text to sing language	yes
Keyboard	Open keyboard on button press	yes
Text output	Show inserted text in screen	yes

4.5   Evaluation of Performance

4.5.1   Experimental result

We checked our application at our campus. We asked people for testing our application. We have checked our application by eight different people with six different words and the results were good. The signs were playing continuously and the speech recognition system played well.

We have done our experiment on various people. General people testing our system by giving their speeches. In the below table we show how many times our system successfully convert the voice to sing language for the words স্থায়ী, স্বয়ং, নিজে, নিজ, আমরা:

Table 4.2: Test result in campus.

Tested words	Showing results of eight people							
	1	2	3	4	5	6	7	8
চারিদিক	4	4	3	3	4	4	3	3
বর্ষাকাল	5	5	5	4	4	5	4	5
পানি	4	4	5	4	4	5	5	5
সোমবার	5	4	5	5	4	5	5	5
আকাশী	5	5	5	4	4	5	5	4
আলাদা	5	5	5	4	4	4	5	5

Table 4.3: No of successful speech to sign conversion .

General people	Tested words				
	1	2	3	4	5
1	5	4	3	5	4
2	5	4	5	5	4
3	4	4	5	4	4
4	5	4	5	4	4
5	5	3	5	4	4

But some signs are not recognized by the Deaf people. The no of signs that are recognized are given below:

Table 4.4: No of times Deaf people can recognize signs .

Deaf people	Tested words				
	1	2	3	4	5
1	5	5	4	5	4
2	3	4	4	5	4
3	5	5	5	4	4
4	4	4	5	4	4
5	5	3	5	4	4

The testing of the keyboard was also successful. Below we give the results of testing the keyboard:

After completing the testing we have asked the Deaf people some questions about our application as we can find out the proper judgment of our application. These questions are:

- Do you understand the signs correctly?

- was the keyboard working properly?

- have you face any problem to use this application?

Table 4.5: No of times keyboard shows output correctly .

Deaf people	Tested words				
	1	2	3	4	5
1	5	5	5	5	5
2	5	5	5	5	5
3	5	5	5	5	5
4	5	5	5	5	5
5	5	5	5	5	5

We have also asked the General people some questions about this application as we can find out the proper judgment of our application. These questions are:

- Do you have any problem while using this application?

- is this application use friendly?

- How useful this application is?

They have replied with our questions on a 1 to 5 star rating. 1 is the minimum and 5 is the maximum score.

The answer of the questions Q1, Q2, Q3 are given below:

Table 4.6: Answers of our questions from Deaf people .

Questions	Deaf people				
	1	2	3	4	5
Q1	5	2	5	3	5
Q2	4	5	4	5	4
Q3	5	5	2	4	3

The answer of the questions Q4, Q5, Q6 are given below:

Table 4.7: Answers of our questions from General people .

Questions	General people				
	1	2	3	4	5
Q4	5	4	5	4	3
Q5	4	5	4	4	5
Q6	4	3	5	4	3

4.6   Conclusion

We have found out some important facts after completing the experiment of our application. Most of the applications available in the google play store require

some steps to operate. But the users of our application say that they do not face any difficulties to use our application. Because we implement very few steps to operate this application. And the expected result of our application is above average. Users say that they will use this application when needed. The sign language that is converted from speeches is acceptable to understand. And the voice recognition system works really well to convert speech to text. Overall we are successful to achieve our expected result from this application

Chapter 5

Conclusion

5.1 Conclusion

At the end of the project, we can say that this application will be really helpful to bridge the communication gap between deaf people and general people. People who do not have any knowledge about sign language can easily communicate with deaf people with this application. This application gives a very easy-to-use interface for users. Deaf people can easily understand the signs used in this application. This application can be used to teach deaf people about various movements of sign language. There are some spaces that can be updated on this application. This application fulfills our goal as we expected. This application will encourage people who want to do better things in this field. We hope the communication barrier will be reduced more in future work in this field.

5.2 Future Work

For the future update of this application, we found a lot of suggestions from our end users. They give us valuable suggestions to make this application better. We take their views seriously. The following sections can be added to our application:

- Word list should be increased

- Sharing option can be added

- Animation quality should be better

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