CHAPTER 1

INTRODUCTION

1.1 Project Background

The Malaysian Sign Language (MSL) has been the principle sign language used among the deaf community of Malaysia since the establishment of the Malaysian Federation of the Deaf back in 1998. Currently, there are approximately 40,000 legally deaf people living in Malaysia. However, a minority of the Malaysian population excluding the Deaf community can converse in MSL, or any other form of sign language for that matter. This creates difficulties in situations where communication between hearing people and deaf people occur.

Apart from miscommunications, it also impairs to an extent the ability for deaf people to build strong relationships with hearing people, finding employment, and the general ignorance of hearing people to adhere to the special needs and requirements of deaf people. For the most part, this problem arises due to the fact that a majority of hearing people does not see the need to study MSL seeing as how their interactions with deaf people are little to none. For the minority of people who have to deal with deaf people on a regular basis, a majority of these people are unwilling to put up the time to study MSL or have to rely on undependable impromptu signs that only cover a small portion of communication and are unable to converse as fluently as those who sign with MSL.

1.2 Problem Statement

1.2.1 Problem Identification

Assuming the person trying to communicate with deaf people have no prior knowledge on MSL, there are several problems with current solutions to bridging the gap of communication between deaf and hearing people such as hiring a translator, writing down the words, taking classes, and referring to the internet or books. Among them are:

1. **Time and Money**

   Realistically, only a minority of the population would take the time and money to spend on taking sign language classes. These are the people who have to deal with deaf people on a regular basis such as family and friends as well as social workers who deal with deaf people. Therefore, a large portion of the population does not see the justification of resourcing their time and money to attend classes nor do they see the urgency to do so. Similarly, hiring a translator is a also costly and few see the need to do so.

2. **Impracticality of Books and Internet**

   For the purpose of facilitating the learning of sign language, books and the internet are undeniably an effective and irreplaceable source. However, both of these sources are unreliable in acting as a direct translator during conversations seeing as how it is impractical to carry the book around at all times. The same can be said for using the internet, even should they have access to the internet via their mobile devices, translating the words will be time consuming

3. **Tediousness of Writing**

   A common solution to deal with communication between deaf and hearing people is to write down the words that one wants to convey. Similar to using the internet and books however, it cannot be guaranteed that a pen and paper will always be around. Of course, using a phone to input text can replace the need for writing surface and materials, however this method does not help to develop a proper understanding of how to communicate through sign language.

1.2.2 Significance of Project

The significance of the project of course comes in the fact that they address the issues that have been addressed earlier. Among them are:

1. **Does not take up Time and Money**

   As opposed to taking classes, the application does not cost spending time to study MSL. Furthermore, the application will be provided for free download in the future through easily accessible mediums such as the Android market as well as the internet.

2. **Availability and Accessibility**

   Smartphones which runs on the Android operating system are easily available to own and the fact that the application is easily accessible, requires no internet connection as well as phones being practical to carry around addresses the issue that books and the internet have.

3. **Facilitates Learning**

   As opposed to writing down the words, the application will involve using MSL to communicate. Therefore apart from functioning as a translator, the application will also be able to facilitate learning MSL so that future need of the application may become unnecessary due to being able to converse proficiently in MSL without the need of any form of translator.

1.3 Objectives and Scope of Study

1.3.1 Objectives

1. To examine the Malaysian Sign Language and investigate existing related applications in order to attain a firmer grasp on the language and its structure.

2. To identify the criteria that determine what functions should be included in the sign language translator application.

3. To develop an Android application that will help translate and facilitate learning MSL and allow for communication between deaf and hearing people.

1.3.2 Scope of Study and Limitations

The need to have a firm understanding on MSL is unequivocally important to understanding the language structure as well as having a complete set of signs for numerous different situations. Therefore, further research on MSL will be conducted to address these issues. The findings will go into providing a database of all the signs to implement within the application. The findings will also go into determining what functions are absolute necessities to be put into the application.

Unfortunately, there are subtle differences of the use of MSL between different states similar to different dialects. Consequently, only the MSL used within the state of Perak will be used during the research and development of the current application due to the research being conducted and tested in Perak.

1.4 Relevancy of Project

To determine on the relevancy and the justification of pursuing the project, one must look at how the project will address the problems stated earlier and the impact at which it does so as well as the relevancy of the technology used to pursue the project. Therefore, to do so one must realize the potential in which the project can benefit deaf people and society as a whole. As stated previously, the application will help in bridging the gap of communication between deaf and hearing people. In doing so, it has the potential to minimize the problems faced by deaf people when dealing with those without hearing impairment. Furthermore, the project could potentially be opening new opportunities for deaf people to climb the corporate ladder by opening up possibilities of getting employment seeing as how communication between deaf and hearing people can be improved.

Moreover, the project has the potential to allow deaf people to build stronger bonds with hearing people. In addition, the project can serve as the basis for other similar projects in the future. Of course, there are no delusions that the project will be able to immediately and permanently solve the problems deaf people are facing in society. However, future improvements on the system will be able to further minimize miscommunications between deaf and hearing people and this project can be considered a stepping stone in the right direction.

In regards to the technology used to address these problems, development of the project on a smartphone is crucial due to the need for the project to be present on a readily available medium. Additionally the need for a camera is crucial to allowing hand gesture detection therefore, the most practical medium to develop the project is determined as a smartphone. Android was chosen as the preferred platform for development due to Android holding the largest market share in respect to smartphones as opposed to other smartphones such as those operating on the iOS and Blackberry smartphones.

1.5 Feasibility of Project

The time allocated for the first part of the project is for research purposes whereby it takes up approximately four months. The research conducted will involve mostly reviewing and analyzing other similar applications to determine the benchmark of what needs to be included and what needs to be improved upon during the development of the application. Apart from that, the research will also encompass going through further research on MSL in general. The second part of the project which involves developing the application is also within the time frame of four months. Based on the level of technical skills involved to develop the application, the only concern is in ensuring the entire vocabulary is included within the application. However, the combined time frame of eight months should be more than enough time to conduct a full research and implement the function in the final iteration of the application.

CHAPTER 2

LITERATURE REVIEW

2.1 Sign Languages in Malaysia

Language is the medium developed by civilizations by which we use to communicate and understand one another. To further elaborate upon the history of languages, we must first inspect the roots of the language. For example, as a result of the introduction of Germanic language to Britain, the Anglo-Frisian language came about, which further developed to form the Anglic language until it finally branched out into forming the English language [1]. All languages therefore have roots that can be used to trace the development and history of said language. Similarly, the same can be said for the development of sign languages.

In the 1960s Mr. Tan Yap, a Malaysian advocate for the deaf community took a year off from work to study American Sign Language (ASL). ASL then became the basis for further development on other forms of sign languages used in Malaysia today, namely the Kuala Lumpur Sign Language (KLSL) and Malaysian Sign Language (MSL) [2]. Prior to the introduction of these two languages however, there was also the use of Penang Sign Language (PSL) which was developed by students in Penang, the only state at the time which had a school that catered to deaf people. Over the years, use of KLSL and PSL diminished (although, the use of both can still be seen in older generations) and MSL has become the dominant sign language used within the deaf community of Malaysia [2].

Also similar to languages are the presence of different dialects. The practice of MSL throughout Malaysia differs by states due to influence of each state on MSL. A study was conducted in 2000 to show the percentage of similarities between different states on the use of MSL [2]. Table 2.1(a) illustrates the findings of that study.

Percentage of Similarities in the use of MSL in Different States

	JHR	KDH	KEL	KL	MEL	N9	PHG	PNG	PRK	PER	SBH	SWK	SEL	TER
JHR														
KDH	64													
KEL	68	72												
KL	72	80	80											
MEL	75	75	75	82										
N9	69	74	79	79	74									
PHG	75	67	80	75	72	74								
PNG	70	76	79	88	75	74	74							
PRK	72	73	78	80	74	78	77	76						
PER	71	77	83	84	75	80	75	84	80					
SBH	73	68	75	80	69	72	72	76	75	74				
SWK	68	72	76	83	81	73	68	79	71	80	70			
SEL	68	68	73	75	73	73	71	70	74	76	66	70		
TER	68	63	73	74	71	65	75	69	74	75	69	68	69	

JHR – MSL variation used in Johor
KDH – MSL variation used in Kedah
KEL – MSL variation used in Kelantan
KL – MSL variation used in Kuala Lumpur
MEL – MSL variation used in Melaka
N9 – MSL variation used in Negeri Sembilan
PHG – MSL variation used in Pahang
PNG – MSL variation used in Penang
PRK – MSL variation used in Perak
PER – MSL variation used in Perlis
SBH – MSL variation used in Sabah
SWK – MSL variation used in Sarawak
SEL – MSL variation used in Selangor
TER – MSL variation used in Terengganu

Table 2.1(a) Percentage of Similarities in the use of MSL in Different States

Another interesting thing to note about MSL and most other sign languages for that matter is the sentence structure used. The vocabulary of MSL is obviously limited as compared to the number of words featured in both Bahasa Malaysia and English. Therefore, the structure in constructing words may grammatically differ to how people speak orally [2]. For example:

Oral (English)	:	I am already married.
Sign Language (MSL)	:	[Marry] [already]
Oral (English)	:	My son is six years old.
Sign Language (MSL)	:	[Male] [child] [age] [year] [six]
Oral (English)	:	What is your name?
Sign Language (MSL)	:	[You] [name] [what]
Oral (English)	:	How old are you?
Sign Language (MSL)	:	[You] [age] [what]

2.2 Hearing Impairment and Deafness

Hearing impairment or deafness can be defined as the partial or complete loss of the ability for humans to sense sound. In order to get a firmer grasp on what hearing impairment deals with, one must first understand the basic concepts of how humans perceive sound through their ears. To put it simply, sound waves projected from the surrounding environment flows through the auditory canal which channels the sound energy to the tympanic membrane or more commonly known as the eardrum. The ear drum then directs the sound through the ossicles, which are three tiny bones found in the middle part of the ear. The sound is then transferred to the cochlea through the oval window. Afterwards, the cochlea allows the sound to be sent through the spiral ganglion, a group of nerve cells to be transmitted to the brain for processing to finally allow humans to perceive sound [3].

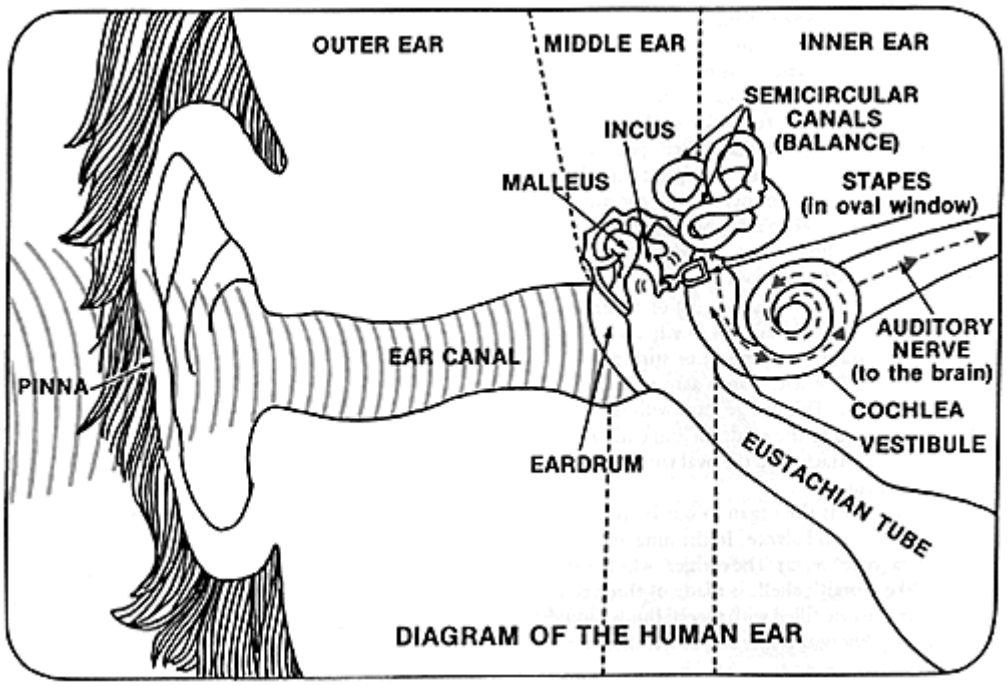

Figure 2.2(a) Anatomy of Human Ear

Upon understanding how the human ear works, the classification of the two types of hearing impairment can be more easily understood. The first of which is called conductive hearing loss which is when there are abnormalities in the normal function of the outer and middle ear. This can be caused by a number of different factors, the most common of them being an ear infection, excessive buildup of ear wax in the ear canal, or a perforated eardrum. Uncommon factors that lead to conductive hearing loss include the formation of a tumor in the middle ear or cholesteatoma, and otosclerosis which is the abnormal growth of the ossicles [4].

The second type of hearing loss is called sensorineural hearing loss which can be traced back to problems occurring mainly within the inner part of the ear. Common causes of sensorineural hearing loss include aging, pressure changes (for example, when flying), use of certain drugs, and loud noises. Less common factors are for example brain tumor, congenital infection or abnormalities, Meniere's disease, deterioration of the myelin sheath to name a few [4]. Of course, a combination of both can occur as well.

The extent of hearing loss can be measured by the intensity of sound in decibels that is required to perceive sound. Figure 2.2(b) shows the categorization of the different levels of hearing impairment.

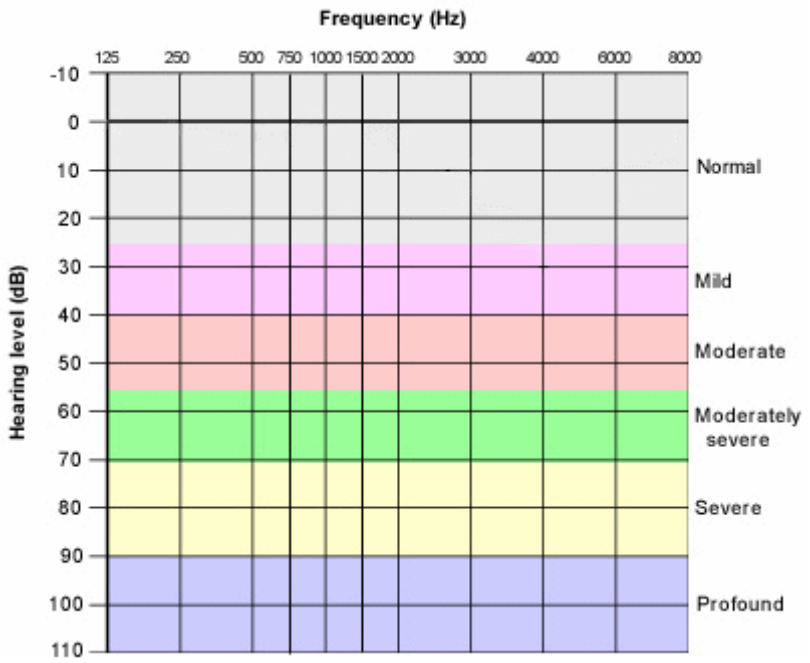

Figure 2.2(b) Severity of Hearing Impairment

2.3 The Deaf Community

Prior to progressing any further beyond this point, a clear distinction must be made to differentiate the use of the word “deaf” and “Deaf”. The use of the word “deaf” using a lower case “d” refers to the clinical usage of the word whether partial or complete deafness. Spelling of the word “Deaf” using an upper case “D” is used upon referring to the community that adheres to the culture and self-identity which centers on deafness although, it is not strictly limited to those that are clinically diagnosed as deaf. The clear distinction in the spelling of “deaf” and “Deaf” arose in the fact that a significant amount of the Deaf community has taken view of their condition as being something to take pride in as a culture and way of life rather than a disability. Regardless, the condition in reality still affects to an extent on the communication between deaf and hearing people. Tables 2.3(a) and 2.3(b) shows the statistics gathered by the Department of Social Welfare (JKM) on deaf in Malaysia [5][6].

Year	2006	2007	2008	2009	2010
Population of Deaf People	29522	31715	34580	37729	39824

Table 2.3(a) Population of Deaf People (2006-2010)

State	M	C	I	PSm	PSb	PSw	O	Total
Johor	2600	1179	422	5	0	5	83	4294
Kedah	2368	380	158	0	0	0	11	2917
Kelantan	4032	108	13	0	0	1	197	4351
Melaka	896	694	218	0	8	6	5	1827
Negeri Sembilan	875	404	258	7	0	0	0	1544
Pahang	1282	194	48	8	0	0	3	1535
Perak	2107	1049	474	11	1	3	1	3646
Perlis	458	58	5	0	0	0	3	524
Penang	1145	1132	359	0	1	0	3	2640
Sabah	29	444	6	0	2034	2	46	2561
Sarawak	612	993	0	0	0	642	3	2250
Selangor	3367	1250	995	45	4	7	31	5699
Terengganu	2243	79	61	0	0	0	0	2383
W.P Kuala Lumpur	1638	1436	485	1	3	0	5	3568
W.P Labuan	41	23	3	0	12	2	4	85
Total	**23693**	**9423**	**3505**	**77**	**2063**	**668**	**395**	**39824**

M – Malay
C – Chinese
I – Indian
O – Other

PSm – Peranakan Semenanjung (Indigenous People in Western Peninsula)
PSb – Peranakan Sabah (Indigenous People of Sabah)
PSw – Peranakan Sarawak (Indigenous People of Sarawak)

Table 2.3(b) Population of Deaf People According to States (2010)

2.4 Introduction to the Android Platform

Figure 2.4(a): Android

Android is the operating system (OS) for mobile devices such as smartphones and tablets developed by Google Inc. which is used by a number of different mobile device manufacturing companies such as Acer, HTC, LG, Motorola, Samsung, Sony Ericcson, Dell, Creative, Asus and Toshiba to name a few. According to Andy Rubin, the Senior Vice President of Mobile at Google and co-founder of Android Inc before its acquisition by Google, the number of mobile devices that use the Android OS has reached over 300 million devices worldwide as of February 2012 with 850,000 activations per day [7]. As of the third quarter of 2011, Android's market share was estimated to be over 52.5% coming out at the lead in the mobile device market surpassing its main rival Apple Inc. with its iOS platform of mobile devices (Gartner, 2012). It is because of this reason that Android was chosen as the preferred platform of choice for the current implementation of the application.

Currently, there have been a number of version releases of the Android platform with the current version being Android 4.0 (Ice Cream Sandwich). Figure 2.4(b) shows the usage share of the different versions of the Android OS [8].

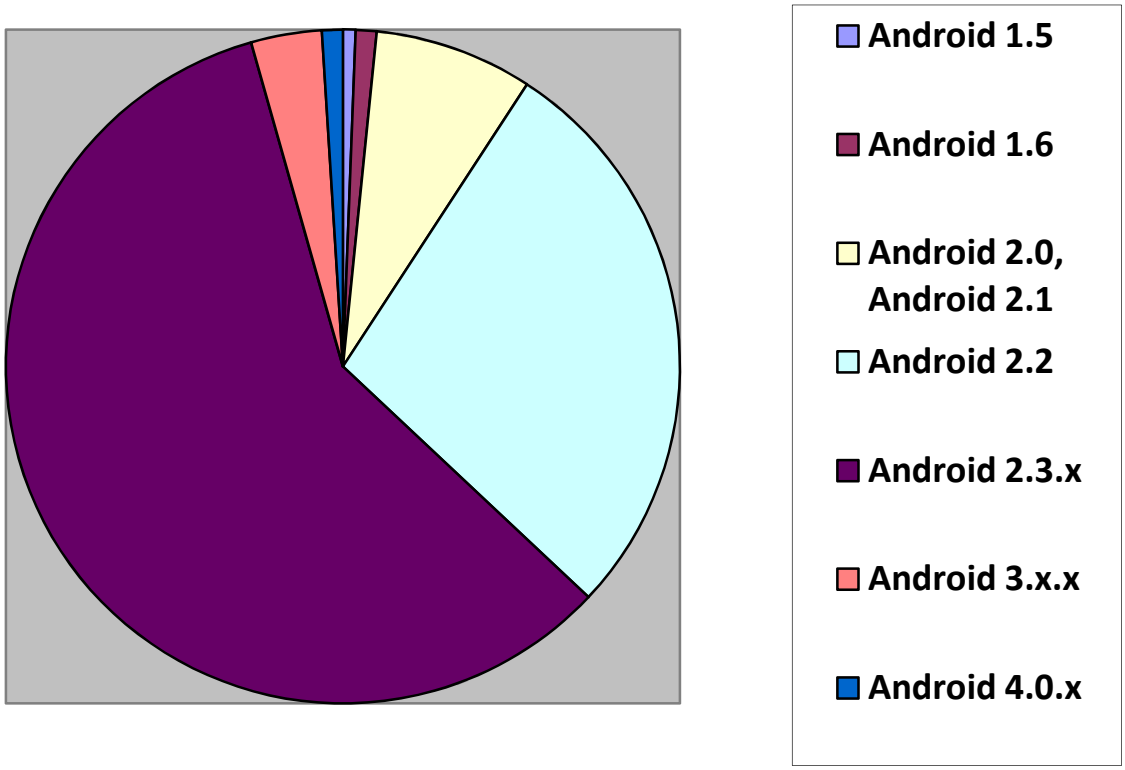

Figure 2.4(b): Usage Share of Different Android Versions

From the chart, it makes sense that the development of the application will proceed on Android 2.3.x (Gingerbread) due to a higher number of users using this version of Android as compared to other versions (may be subject to change as development of the application begins around the mid of the second quarter of 2012 where there should be an increase in Android 4.0.x users).

The development of the application will be directly performed using an integrated development environment (IDE) that supports the Android software development kit (SDK). The preferred IDE of choice that will be used during the development of the application is Eclipse 3.7.2 (Indigo) seeing as it is the officially supported IDE by Android with its Android Development Tools (ADT) Plugin that allows ease of integrating the Android SDK. Due to being targeted at Android 2.3.x users, the application programming interface (API) of the Android SDK used will be API 10 which supports development up until Android 2.3.3.

2.5 Current Android App Used To Address Communication Issues between Deaf and Hearing People

Of course, due to the fact that Android platform has been commercially launched since 2008, the Android developer community has been growing and multitudes of Android application have been developed and launched since then with a reported number of over 500,000 apps on the market as of the third quarter of 2011 [9][10]. Due to this, it is hardly a surprise that there are a number of sign language translator app distributed through the Android app and third party online distributors. However, there are a number of problems with these apps that make them an ineffective medium for improving communication between deaf and hearing people. Among them are:

1. **Limited Number of Words**

   A number of the apps available on the market online provide for a limited number of words in their vocabulary such as "ASL American Sign Language" by TeachersParadise.com which only features signs for letters.

2. **Not Localized**

   There is currently no available sign language app that deals with MSL. For instance most apps deal with American Sign Language (ASL) such as the aforementioned "ASL American Sign Language" by TeachersParadise.com as well as "ASL Lite" by Zoosware, and "Greek Sign Language" by ΚΈΝΤΡΟ ΕΛΛΗΝΙΚΉΣ ΝΟΗΜΑΤΙΚΉΣ ΓΛΏΣΣΑΣ.

Figure 2.5(a): ASL American Sign Language

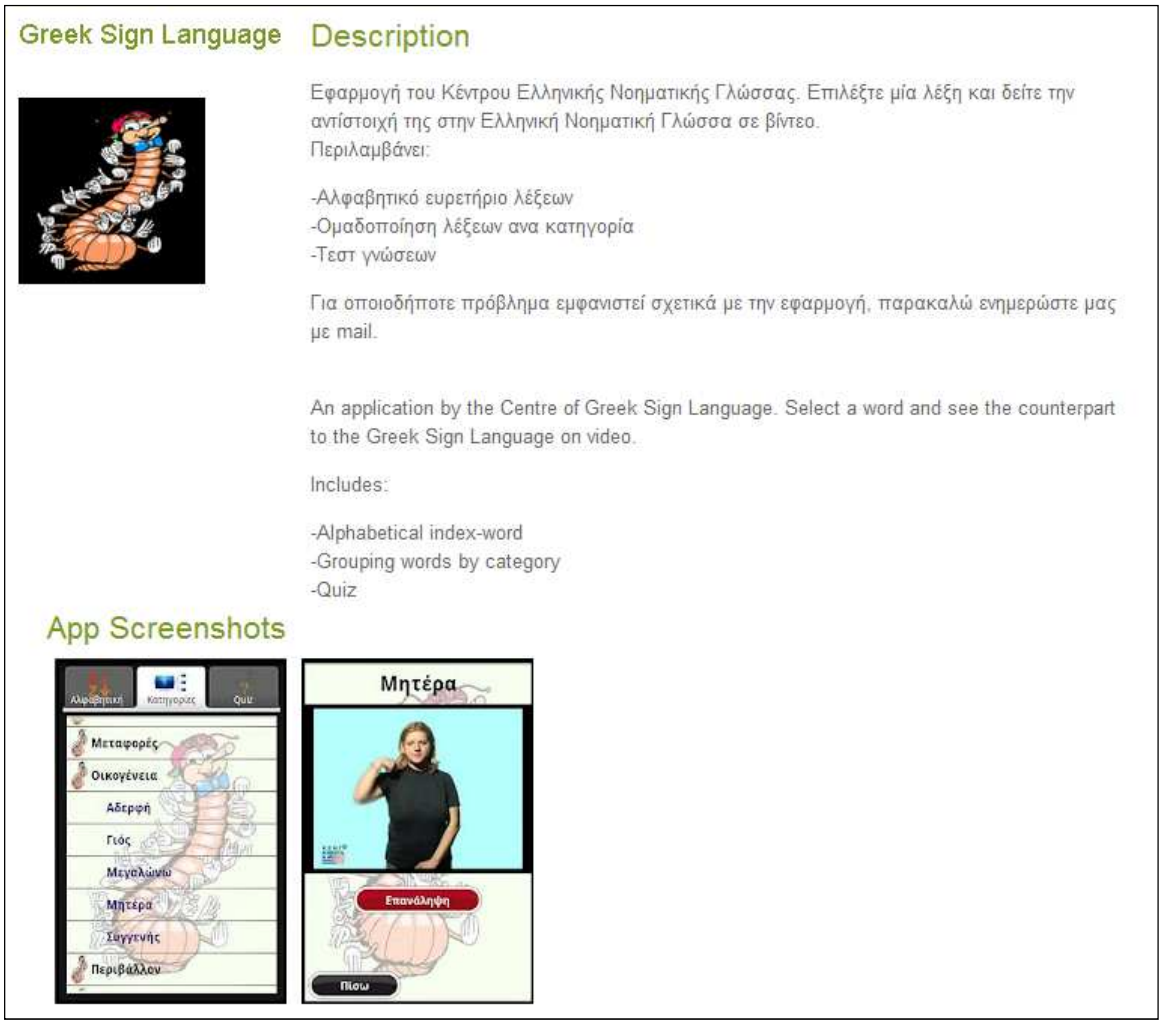

Figure 2.5(b): Greek Sign Language

CHAPTER 3

METHODOLOGY

3.1 Research Methodology

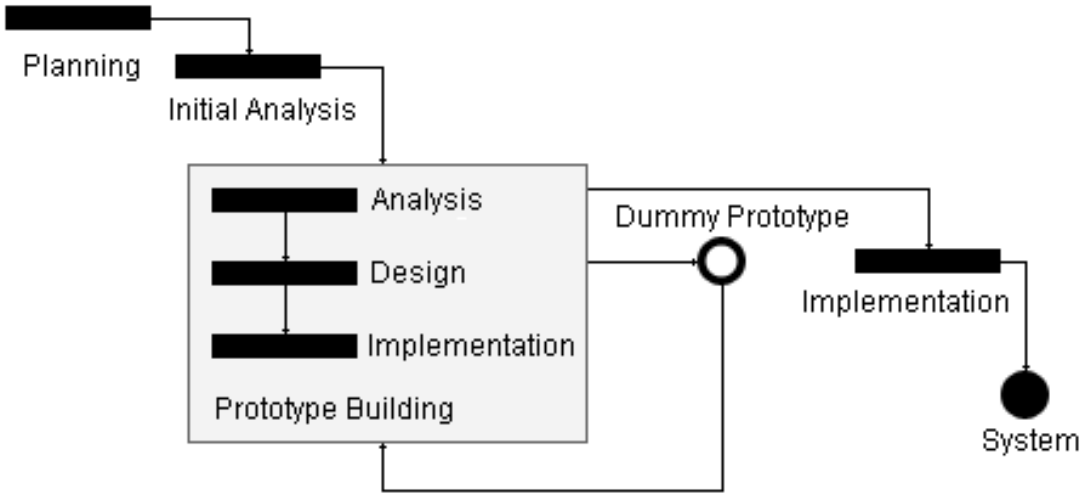

Figure 3.1(a): Prototyping Methodology

The methodology used to conduct the research on the project is the prototyping model. This methodology is chosen due to the fact that there are a number of uncertainties regarding the development of the project that may change the implementation of certain functionalities to be featured within the system such as hand gesture detection and the vocabulary of MSL to be included within the database. However, the methodology also helps the development of the application in a number of ways such as allowing active participation of the developer and target users. This will allow for early testing and ease of determining what works and what needs to improved upon during the development of the system. Furthermore, given the limited time allocated for the development of this application, the prototyping methodology allows for faster development of the system. Moreover, by producing a prototype, the development can run more smoothly as early development cycle allows for a grasp on the final product.

1. Planning Phase:

   During this phase, planning for what needs to be studied to proceed with development of the system takes place. Research is conducted to determine what criteria needs to be scrutinized in order to establish an understanding on the basic requirements of the system, what functionalities are required, and what data is required to determine these factors. Further research on existing technologies that address the problem of communication between deaf and hearing people also need to be conducted to get a benchmark on the basic functionalities of the system. The methods of

2. Analysis Phase:

   The analysis phase is conducted to perform a user need analysis to gather data and statistics that will determine the requirements of the system. This phase will involve conducting surveys and interviews to be conducted on the Deaf community to understand what technical difficulties they face when trying to communicate with hearing people. Any incomplete requirement analysis that occurs during this stage will be addressed during the prototyping phase that will allow for further inspection and testing. The deliverables of this stage will allow for the design of the prototype.

3. Prototyping Phase

   A prototype of the system will be developed during this phase. This will allow for numerous testing of the product during the iteration period for a number of purposes such as validating the system specifications and requirements, addressing any newly discovered requirements, and uncovering any design flaws. This phase will be repeated continuously to allocate room for improvement of the system until the prototype reaches the level of executability and scope that is expected of the system.

4. Implementation Phase

   Upon finishing the initial prototype of the system and reaching a significant level of approval in terms of performance and executability, implementation of the system is conducted with the target user. In this case,

the implementation of the system will occur between a deaf and a hearing person to determine whether or not the system achieves its set purposes in allowing for a better communication between deaf and hearing people. The implementation of this project will also take place in parallel to other methods of communicating with deaf people such as using books and the internet to determine the impact of which the system is able to pull off in regards to its purposes. At the end of this phase, the final product, the development of the system is complete and the application is the final deliverable of the project.

3.2 Result Analysis

3.2.1 Project Activities

A survey was conducted (refer to Appendices: FORM-A) to analyze the basic requirements of the application in order to be an effective solution in improving communication between the hearing and the Deaf. The survey was sent to15 workers who had to deal with Deaf people on a regular basis in their line of work. The results of the survey are as follows:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. You deal with deaf people on a regular basis in any given year.	0	0	0	0	2	5	8
2. You have a firm grasp on Malaysian Sign Language in dealing with the Deaf.	0	5	4	2	2	2	0
3. If a mobile application version of MSL is developed for use on the Android platform of smartphones, it can better facilitate learning of MSL as opposed to using books, using the internet and going to class.	0	0	1	2	1	5	6

4. Having a still image but with detailed instructions on the movement of the hand gesture works just as fine as having an animated image of the hand gesture.	0	3	5	1	2	3	1
5. You are familiar with Android smartphones.	1	4	3	0	2	3	2

A personal observation was also conducted through a meet-up with a Deaf person; Mohd Yunus bin Yusof in order to test out the reliability of currently available solutions to communicate with the Deaf including books and the internet. Throughout the conversation, multiple criteria were scrutinized in order to measure the effectiveness of the available resources. The outcome of the observation was as follows:

Books	Internet (via mobile phone)
Pros: - Properly categorized words - Accessibility	Pros: - Properly categorized words and search functionality - Animated movements of hand gestures provide for simpler grasp - High content
Cons: - Slightly difficult in searching for words through different pages	Cons: - Accessibility issues (slow internet connection could affect how fast one can respond)

Table 3.2 (a): Pros and Cons of Books and Internet

Therefore, based on the survey and the observation conducted, a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis can be made.

Strengths	Weaknesses
- Accessibility - Categorization of words allow for easy access	- Does not provide animated movement of hand gestures - Low content
Opportunities	**Threats**
- Deployment of the application can reach a wider audience with possibilities of porting the application to other platforms such as the iOS, Symbian and Windows Mobile upon completion.	- Relatively low familiarity with Android smartphones might affect effectiveness of some people in using the application.

Table 3.2 (b): SWOT Analysis

3.2.2 Flowchart

Figure 3.2 shows the proposed flowchart of the system based on the functionalities defined after the survey, observation and SWOT analysis as well as the research done in FYP II to determine which prototype is to be used. The user will be given the option of choosing from a list of categories what sign they would like to learn/use in for conversational use with a deaf person. Furthermore, the user will be able to test himself/herself in their memory retention of the signs in MSL through the use of the quiz option. This tests the user's memory by having the user correctly identify the signs that are randomly shown.

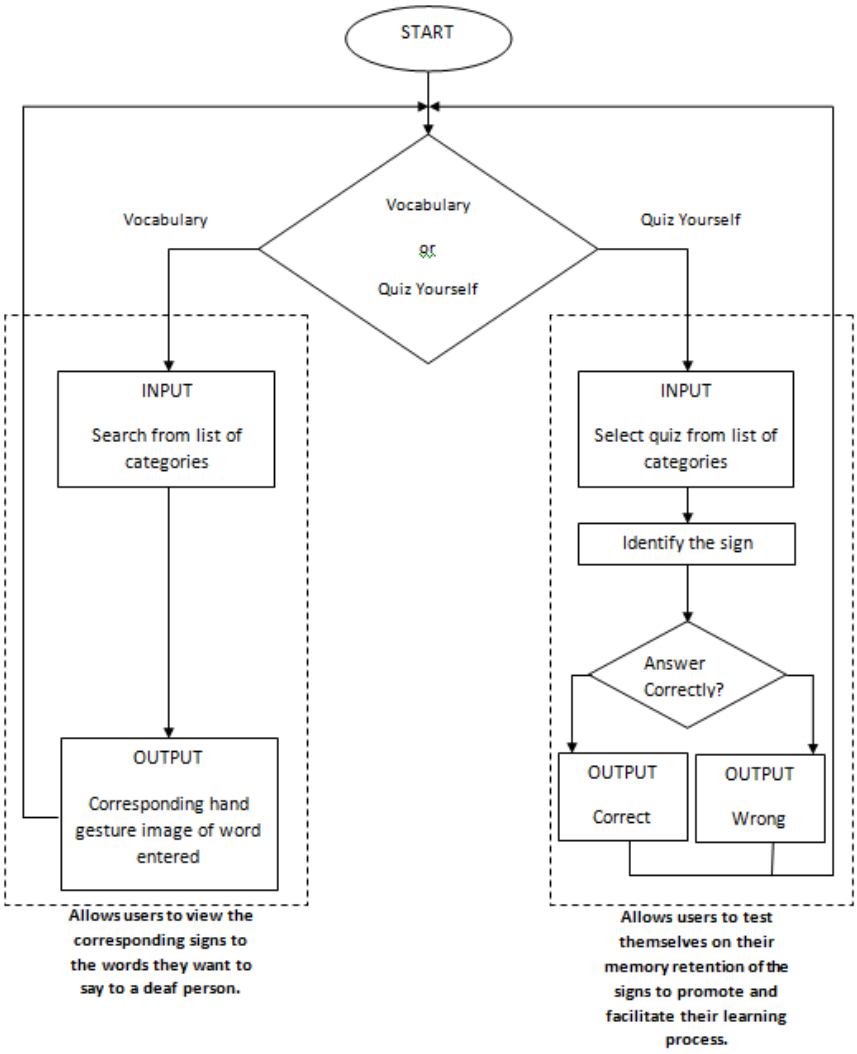

Figure 3.2 Flowchart of the System

3.3 Tools and Equipment Used

3.3.1 Mobile Device

The mobile device to be used during the development and testing of the system includes a smartphone and also a tablet. For the smartphone, the system will be developed on a HTC Desire HD running on Android 2.3.5. As for the tablet, the Samsung Galaxy Tab running on Android 2.3.3.

3.3.2 Software

The coding of the system will be conducted using an IDE, in this case the Eclipse (Indigo) which is supported by the Android SDK through the JDT plugin featured within Eclipse. This will allow for easier set up of the project as well easier integration. The coding of the system will be conducted using JAVA and XML which is fully supported by Eclipse. Furthermore, a companion tool to the Android SDK, the Android native development kit (NDK) will also be considered to allow for performance optimization on the code and algorithm of the system should it come as necessary.

3.4 Gantt Chart

Final Year Project Part I

Detail Week	1	2	3	4	5	6	7	8	9	10	11	12
Selection of Project Topic & Supervisor												
Submission of Proposal to research cluster												
Submission of Extended Proposal												
Research Class												
Conduct the survey												
Submission of Viva: Proposal defense and Progress Evaluation												
Submission of Interim Report												

Table 3.4(a): Final Year Project I Gantt Chart

Final Year Project Part II

Detail Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Programming Research														
Prototype Development														
Submission of Progress Report I														
Submission of Progress Report II														
Seminar														
Pre-SEDEX														
Submission of Final Report Draft														
SEDEX														
Oral Presentation														
Submission of Final Dissertation														

Table 3.4(b): Final Year Project II Gantt Chart

CHAPTER 4

RESULTS AND FINDINGS

4.1 Prototype

Throughout the development process of the project, several iterations of the application have been developed or partially-developed to explore the possible options to address the aforementioned problems. Below are the lists of prototypes developed throughout the development phase:

4.1.1 Prototype 1

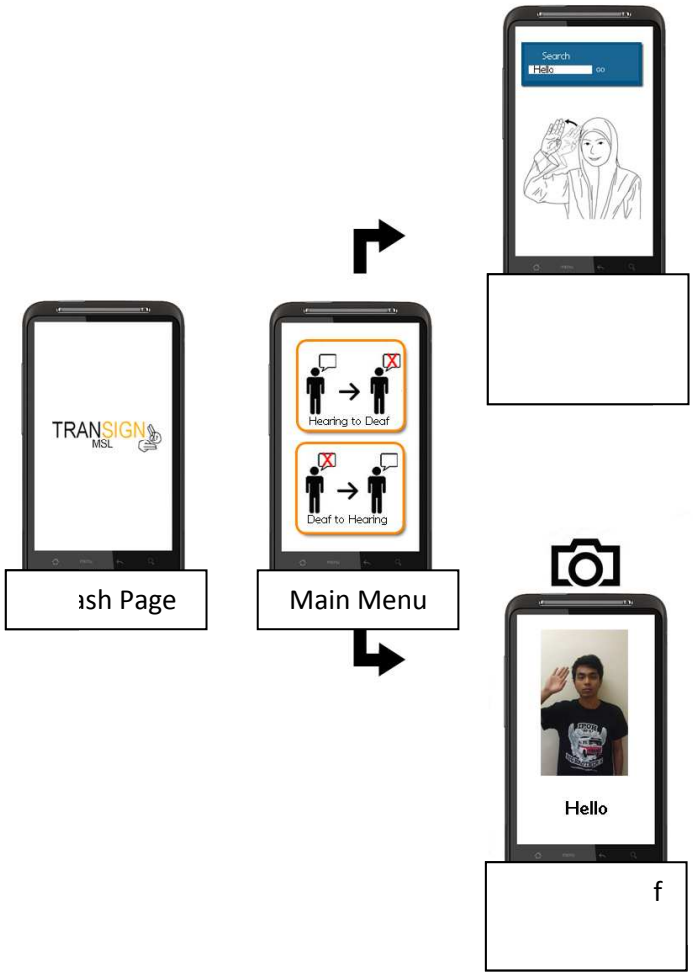

Figure 4.1: Prototype 1

The initial development for Prototype 1 of the application was designed to address the issues stated earlier as well as allowing for the functionality of digital image processing to allow for the conversion of real time videos of a person

performing signs from the MSL vocabulary. The main menu contains two options which are the “Hearing to Deaf” option and “Deaf to Hearing” option.

The first option allows for users to navigate through the MSL vocabulary to view the corresponding pictures of the signs the user is searching for. This will allow users to input what they wish to say to a deaf person and perform the correct sign(s). The second option uses digital image processing to record a person while said person is performing a sign, and by cross-referencing the available signs within the local database converts the video into the corresponding word in English. This would be useful in situations where the user can translate directly what a deaf person is signing. With these two options, the application would have provided a complete two-way communication between the hearing and the deaf person, greatly decreasing communication barriers between the them.

Unfortunately, implementation of the second option was ultimately dropped. This is due to the fact that the hardware capabilities of current Android smartphones are very limited in regards to digital image processing technology. The method to be used which was through facial, skin and hand gesture recognition proved to be too complex for the hardware of most smartphones to be able to implement. Further adding to the complexity is the fact that according to past research, the fastest way to potentially implement such a feature is through the use of an unstable version of OpenCV for Android. Considering the time constraints and limited knowledge of mathematical algorithms regarding digital image processing, the prototype was scrapped during the earlier stages of development.

4.1.2 Prototype 2

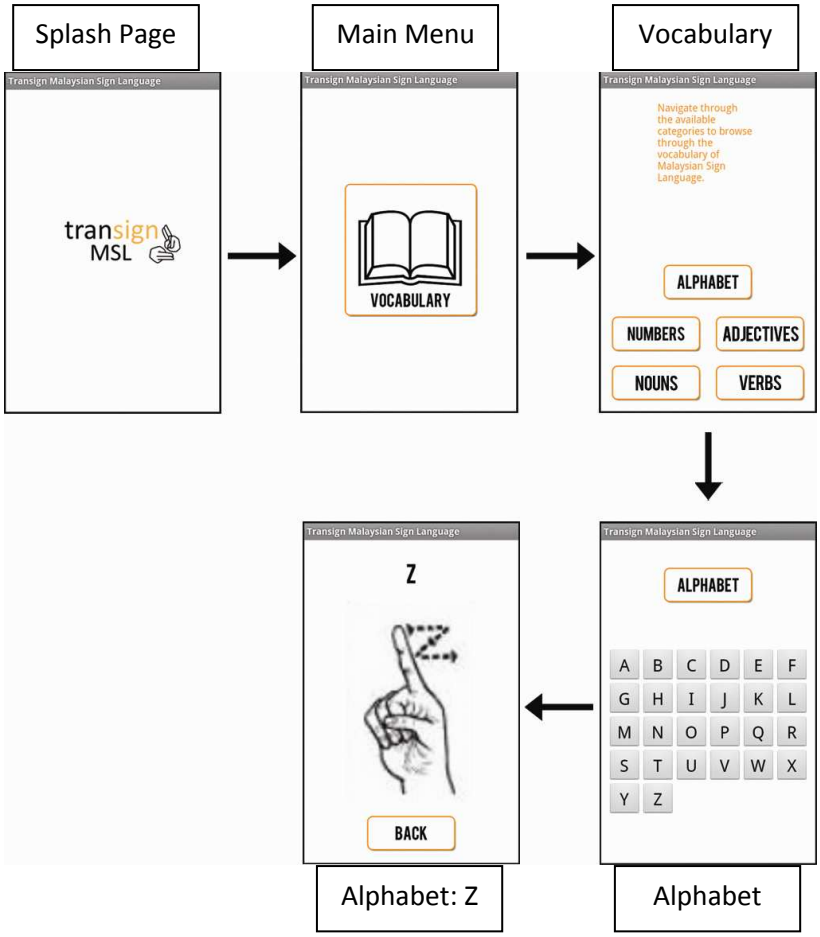

Figure 4.2: Prototype 2

Development of the second iteration of the application was to be focused on implementation of the application as a stand-alone e-dictionary of the MSL vocabulary to allow for users to quickly access what words they would like to sign in MSL to allow for conversations with. This allows users to disregard books and the internet (should neither of the two be available) for an easier method of looking up for the corresponding signs of the words the user wants to say to the deaf person.

Furthermore, this prototype would also allow users to practice and memorize the words in any of their spare time such as at home or while waiting for the bus to arrive at the bus stop for example. This will allow users to become more familiar with the language, thus facilitate their learning process and eventually allowing them to converse with deaf people more easily in the future.

The user has the option of selecting from a number of categories from the vocabulary page which are the alphabet, numbers, adjectives, nouns and verbs. Within each of these categories are a number of different signs. For example, within the category of the alphabet, users can choose from a range of signs ranging from “A” to “Z”. Similarly, the other categories also have a range of different words within those respective categories. After selecting which word the user wishes to sign, the picture of the respective sign is shown, allowing users to sign the words to a deaf person.

Regrettably, the implementation of this prototype was regarded insufficient as after further research (as documented in chapter 4.2 Results and Findings) conducted on participants on the effectiveness of the application showed that the prototype was not as effective as was expected in promoting an effective and reliable teaching aid for understanding and memorizing the words. The features from this prototype are however carried over to the implementation of the next prototype.

4.1.3 Prototype 3

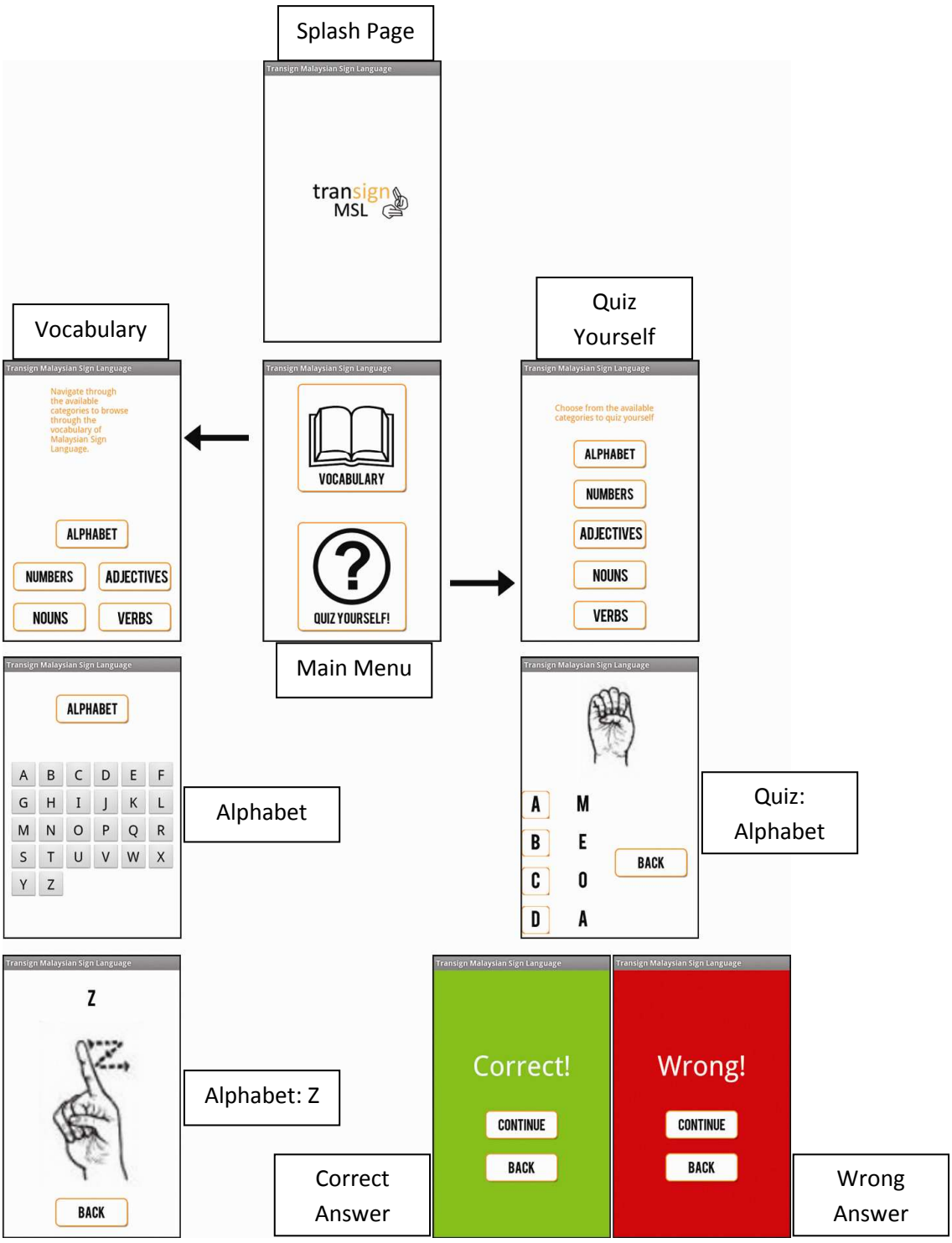

Figure 4.3: Prototype 3

The implementation of the third prototype has retained the vocabulary feature from Prototype 2 as explained earlier. In addition to that, a new feature was also

added which is a quiz feature. This new feature allows users to test their memorization of the vocabulary through repeated quizzes and allows for easier transition in learning MSL as opposed to solely relying on the e-dictionary feature of the application. Through repeated use, the quiz cements the signs into the user's memory, which ultimately results in better memory retention of the signs and allows for a faster learning curve in promoting a more fluent usage of MSL.

In selecting the quiz feature, the user is again allowed to choose from the available categories as listed in the e-dictionary feature. Similarly, after selecting a particular category, the user is presented with random quizzes, testing the user's memory retention on the signs within the selected category. Upon answering the quiz which features four different answers, the user will then choose the right answer, followed with a page displaying that the user is correct. Understandably, upon selecting the wrong answer(s), a page displaying that the user is incorrect will follow.

After conducting further research on this prototype (as documented in chapter 4.2 Results and Findings) this prototype has been chosen for the final implementation of the application as it caters to the objectives stated earlier and proves to provide a faster and more effective way in facilitating the learning curve of learning MSL.

4.2 Evaluation through Prototype Testing

Prototypes 1 and 2 were tested out by being distributed to 15 participants in determining the following criteria in the implementation of the application, with the results of the first three criteria gathered through surveys and the final criteria evaluated through observation of the interaction of three participants with a legally deaf person.

1. Images of the signs are easy to understand and follow.
2. The signs are easy to memorize.
3. The application allows for quicker access to the desired words the users wish to communicate as opposed to through books and dictionaries.
4. The overall application allows for an easier method in communicating with a deaf person.

On whether or not the signs are easy to understand as well as the relative ease of accessing the signs compared to using books and the internet, the method of conducting a survey through the use of questionnaires is utilized. As for collecting information on the capability of the application in allowing ease of memorizing the words, the questionnaire is utilized and further clarified by testing the participant's ability in identifying the signs using flash cards on 50 signs shown randomly after having the participants use the application for a period of two days. The overall effectiveness of the application is tested in having the top three participants who identified the most signs correctly try to converse with a deaf person. The three participants are required to properly communicate with the deaf person by correctly communicating a sample of 20 sentences.

4.2.1 Testing of Prototype 2:

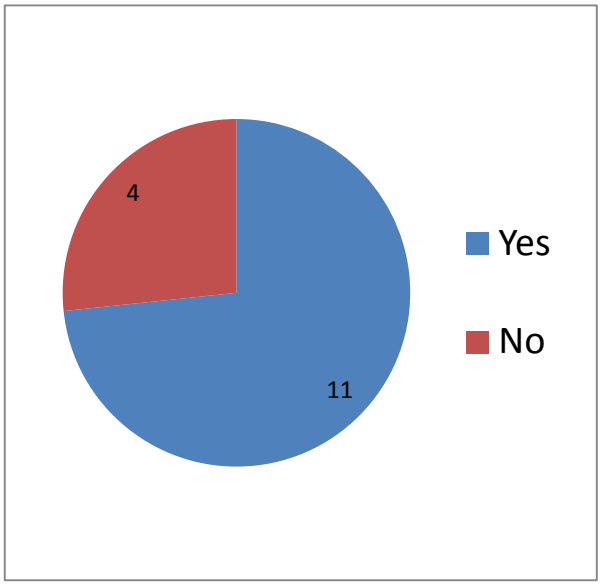

Figure 4.4: Images of the Signs are Easy to Follow through use of Prototype 2

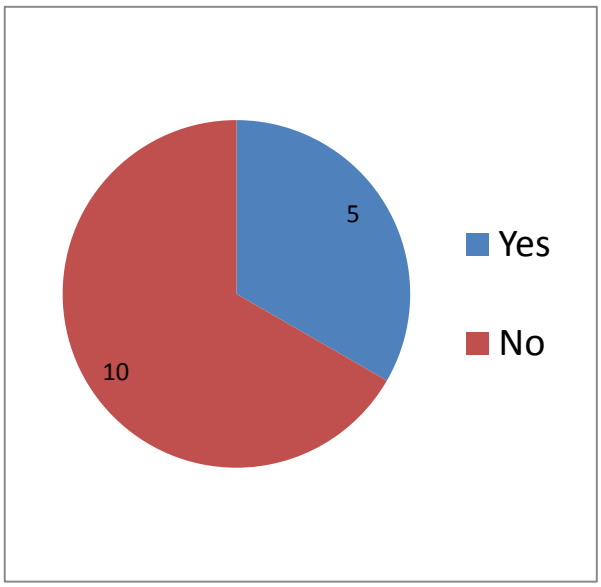

Figure 4.5: Signs are Easy to Memorize through use of Prototype 2

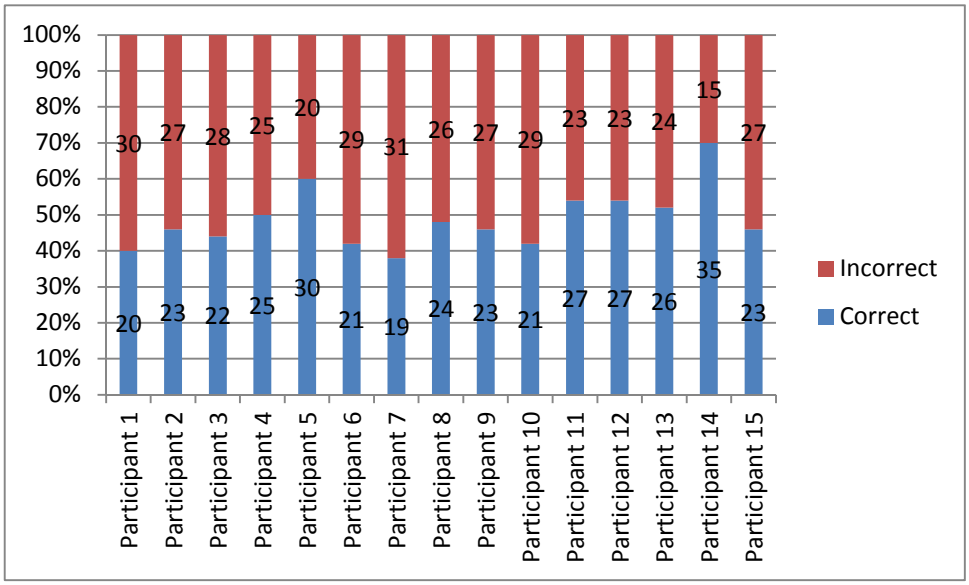

Figure 4.6: Number of Signs Identified Correctly through use of Prototype 2

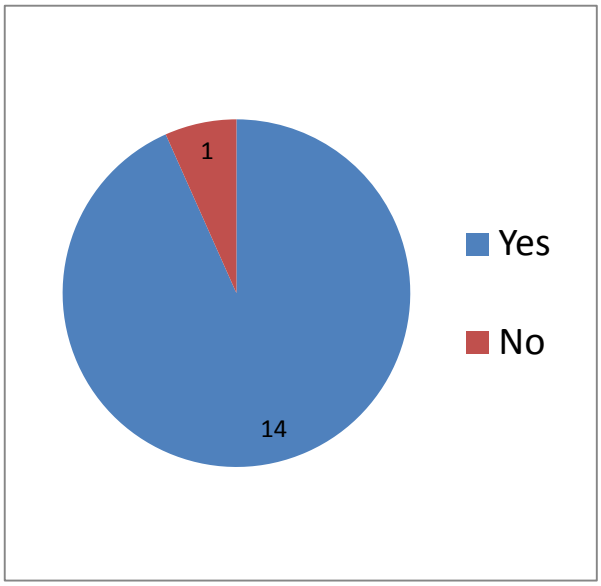

Figure 4.7: Quick and Easy Access of the Signs through use of Prototype 2

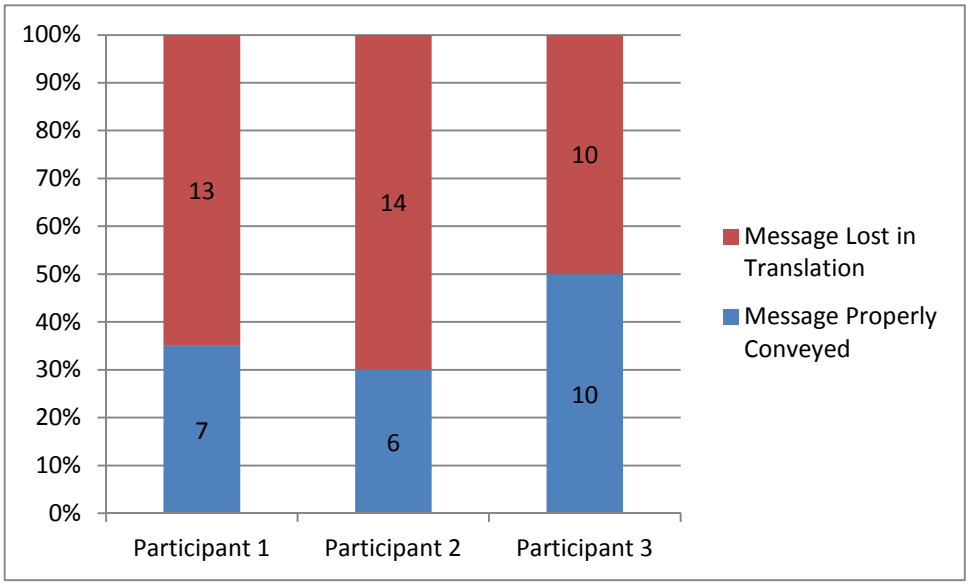

Figure 4.8: Number of Messages Properly Conveyed through use of Prototype 2

4.2.2 Testing of Prototype 3:

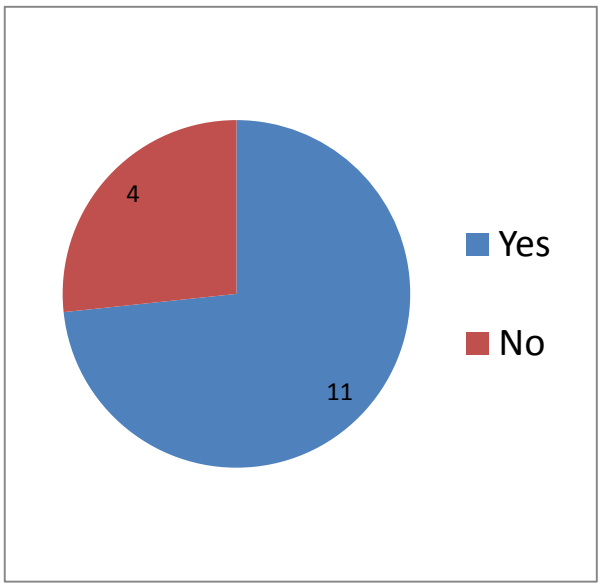

Figure 4.9: Images of the Signs are Easy to Follow through use of Prototype 3

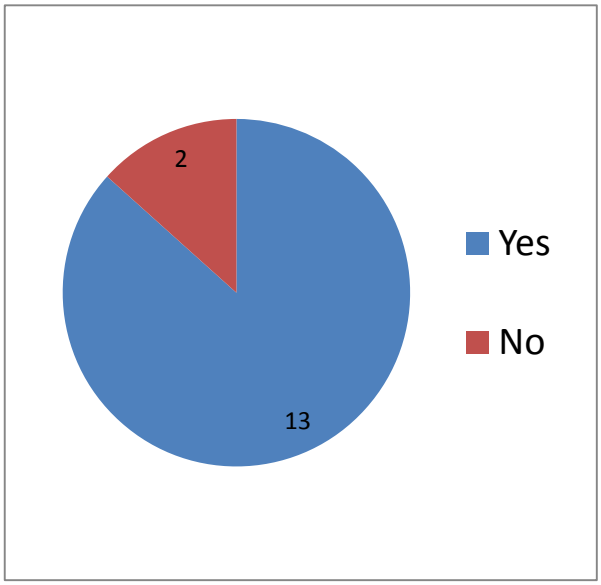

Figure 4.10: Signs are Easy to Memorize through use of Prototype 3

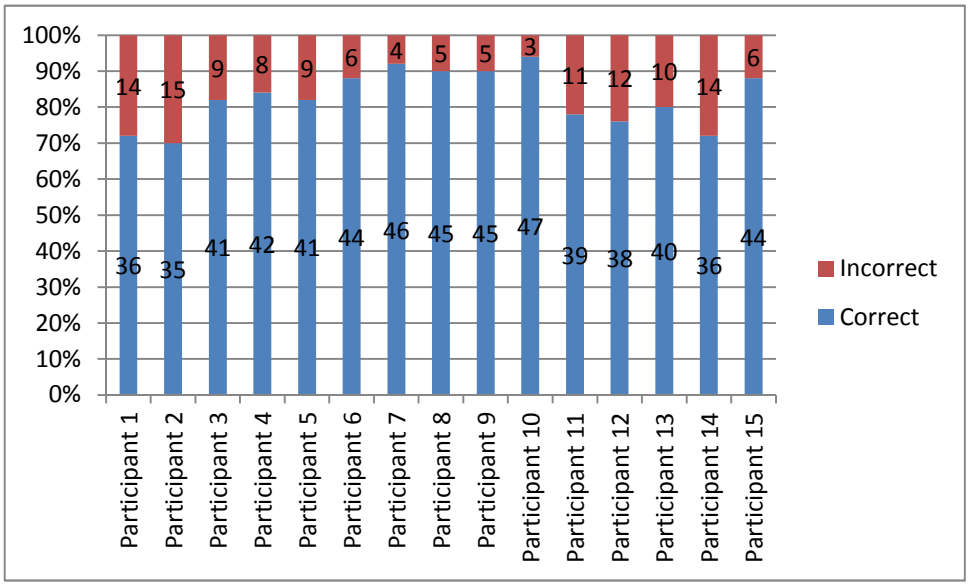

Figure 4.11: Number of Signs Identified Correctly through use of Prototype 3

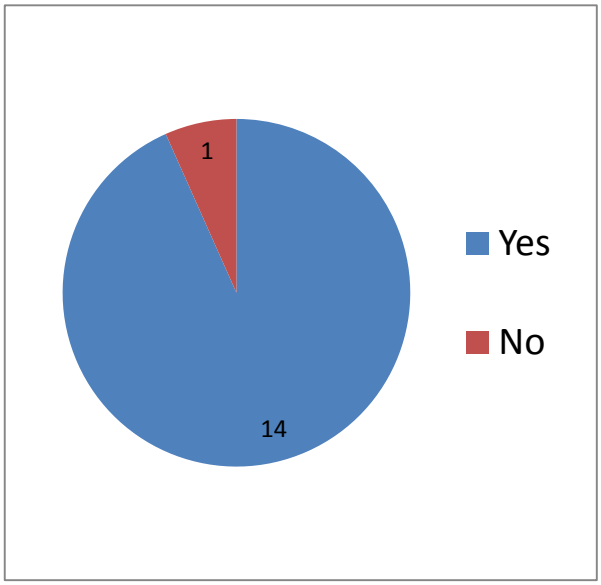

Figure 4.12: Quick and Easy Access of the Signs through use of Prototype 3

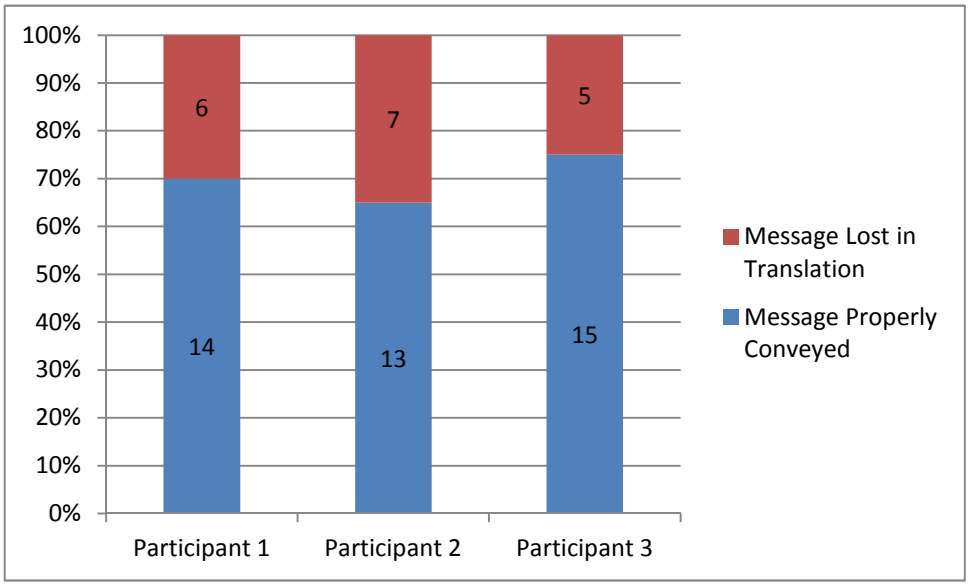

Figure 4.13: Number of Messages Properly Conveyed through use of Prototype 3

4.3 Discussion

After successfully gathering the data on Prototype 2 in each respective criterion, several conclusions can be made on the application. As shown in figures 4.4 and 4.7, we can conclude that Prototype 2 is successful in allowing a majority of users to properly understand and follow the instructions in performing the signs as well as providing a relatively quicker access to the words as opposed to having to refer to books and the internet. However, upon determining the ease of memorizing and correctly identifying the signs, figures 4.5 and 4.6 clearly show that the users have problem in retaining their memory of the signs. Of the 15 participants, 66% said that they had trouble memorizing the signs. Upon testing the participants in identifying the signs using flashcards, an average of 24 words were identified correctly out of the possible 50 signs. Finally, in testing the overall effectiveness of the application, the top three participants were asked to converse with a deaf person, Mr. Yunus bin Yusof by signing 20 random sentences. As shown in figure 4.8, an average of seven sentences was properly conveyed out of the possible 20 sentences.

Therefore, upon evaluating Prototype 2, we can conclude that it has correctly addressed the issue of allowing users to access the signs of MSL and are able to do so with relative ease and quicker access as opposed to using books and the internet. However, the application has difficulty in facilitating memory retention of the signs for users, which ultimately affects the overall effectiveness of the application in allowing an easier way of communicating with a deaf person. Consequently, Prototype 2 was considered incomplete in achieving the desired objectives.

The data gathered on Prototype 3 in each respective criterion shows that the prototype is considerably more effective than Prototype 2. Similar to Prototype 2, figures 4.9 and 4.12 proves that the prototype is successful in allowing a majority of users to properly understand and follow the instructions in performing the signs as well as providing a relatively quicker access to the words as opposed to having to refer to books and the internet. Nevertheless, upon determining the ease of memorizing and correctly identifying the signs, figures 4.10 and 4.11 clearly show an improvement in allowing users to better memorize the signs as opposed to Prototype 2. Of the 15 participants, 87% said that the signs are easier to memorize through Prototype 3. Upon testing the participants in identifying the signs using flashcards, an average of 41 words were identified correctly out of the possible 50 signs. Finally, in testing the overall effectiveness of the application, the top three participants were again asked to converse with a deaf person, Mr. Yunus bin Yusof by signing 20

random sentences. As shown in figure 4.13, an average of 14 sentences was properly conveyed out of the possible 20 sentences.

Therefore, upon evaluating the application, we can conclude that Prototype 3 has preserved the property of correctly addressing the issue of allowing users to access the signs of MSL and are able to do so with relative ease and quicker access as opposed to using books and the internet. Moreover, the application has shown a visible result in increasing the memory retention of the signs for users. A hypothesis can be derived from this in the fact that the implementation of the quiz feature has allowed users to test their memory on the signs. Thusly, this promotes better memory retention of the signs as opposed to Prototype 2 which lacked this feature. This can be justified by the increase of the average number of words correctly identified by the 15 participants by 17 words (70%) and the increase of the average number of sentences properly conveyed by seven sentences (100%), further signifying the overall increase in effectiveness of the prototype. Therefore, it is due to this reason that Prototype 3 is chosen as the final product of the project.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The objectives that were previously stated in the objectives and scope of study are:

1. To examine the Malaysian Sign Language and investigate existing related applications in order to attain a firmer grasp on the language and its structure.

2. To identify the criteria that determine what functions should be included in the sign language translator application.

3. To develop an Android application that will help translate and facilitate learning MSL and allow for communication between deaf and hearing people.

In respect to examining MSL and its structure, most of the available resources were amply provided through an online medium. Further assistance on the subject was given by deaf instructors from Politeknik Ungku Omar who had agreed to provide assistance in the matter. In respect to the second objective, the criteria have already been determined through the survey, observation and SWOT analysis. Based on these findings, the key functionality that is to be expected of the system is the ability to provide users with an on-the-go alternative to searching through the MSL vocabulary to find the words that the users wish to convey. Accordingly, these two objectives were addressed during FYP I, which allowed for a more accurate view on what should be included within the final product of the application. As of the implementation of Prototype 3, these features have been clearly included which is being readily accessible, practical, and easy to use as well as being a better alternative to books and the internet due to the application being planned for a free release and requiring no internet connection. The study conducted throughout the whole FYP I time period has led to a sufficient amount of knowledge to start on the development of the prototype by FYP II. Overall, the aforementioned objectives of the study can be considered achieved.

5.2 Suggested Future Work for Expansion and Continuation

There are numerous undertakings that can proceed to improve upon the developed application. Among them are:

1. Use of animated images/images to represent hand gestures.
2. Inclusion of every MSL sign in existence.
3. Inclusion of MSL of every different state.
4. Real-time translation of hand gestures into words through use of digital image processing.
5. Port of the application onto other platforms such as the iOS.

Due to time constraints and limited technical expertise, several of these improvements are not feasible to be implemented into the system within the given time frame. The implementation of animated images or videos to portray the hand gesture movement can allow for a more accurate depiction of the sign which will correspondingly allow the person using the system to perform the sign more accurately.

Furthermore, for the purpose of the project, the number of words to be included in the application will only be 200 words in order to show the functionality of the application. Further inclusion of the whole vocabulary of MSL including the use of MSL in different states can be implemented if time is permissible. Due to time being insufficient in including all these features, the source code of the application will uploaded to Google Code in order to allow for open-ended development of the application for interested individuals or groups that wish to improve the application.

Moreover, due to limited technical expertise, the functionality of providing a real-time translation of hand gestures into words through digital image processing is also unfeasible considering the time limit of the project. The inclusion of such function however can prove to be a substantial improvement that will increase the efficiency and effectiveness of the system due to being able to translate a full sentence of words signed in MSL by a deaf person. This will allow for seamless translation of the signs being performed by the deaf person in question, and will allow for a

complete two-way communication between the hearing and deaf person. Similar to the aforementioned plans for including the whole vocabulary of MSL, the uploaded code on Google Code can provide for any interested parties to include this functionality in the system.

Finally, the application can also be ported onto different platforms such as iOS, Symbian, and Windows Mobile to allow for wider use and availability for the public.

References

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Appendices

1. FORM-A

Survey on Android MSL Application for Improved Communication between Deaf and Hearing People

Name : _____

Date:_____

Address:

_____

__

Tel No. : Home (___)_____-_____ Date of Birth:_____

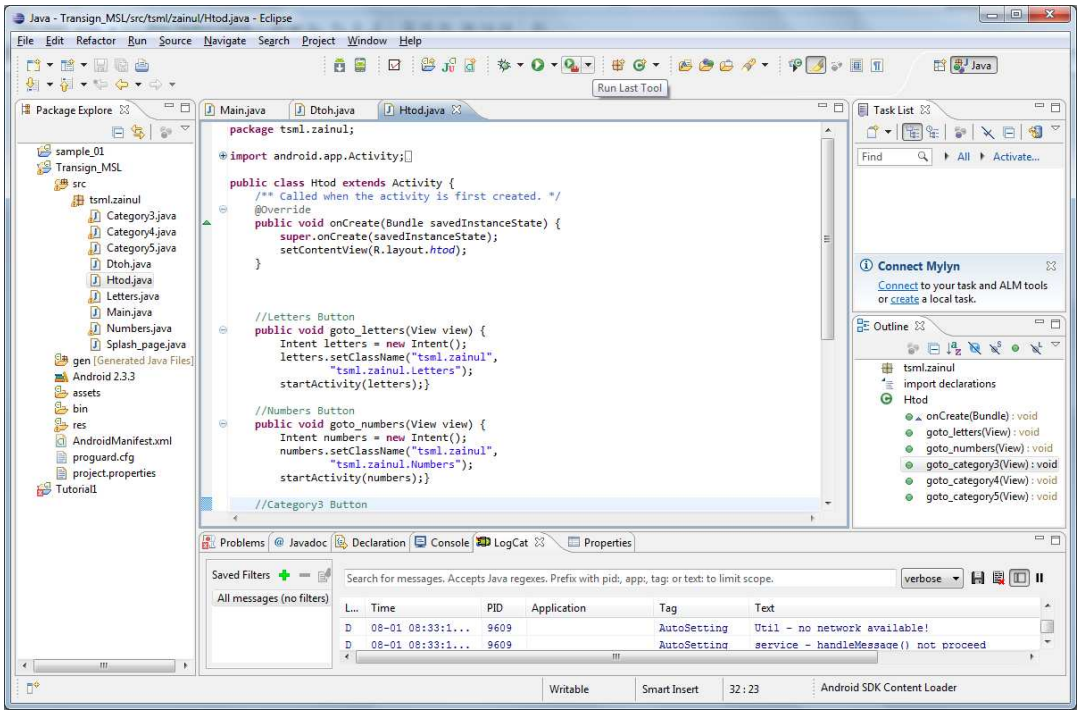
Work (___)_____-_____ Sex: □ Male □ Female

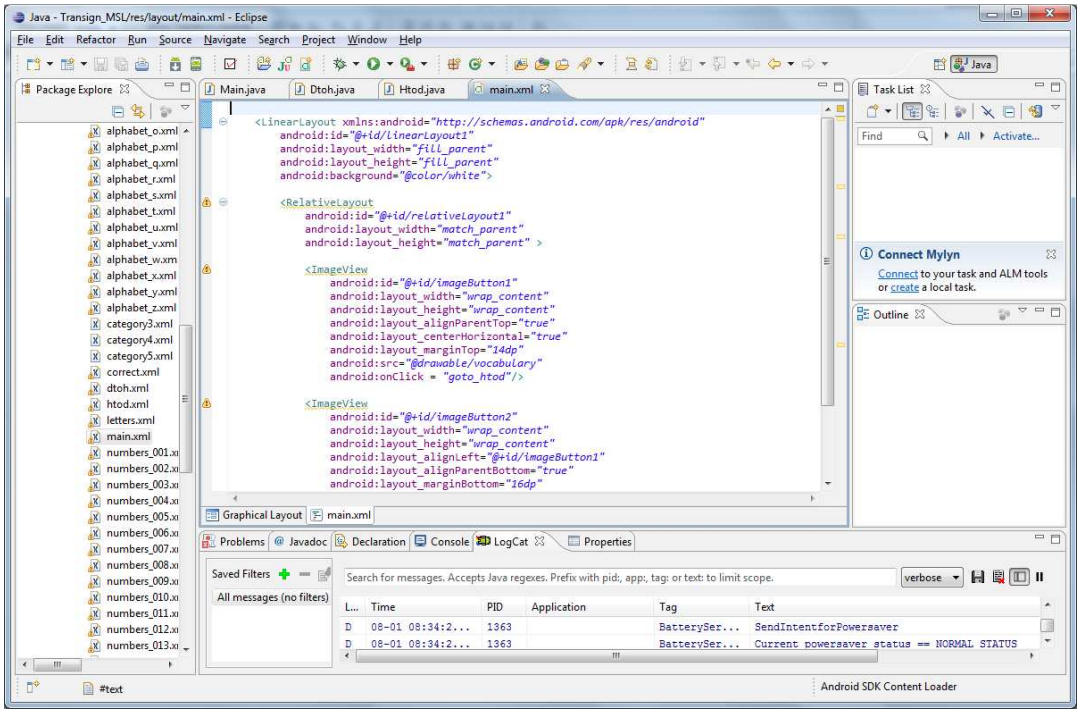
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. You deal with deaf people on a regular basis in any given year.	□	□	□	□	□	□	□
2. You have a firm grasp on Malaysian Sign Language in dealing with the Deaf.	□	□	□	□	□	□	□

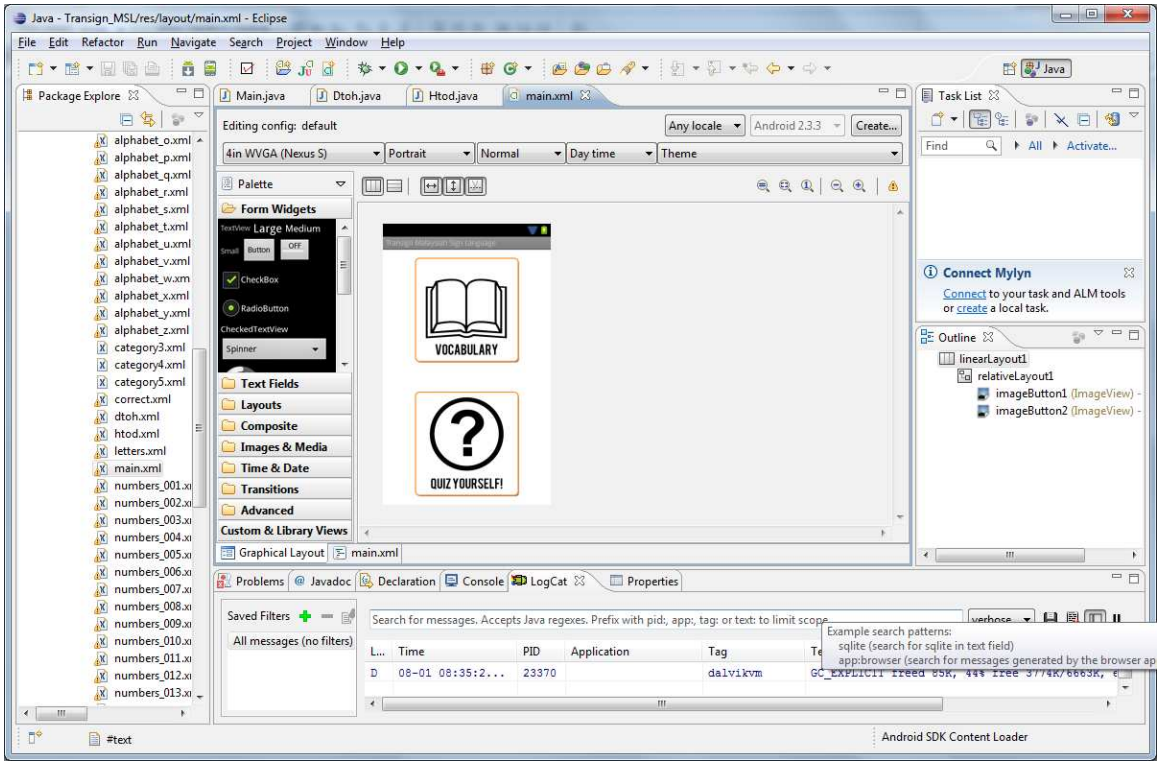
3. If a mobile application version of MSL is developed for use on the Android platform of smartphones, it can better facilitate learning of MSL as opposed to using books, using the internet and going to class.	☐	☐	☐	☐	☐	☐	☐
4. Having a still image but with detailed instructions on the movement of the hand gesture works just as fine as having an animated image of the hand gesture.	☐	☐	☐	☐	☐	☐	☐
5. You are familiar with Android smartphones.	☐	☐	☐	☐	☐	☐	☐

2. OKU Card of Mohd Yunus bin Yusof (Interviewee mentioned in 3.2.1)

3. Code Snippets of the Project in Eclipse (Indigo)






Java - Transign_MSL/res/layout/main.xml - Eclipse
File Edit Refactor Run Navigate Search Project Window Help
Package Explore
Main.java
Dtoh.java
Htod.java
main.xml
Editing config: default
Any locale
Android 2.3.3
Create...
4in WVGA (Nexus S)
Portrait
Normal
Day time
Theme
Palette
Form Widgets
Text Fields
Layouts
Composite
Images & Media
Time & Date
Transitions
Advanced
Custom & Library Views
VOCABULARY
QUIZ YOURSELF!
Graphical Layout
main.xml
Task List
Connect Mylyn
Connect to your task and ALM tools or create a local task.
Outline
linearLayout1
relativeLayout1
imageButton1 (ImageView)
imageButton2 (ImageView)
Problems
Javadoc
Declaration
Console
LogCat
Properties
Saved Filters
All messages (no filters)
Search for messages. Accepts Java regexes. Prefix with pid:, app:, tag: or text: to limit scope.
Example search patterns:
sqlite (search for sqlite in text field)
app:browser (search for messages generated by the browser ap
Time
PID
Application
Tag
08-01 08:35:2...
23370
dalvikvm
#text
Android SDK Content Loader