MUHAMAD HILMI B.TECH. (HONS) INFORMATION TECHNOLOGY SEPTEMBER 2021

WEB APPLICATION SIGN LANGUAGE TRANSLATOR

MUHAMAD HILMI BIN MOHAMED HANIFFA

INFORMATION TECHNOLOGY
UNIVERSITI TEKNOLOGI PETRONAS
SEPTEMBER 2021

WEB APPLICATION SIGN LANGUAGE TRANSLATOR

by

Muhamad Hilmi Bin Mohamed Haniffa

17001331

Dissertation submitted in partial fulfilment of

The requirement for the

Bachelor of Information Technology (Hons)

SEPTEMBER 2021

Universiti Teknologi PETRONAS,

32610 Seri Iskandar,

Perak Darul Ridzuan.

CERTIFICATION OF APPROVAL

Web Application Sign Language Translator

By

Muhamad Hilmi Bin Mohamed Haniffa

17001331

A project dissertation submitted to the
Information Technology Programme
Universiti Teknologi PETRONAS
In partial fulfilment of the requirement for the
Bachelor of Information Technology (Hons)

Approved by,

____

(Ts. Saipunidzam Bin Mahamad)

UNIVERSITI TEKNOLOGI PETRONAS

32610,SERI ISKANDAR,

PERAK DARUL RIDZUAN.

SEPTEMBER 2021

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

MUHAMAD HILMI BIN MOHAMED HANIFFA

Abstract

People with this disability use different modes to communicate with one another, there are some number of methods available for their communication and such a common method of communication is Gesture (sign language). The translation orderly replaces the original text in the live camera stream, matching the background and leading-edge colours estimated from the source images. A number of observations have also been carried out to determine a set of best tune-up for the development. The web based sign language translator is a system that allows the user to show a few words of the American Sign Language to a webcam and the webcam detects the words and translates it to text and this can help break the language barriers between the hearing impaired people and the ones that are not. The sign language translator is created using OpenCV, TensorFlow, MediaPipe and Python. The main purpose of this is to help people communicate better with the hearing impaired people as this has been a problem for many years. The sign language translator is mostly implemented with the concept of object detection as the hand in the camera is detected and the sign language is translated to text.

Acknowledgment

First and foremost, I would want to express my gratitude to Allah SWT, the Almighty God, for providing me with the strength and knowledge necessary to finish my Final Year Project (FYP). After that, I'd want to show my thanks to Universiti Teknologi PETRONAS for providing me with this invaluable chance to learn new things as a result of completing this FYP.

In addition, I would like to express my heartfelt thanks to my supervisor, Mr Saipunidzam Bin Mahamad, for his enthusiastic support, counsel, and invaluable help and direction during the execution of this project. Throughout the system's development, he provided me with unwavering support and inspiration. His vast knowledge and wealth of experience have inspired me throughout my academic studies and daily life.

Aside from that, I'd want to convey my heartfelt gratitude to my family and relatives for providing me with the drive I required from beginning to conclusion. They have had a major effect on my whole university journey, for which I will be eternally thankful. Without their understanding and support over the previous several years, completing my final year project would have been an impossible challenge.

Finally, I'd want to thank my course mates for their assistance during my university life. They had assisted me in several ways in order for me to achieve this level.

Thank you.

Table of Content

List of Figure

List of Table

ABBREVIATIONS

1.	BIM	Bahasa Isyarat Malaysia
2.	OD	Object Detection
3.	AI	Artificial Intelligence
4.	ICT	Information Communication Technology
5.	CODA	Children of Death Adult
6.	RT	Robot Technology
7.	ILSVRC	ImageNet Large Scale Visual Recognition Challenge
8.	OICOD	Open Image Challenge Object Detection
9.	MS COCO	Microsoft Common Object in Common
10.	ASL	American Sign Language
11.	FYP	Final Year Project
12.	UTP	Universiti Teknologi Petronas
13.	UML	Unified Modelling Language
14.	GPU	Graphics Processing Unit

CHAPTER 1

INTRODUCTION

1.1 Overview

Since the beginning of time, sign language has been mostly ignored. It is a vital means for individuals who are speech and hearing impaired to communicate with people who are not, as well as for people who are speech and hearing impaired to communicate with those who are. Pidgin Signed English is the most often used sign language. However, in Malaysia, sign language is known as Bahasa Isyarat Malaysia (BIM or Malaysian Sign Language). Since the establishment of the Malaysian Federation of the Deaf (Persekutuan Orang Pekak Malaysia) in 1998, the BIM has become the most extensively used sign language in Malaysia. By late December 2011, there were around 40,000 deaf people registered with Malaysia's Social Welfare Department. The issue arises when only a very small proportion of Malaysians, excluding the deaf minority, can communicate in BIM or any other sign language. Kabrisi et al. (2017) This makes it difficult for hearing-impaired persons to converse with others who are not. This is also a difficulty for parents who have hearing-impaired children. According to one survey, almost 90% of the deaf population has two hearing parents, and 88 percent of those parents do not know or are not well knowledgeable in sign language. 2020 (Shaw and Blue).

The need for a sign language translator has been expressed for many decades, and with today's technology, it is more than conceivable to develop such a system. In this situation, the most basic system that can be constructed is a picture to text system, and in a country as densely populated as Malaysia, a translating system would be extremely useful in communication. In the situation of sign language being the picture and the words that come out of it being the text following translation, the image to text translation will be formed. The background of the project, as well as the genuine problem, may be detailed further down. The research questions will be provided, and the aims of those studies will be defined in greater detail. Following that, a definition of essential ideas and a research technique, as well as the work, will be proposed. Then follows the project's principal goal, objectives, and skills. Finally, the sources and resources are completed.

A sign language interpreter is critical, yet many people, particularly in Malaysia, believe that sign language is not important enough to learn. However, according to a 2016 research conducted by the Modern Language Association, ASL or American Sign Language is the third most learned language in the United States, trailing only French and Spanish as said by Rim in 2019. This is why Malaysians must adjust to BIM and engage in more frequent communication with those who are deaf or hard of hearing. With the sign language translator, talks between both parties will be less uncomfortable and more comprehendible, rather than relying on guesswork to decipher what the other is saying.

1.2 Background of the project

Background of the project includes a few different areas where it consists of the research of area and the reason for the development. This is to mainly prepare a detailed explanation of the technology adapted in this project.

The project is called Sign Language Translator and this projects main aim is to capture images of the sign language and translate to alphabets. This research focuses on the development of sign language translator application TensorFlow and Python language. Results of the research done by the Informatics Department, Politeknik Negeri Semarang showed that the coordinates of the fingertip search methods can be used to recognize a hand gesture to the conditions contained open arms while to figure gesture with the hand clenched using search methods Hu Moments value. (Triyono et al., 2017)

The translator is basically a web camera that is used which is already pre-installed in a laptop or computer. The mounted web camera is used to capture the image of the hand movements using the technology of image detection. Image detection is the when the camera lens captures and object that is in front of the lens and detects it.

An object detection system finds objects of the real world present either in a digital image or a video, where the object can belong to any class of objects namely humans, cars, etc. A researcher named, Sharma and Thakur told in the year of 2017 that in order to detect an object in an image or a video the system needs to have a few components in order to complete the task of detecting an object, they are a model database, a feature detector, a hypothesiser and a hypothesiser verifier.

Object detection (OD) system finds objects in the real world by making use of the object models which is known a priori. This task is comparatively difficult to perform for the machines as compared to Humans who perform ODvery effortlessly and instantaneously. Basically an OD system can be described easily by seeing Figure 1 which shows the basic stages that are involved in the process of OD. The basic input to the OD system can be an image or a scene in case of videos. The aim is pretty straight forward, which is to detect objects that are present in the image or scene or simply in other words the system needs to categorise the various objects into respective object classes. (Sharma and Thakur, 2017).

Figure 1 Basic OD model

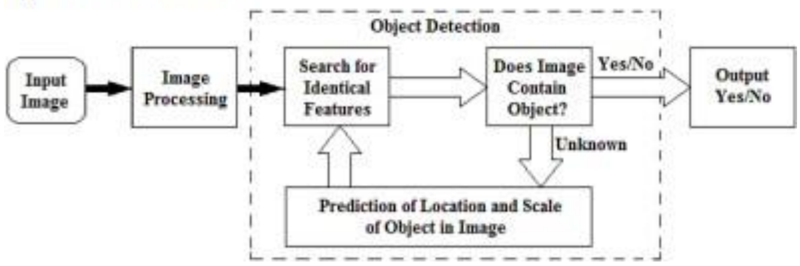


Figure 1 (Basic OD model)

In the case of this project, when the sign language is being done in front of the camera, the hand is the object it detects and it recognizes that particular sign to an alphabet which comes from the Bahasa Isyarat Malaysia(BIM or Malaysian Sign Language) language.

1.3 Problem statement

This proposed solution is expected to solve the current problem faced by people's in Malaysia. The problem statement of this project is that some people facing hard times in communicating with the hearing impaired people. The problem that I identify that made me to help and want to remove language barrier between normal and hearing impaired people. This project is to see how well this project works in today's world in a research form. The world today needs something significant to help communicate and understand sign language better than before. The sign language translator has to be significant in helping those communications between the speech impaired and non-speech impaired people. The efficiency of the project is vital and important.

1.4 Project Objective

The objective of this project is to help the impaired speech and hearing impaired and also for people who are speech and hearing impaired to communicate with people. The objective are such as :

- To develop hand signs using image detection
- To integrate the API system called TensorFlow to achieve Image Detection.

1.5 Project Scope

This project contains a few fundamental principles, the first of which is picture detection. Image detection is complemented by image recognition in this example, which is done with the aid of TensorFlow and programmed in Python. In this scenario, image detection is utilised to detect hand signals, which are alphabets of the sign language, which are then converted to text on the screen. This image recognition notion is critical to the project's success since without it, there would be no project.

The hardware is also an important concept. To work, the hardware must be a laptop or desktop computer with a camera or webcam camera. The camera is incredibly important since it works in tandem with image detection. Picture detection and sign language translation are impossible without the use of a camera lens to capture the image. This is a critical idea.

Detecting and recognising pictures, detecting hand patterns, and eventually displaying the alphabet on the screen once it has been translated are all methods for recognising hand signals. Its fundamental cognitive process is to reorganise the picture by examining only the important data and rejecting the irrelevant information that isn't necessary for recognition. It employs an edge-finding method that can only contain the most critical data. It refers to the reduced component of an image as an element vector. When the image size is huge, this approach is used. As a result of this cycle, image identification becomes easier. It starts with often estimated facts and highlights that provide some kind of proof promoting further advances.

TensorFlow is also important in this project. It is utilised to process the picture in this scenario. The task of submitting an image to a neural structure and having it generate some form of label for that picture is referred to as picture categorization. The organization's mark will be compared to a pre-defined class. There may be several classes assigned to the image, or simply one. In the case that there is just one class.

CHAPTER 2

LITERATURE REVIEW

2.1 Artificial Intelligence

Artificial intelligence (AI) is an important technology that assists people in their daily lives and enterprises. It contributes significantly to Japan's long-term economic development and handles a number of social challenges. AI has received a lot of attention in recent years as a means of achieving growth in both industrialised nations such as Europe and the United States, as well as emerging countries such as China and India. The most focus has been paid to the advancement of contemporary artificial intelligence information communication technology (ICT) and robot technologies (RT). Because of its computational capability, it has made its way into the business world and public debate today, thanks to the introduction of Big Data and technical breakthroughs. AI may be classified as analytical, human-inspired, and humanised AI, as well as Artificial Narrow, General, and Super Intelligence depending on the types of intelligence it shows cognitive, emotional, and social intelligence. (Haenlein and Kaplan, 2019)

Artificial intelligence also includes the evaluation of intellectual aptitude using simulation approaches. Artificial intelligence plays a significant role in comprehending and executing intellectual tasks such as thinking, learning new abilities, and coping with a wide range of situations and challenges. There have been several techniques to artificial intelligence introduced, such as Neural Networks, Fuzzy Logic, Evolutionary Computation, and Hybrid Artificial Intelligence. (Haenlein and Kaplan, 2019)

Machine learning is another classic subject of computer science in which algorithms quickly sift complex patterns from very large data sets using either supervised or unsupervised learning. In particular, in the last five years, the confluence of two disciplines of machine learning, deep learning and reinforced learning, has shown promising results. Algorithms of several types are employed in machine learning. The most significant distinction between the two is whether they study alone or supervised. Unsupervised learning challenges a learning system to solve classification in the details, maybe by grouping items together, utilising an unlabeled data set with no correct or wrong replies. (Haenlein and Kaplan, 2019)

Drawing and studying the boundaries of Artificial Intelligence with robotics is beneficial in order to completely appreciate Artificial Intelligence as a burgeoning field of research. Because an algorithm is a robot, the term 'bot' is used to refer to interactive computer programmes. However, although robotics is largely material in its conceptions and functions at the convergence of mechanical engineering, electrical engineering, and computer sciences, AI is mostly immaterial and interactive. To optimise for analysis, intelligence is the AI in a "autonomous system," which refers to cognitive processes, whereas robotics refers to motor co-ordination as written by Miailhe and Hodes in 2017.

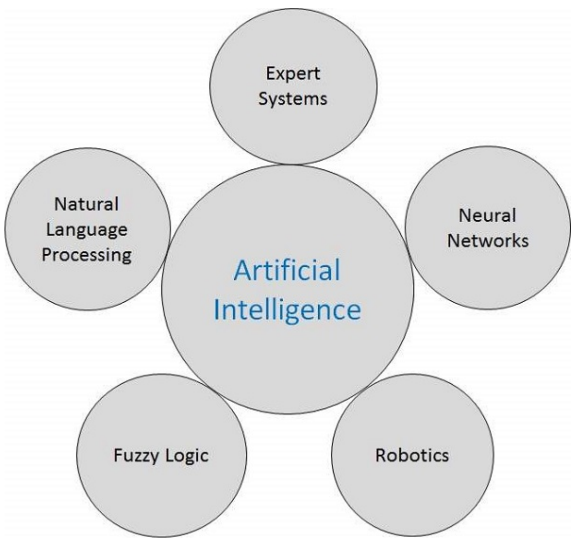


Figure 2 Artificial Intelligence

2.1.1 Neural Networks of AI

Neural Networks are otherwise called fake neural organizations. It is a subset of AI and the core of profound learning calculations. The idea of Neural organizations is motivated by the human mind. It copies the way that organic neurons convey messages to each other. Neural organizations are made out of hub layers, containing an information layer, at least one secret layers, and a yield layer.

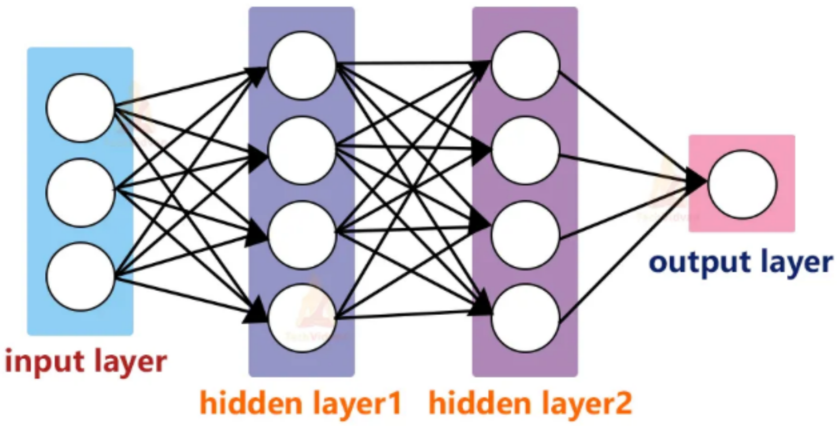


Figure 3 Neurons Convey Messages

We'll first use MediaPipe to recognize the hand and the hand key points. MediaPipe returns a total of 21 key points for each detected hand.

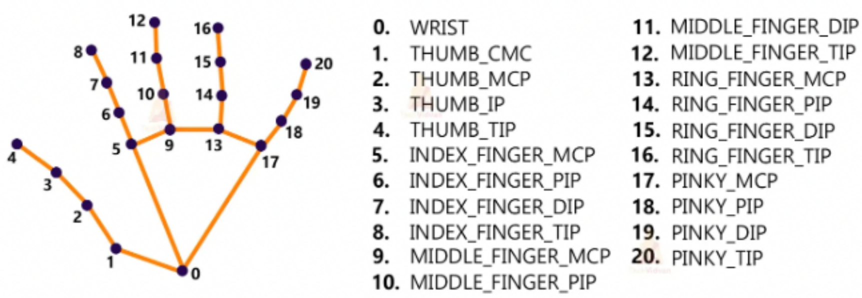


Figure 4 Hand Key Points

2.2 Deep Learning

Deep learning allows computational models with several processing layers to learn and represent input at different levels of abstraction, replicating how the brain sees and processes multimodal knowledge and implicitly capturing complicated data structures. Deep learning approaches include neural networks, hierarchical probabilistic frameworks, and a variety of unsupervised and supervised feature learning algorithms. Deep learning algorithms have lately piqued the interest of researchers owing to their capacity to beat prior state-of-the-art techniques in a number of tasks, as well as the amount of complicated data from a variety of sources. For instance, visual, auditory, medical, social, and sensor data. (Voulodimos, Doulamis, Doulami and Protopapadaki, 2018)

The urge to create a technology that could duplicate the human brain fueled the early development of neural networks. McCulloch and Pitts sought to explain how the brain could form very complex patterns by employing linked basic cells called neurons. Hinton et al. achieved one of the most significant achievements in deep learning in 2006. He developed the Deep Belief Network, which was made up of numerous layers of Restricted Boltzmann Machines that were greedily trained one at a time in an unsupervised fashion. The guidance of intermediate levels of representation via unsupervised learning, conducted locally at each layer, was the key principle underlying a sequence of advances that led to the previous decade's boom in deep architectures and deep learning algorithms. (Voulodimos, Doulamis, Doulami and Protopapadaki, 2018)

Deep learning has made significant progress in a wide range of computer vision issues, including object identification, motion tracking behaviour recognition, human pose estimation, and semantic segmentation.

2.3 Object Detection

Detecting instances of a given class of visual objects (such as persons, animals, or automobiles) in digital photographs is a critical computer vision task. According to Zhao, Zheng, Xu, and Wu in 2019, the purpose of object detection is to construct computational models and procedures that incorporate one of the most essential bits of data that computers require. As one of the most fundamental issues in computer vision, object detection serves as the foundation for many other tasks in the field, including instance segmentation, picture captioning, and object tracking. Object detection research can be divided into two topics: "general object detection" and "detection applications," with the former aiming to investigate methods for detecting various types of objects in a unified framework to simulate human vision and cognition, and the latter referring to detection in specific application scenarios, such as surveillance, as stated by the researcher the same year.

The rapid growth of deep learning techniques in recent years has breathed new life into object detection, resulting in impressive breakthroughs and propelling it to the forefront of science with unparalleled attention. Object detection is now commonly used in a variety of real-world applications, including autonomous driving, robot vision, and video surveillance. (Zhao, Zheng, Xu and Wu, 2019)

The writer said because of its strong relationship with video analysis and visual understanding, object detection has gained a lot of study interest in recent years. Traditional object identification methods are built on handcrafted features and shallow trainable structures. Their output may easily plateau by generating complicated ensembles that mix several low-level picture characteristics with high-level background from object detectors and scene classifiers. (Zhao, Zheng, Xu and Wu, 2019)

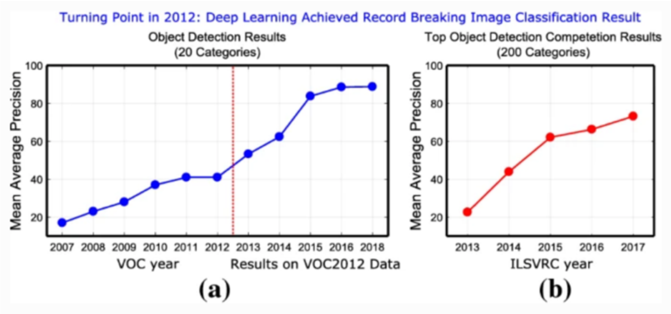


Figure 5 Image classification record

2.3.1 Object Detection with Deep Learning

It has becoming more possible to overcome the issues that plague traditional systems with more adaptive tools that can learn semantic, high-level, and deeper properties. In terms of network architecture, training methods, and optimization functions, these models are all very distinct from one another. To get a complete understanding of a variety of images, one should not only concentrate on identifying them, but but also make an effort to accurately estimate the concepts and places of the objects depicted in each image. This mission was named Object detection by Liu, Ouyang, Wang, Fieguth, Chen, Liu, and Pietikäinen in 2020.

One of the most fundamental and difficult challenges in computer vision is object detection. Its goal is to recognise item instances in natural photos from a variety of predefined categories. Deep learning has developed as a potent approach for directly learning feature representations from data, resulting in considerable advancements in generic object identification. (Liu, Ouyang, Wang, Fieguth, Chen, Liu and Pietikäinen, 2020)

Researchers claim that deep learning has revolutionised many machine learning applications, from image recognition and video analysis to voice and natural language comprehension. Translation invariance, local connections, and compositional hierarchies are all features of real signals that may be exploited by convolutional neural networks (CNNs). Training data and expensive computer resources are urgently needed, as is the capacity to pick learning parameters and network architectures that are suited for the task at hand. A CNN's most basic layers are made up of a series of feature maps, each of which acts as a neuron. In a convolutional neural network, layer is linked to feature maps from the preceding layer by a set of weights.

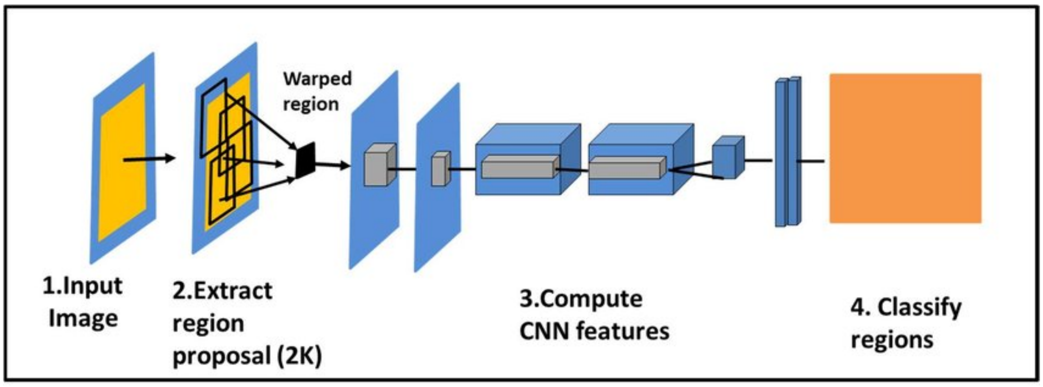


Figure 6 Object detection with deep learning

2.4 Datasets

Research into recognising objects has relied heavily on datasets, which have served both to compare and evaluate the performance of rival algorithms, as well as to push object identification research into ever more complex and challenging situations. With the recent success of deep learning algorithms for visual recognition tasks, vast volumes of annotated data have played a crucial role in the performance of these systems. An incredible amount of variation and richness may be gleaned from a huge number of photos on the Internet, enabling outstanding object recognition. PASCAL VOC, ImageNet, MS COCO, and Open Images are four well-known datasets for generic object detection. Creating large-scale annotated datasets consists of three steps: identifying a set of target item categories, obtaining a wide number of candidate photos to represent the chosen categories on the Internet, and annotating the gathered photographs, which is often done using crowdsourcing methodologies. (Liu, Ouyang, Wang, Fieguth, Chen, Liu and Pietikäinen, 2020)

Data from all sources is used to make each diagnosis. Each challenge contains a publicly accessible collection of images, ground truth annotation, organised assessment tools, and an annual competition and workshop. The Open Image Challenge Object Detection dataset is based on Open Images V5, the world's largest publicly accessible object identification dataset (OICOD). Moreover, OICOD varies from prior large-scale object identification datasets such as ILSVRC and MS COCO not only in terms of the greatly increased number of classes, pictures and bounding box annotations, but also in terms of the annotation process. Even though ILSVRC and MS COCO have annotated the dataset completely, only the labels with high enough scores were submitted for human verification in Open Images V4. As a result, OICOD only annotates entity instances that have been verified by humans.

2.5 Detection Frameworks

The development of object attribute representations and classifiers for identification has progressed significantly, as seen by the drastic shift away from handcrafted characteristics. However, in terms of localization, the easy "slide window" approach continues to be popular, albeit with various modifications to avoid an extensive search process. However, due to the massive number of picture pixels as well as the demand to scan, the number of open windows is enormous and increases quadratically. The use of a variety of sizes and aspect ratios improves the overall appeal of a site. As a result, developing robust and effective detection systems is critical to lowering the cost of computational risk while maintaining performance. (Liu, Ouyang, Wang, Fieguth, Chen, Liu and Pietikäinen, 2020)

2.6 Sign Language

There is a popular misconception that American sign language translators first arose in the early 1800s, when major advances in Deaf education were being made. In 1818, Mr. Laurent Clerc used sign language to address the President, Senate, and Congress, making it one of the earliest documented occurrences of official sign language translation. Using loud repetition, instructor Henry Hudson at the Deaf Institute converted Clerc's signs into spoken English. In 1957, William C. Stokoe, recognised as the "Father of Sign Language Linguistics," began researching ASL and sign language interpretation for the first time. There was no one who had done more study on sign language than

Stokoe, an English professor at Gallaudet College, when it came to the subject. According to Gannon, Stokoe was able to pursue his interest in language by creating the Linguistics Study Laboratory (LRL), which is an after-hours summer study initiative at Gallaudet University (1981). In part because of this authentication, Stokoe was able to examine all of the essential language components, including phonology, morphology, syntax, and semantics, in order to decide whether or not sign language was legitimate.

As a result, after ten years of research, Stokoe published the first ASL dictionary, Dictionary of American Sign Language on Linguistic Principles, in 1965. Stokoe's research was also the first to identify ASL signals as part of a separate language framework. (Ball, 2017) There was a considerable need for Deaf interpreters before to the enactment of the Federal Laws, but there were few available. Because interpreting was not recognised a profession, people who possessed the essential language abilities already had full-time occupations and were unable to work as interpreters. CODAs (children of deaf adults) also assisted their parents with interpretation. Unfortunately, many CODA were interpreting for their parents' mortgages, doctor's visits, legal matters, and a variety of other personal and business difficulties. As a result, the demand for competent and accessible interpreters increased, and federal law worked as a driver for interpreting professionalisation. Despite the fact that the federal government mandated the provision of translating services to Deaf individuals, the legislation did not provide appropriate funding for interpreter training. As a result, the VR employed Deaf man Dr Boyce Williams as a consultant to address challenges like as the dearth of Deaf programming and the need for competent interpreters. (Ball, 2017)

2.6.1 American Sign Language

American Sign Language (ASL) is a complete natural language with a syntax distinct from English. It maintains the same linguistic qualities as spoken languages but has a distinctive grammatical structure. ASL communication is accomplished via the use of hand and face gestures. It is the predominant language spoken by many deaf or hard of hearing persons in North America, and it is also spoken by some hearing people. There will never be a universal sign language. A large number of sign languages are utilised by different countries or geographical areas. For example, British Sign Language (BSL) is distinct from American Sign Language (ASL), and Americans who are accustomed to ASL may find it difficult to interpret BSL. In certain cases, features of American Sign Language (ASL) have been incorporated into the indigenous sign languages of certain countries.

In contrast to English, ASL is an entirely distinct language. In addition, it has its own norms for pronunciation, word structure, and sequence of words, and it may be used in any context. Distinct languages have different methods of transmitting different messages, such as asking a question instead of making an announcement. People who use American Sign Language (ASL) can ask questions by lifting their brows, broadening the scope of their gaze, and leaning into the query. Concepts may be expressed in several ways in ASL, just as they can in any other language. Regional distinctions in ASL rhythm, pronunciation, slang and sign use are similar to how some English terms are spoken in various regions of the country. Regional accents and dialects can also be found in ASL. As with spoken languages, other socioeconomic characteristics, such as age and gender, can influence ASL use and add to its variety. ASL includes fingerspelling, which is used to sign out English words. Each letter in the fingerspelled alphabet corresponds to a different handshape. Fingerspelling is frequently employed to signify proper names or the English term for anything.

Figure 7 Sign Language Alphabets

2.6.2 Sign Language Translator

Hand gestures are used to transmit thoughts and feelings, as well as to reinforce facts presented in regular interactions. In sign language, many parts of the body, such as the fingers, hand, arm, head, torso, and facial expression, are utilised to transmit information. The hearing community does not use sign language very much, and those who can comprehend it are a small minority. Deaf people and the rest of society are unable to communicate effectively due to this communication barrier, which has yet to be entirely addressed. (Jin Cheok, Omar, and Jaward, 2019)

The majority of sign language is limited to the upper body from the waist up. Furthermore, depending on where it comes in the phrase, the identical symbol will take on a number of forms. Some examples of hand gestures are conversational gestures, manipulative gestures, deceitful gestures, and communicating movements. Sign language is a type of communicating gesture. Sign language is a strong option for testing computer vision algorithms since it is highly organised. Hand gesture recognition research has a large effect on sign language recognition research since sign language is a sort of communicative gesture. As a result, while examining the literature on sign language recognition, it is also necessary to examine the literature on gesture recognition. Gesture and sign language recognition is the process of capturing and identifying gestures and turning them into semantically significant words and expressions. Gesture recognition techniques, which were modified from voice and handwriting recognition techniques, were first utilised in 1993. Darrell and Pentland used Dynamic Time Warping (DTW), a previously popular speech recognition algorithm, to recognise dynamic gestures. Sign language is the primary language of the deaf community. Sign languages, contrary to common perception, have their own set of linguistic rules and do not verbatim translate spoken languages. As a result, despite several advances in SLR, including the transition to the more challenging Continuous SLR (CSLR) problem, we are unable to make meaningful interpretations. The distinction between CSLR and SLT is that CSLR is a representation of what a signer says, whereas SLT is a representation of what a signer says. 2018 (Bantupalli and Xie)

As an example, machine translation, which focuses on developing methods for learning the mapping between two languages, is a frequent sequence. Machine translation cannot use CTC because the source and target sequences must be in the same order for it to work. A network cannot build an implicit language model because of the conditional independence presupposed by CTC. It was as a result that the Encoder-Decoder Network (NMT) region was born. Encoder-Decoder Networks use an intermediate latent space, similar to the latent space in auto-encoders but for temporal sequences, to map two sequences. This is accomplished by encoding source sequences into a fixed-size vector and then decoding target sequences from that vector. Kalchbrenner and Blunsom's initial architecture utilised a single RNN for both encoding and decoding. Sutskever and Cho later recommended outsourcing encoding and decoding to distinct RNNs. (Bantupalli and Xie, 2018).

2.6.3 Sign Language Translator with Image/Object Detection

The loss of hearing in one or both ears, whether partial or total, is referred to as hearing disability. The impairment's severity ranges from minor to moderate to severe. According to the World Health Organization (WHO), more than 5% of the global population — 360 million individuals – suffered from serious hearing loss in 2017. There are 328 million people and 32 million children in the country that are affected with this disability. According to studies, one-third of persons over the age of 65 suffer from hearing loss. The vast majority of persons with significant hearing loss live in low- and middle-income nations. 2018 (Ibrahim, Selim, and Zayed)

SLRS is a potential application for HCI. If you are deaf or hard of hearing, you can use SLRS to recognise signals from your environment and translate them into written or spoken language. These systems employ either discrete or continuous indicators. In isolated systems, the performer signs only one letter or word at a time, but in continuous systems, the performer signs one or more entire phrases. SLRS can either be signer-dependent or signer-independent. Signer-dependent systems use the same signers for both training and testing, which enhances recognition rate. Singers who have completed the training stage, on the other hand, are not permitted to go to the testing stage in signer-independent schemes, adding to the complexity of changing the technique to accommodate any signer. A sensor-based or image-based device might achieve the purpose of SLRS. (Ibrahim, Selim, and Zayed, 2018)

To categorise data, marker-based or visual-based approaches might be utilised. In marker-based approaches, predefined-color markers or coloured gloves are applied to the fingertips and wrist. These predetermined colours are then recognised and split from a 2D camera picture using image processing techniques, which also lack normalcy. Visual-based solutions, on the other hand, rely solely on the hands and do not employ any markers. These solutions provide more normalcy and mobility than other types of SLRS. Visual-based SLRS are affordable since just one camera is required. These approaches, however, are impeded by variations in illumination. 2018 (Ibrahim, Selim, and Zayed)

Another drawback is hand occlusion with each other or with the face, as 2D photos lack the depth data required to address occlusion. This opens the way for depth sensors, which use the RGB-D image technology to calculate the depth of each pixel in an image, allowing the creation of a 3D representation of the scene's objects. It is still a relatively untapped field of study. The phrase "vision-based" refers to a visual-based vision system in the majority of investigations. 2018 (Ibrahim, Selim, and Zayed)

The vision-based SLRS has two modes. The first mode is for hearing-impaired to vocal individuals, and it converts a video of sign language (SL) into oral language (OL) via text or voice. This mode is known as vision-based SLRS. The second kind, on the other hand, is from hearing-impaired persons to vocal people, in which the oral language voice record is converted into SL video. The vision-based SLRS mode sparked a lot of curiosity. (Ibrahim, Selim, and Zayed, 2018)

Hand segmentation is a technique for eliminating hands from video frames, according to the researcher. In the video, only the signer's hands or the complete body may be seen.. In the first case, hands are segmented using either a context removal strategy or a skin detection method. Contextual removal can be followed by skin detection, or a skin detection technique can be used on its own, without context removal. When the hands are the only thing moving in the image, the accumulated difference image (AD) is used to remove them.

Many skin detectors that utilise the face to detect skin areas have emerged. The chance of a pixel being skin or non-skin is computed using a face area that includes non-skin non-smooth parts such as the eyes and lips. This has altered the approach's findings by incorrectly recognising the lips, eyes, and brows as skin areas. A 1010 window across the centre pixel of the face, which is usually the nose point, is used to distinguish the skin tone pixels. This area, however, might provide erroneous signs owing to the influence of light. After eliminating the luminance channel, the space is utilised to separate the paws using a dynamic skin detector based on face skin tone colour. The first frame is run through a face detector. The probability distribution function (PDF) histogram bins are computed and truncated at 0.005. Following trimming, a threshold is applied to the residual PDF values to avoid eyes and mouth areas from being misidentified as skin. A dynamic threshold is generated utilising pixels along the main and minor axes of the detecting face's bounding rectangle. 2018 (Ibrahim, Selim, and Zayed)

Finally, two cases were chosen to put the suggested approach to the test. The first step is to understand how altering skin colour and illumination affects hand segmentation. We already assessed the suggested dynamic mid-way threshold histogram skin detector in prior study. According to this evaluation, this detector decreases the false positive rate (FPR) by roughly half while keeping the false negative rate (FNR) approximately the same. It also decreases the amount of pixels to be handled with to roughly 52% of the total face, resulting in a significant reduction in detection time. Finally, because of its adaptable dynamic character, it is suitable for real-time applications and is open to a wide range of races. In contrast, using the YCbCr colour scheme lessens the influence of light. Decreases detection time by roughly 52% since it reduces the amount of pixels that need to be handled with to around 525 of the face. As a result, it is suitable for real-time applications and may be used by a wide range of ethnic groups. However, using the YCbCr colour scheme lessens the influence of light. (Ibrahim, Selim and Zayed, 2018).

2.7 Comparative Study between existing Sign Language Translators

The following are the performance results of some of the highly competitive frameworks used for sign language translation. The research works that depicted the accuracy rate were taken into account. The simulations were done out using various datasets chosen by the researchers. The majority of the studies make use of ASL data, some of which are Indian Sign Language data and some are Indonesian Sign Language data. The following is a survey of the literature on these studies.

Table 1 Different models comparative results

Authors (year)	Methods and Dataset	Accuracy (%)
Jalal et al. (2018)	Capsule-Based Deep Neural Network (Kaggle ASL Letter)	99.74
Rastgoo et al. (2018)	Restricted Boltzmann Machine (Massey University Gesture Dataset 2012, etc)	98.13
Lahamy and Lichti (2012)	Real-Time and Rotation-Invariant (Self-generated Dataset)	93.88
Vaitkevičius et al. (2019)	Hidden Markov classification (Self-generated Dataset Using Leap Motion Device)	86.10
Atwood et al. (2012)	Neural network and principal component analysis (Self-generated Dataset Using Matlab Sofware)	96.10
Bheda & Radpour (2017)	deep CNN (Self-generated Dataset)	82.50
Dong et al. (2015)	Microsoft Kinect (Self-generated Dataset)	90.00
Kacper and Urszula (2018)	Snapshot learning (Surrey University and Massey University ASL Dataset)	93.30
Current research	HOG + SVM (Kaggle ASL Fingerspelling)	99.28
Current research	HOG + NN (Kaggle ASL Fingerspelling)	96.30

CHAPTER 3

METHODOLOGY

3.1 Background

This part of the report discusses about the main functionalities of the project. Every project has its own set of unique requirements. There are 2 sets of requirements one of it being the functional requirement and the other is the non-functional requirement. In terms of this project, the main requirement is to develop a system that can recognise 5 different hand signs from the American Sign Language and translate them text. The methodology used in this project is called the spiral method.

3.2 Methodology

There are 4 different phases when it comes to this methodology. The first phase is called the identification phase. In this phase the planning for the sign language translator was done. The requirement specifics were done and all necessary information was collected in order for this project to be completed was done. Research on OpenCV and TensorFlow was also done to see how efficient work should be done. The second phase is called the identification phase. This is where the requirements of the system are gathered. The third phase is the construct phase or the implementation phase where the development of the sign language translator is done and all the errors are tested again and fixed and the final phase is called the evaluation phase where the whole working system is ready to use by other people. The program is evaluated and documented for future enhancements.

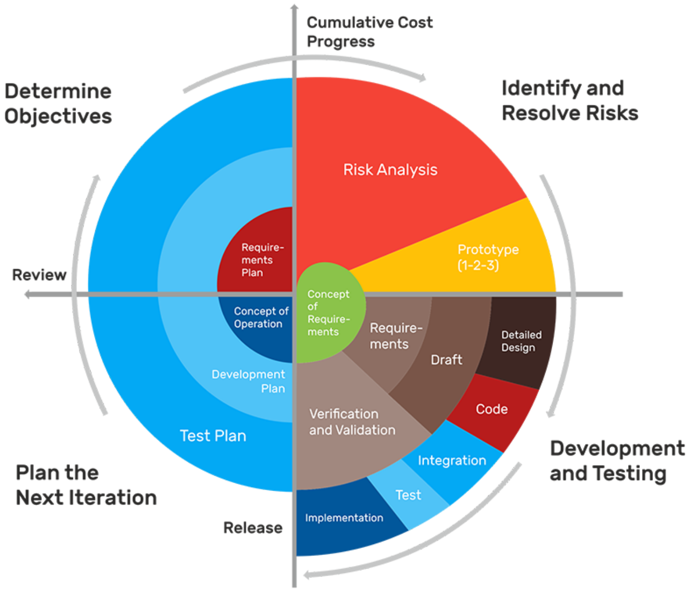


Figure 8 Spiral Method

3.2.1 Project Phase

- Phase 1 : Identification

The first stage is called the identification stage. This is where the requirements of the system are gathered. In the case of this project, the sign language translator, this is the phase where all the required information is gathered. For example, how many laptops and software would one need to get this project done. What are the basic and vital requirements that are needed in this project and how vital is the image detection and camera equipment component in this project. (Point, 2019).

- Phase 2 : Design

Next comes the design phase. The design phase is basically the conceptual and architectural design of the proposed system, which in this case the sign language translator. The sign language translator will be given an almost accurate design in this phase and this is important because if there is no design to follow, there will not be consistency in the design and it will all go to waste. When there is a specific design to follow in this sign language translator system, it makes everything more specific and direct.

- Phase 3 : Construct

The third phase is called the construct phase. The construct phase just as the name says it is the part of the spiral where the system comes to life. The process of producing the real system starts here. The sign language translator will of course be done with image detection and with the help of the API TensorFlow which utilizes the language of Python Programming. These builds are sent out to customers for feedback.

- Phase 4 : Evaluation and risk analysis

The last phase is referred to as evaluation and risk assessment. This phase is when technical feasibility and management risks such as schedule slippage and cost overruns are identified, estimated, and monitored. After testing the build, the customer reviews the programme and offers feedback at the conclusion of the first iteration. After the entire sign language translator is constructed, it will be sent to clients following the conclusion of the first iteration. This provides an opportunity for the client to provide comments.

3.3 Hardware and Software Requirements

This project had a few software and hardware requirements. The requirement for the software was to have a software like notepad ++ and this is used in the development of coding for the project. TensorFlow was another software that was required and so was OpenCV. The hardware required was a working computer, a webcam and a very high amount of GPU (Graphics Processing Unit)

3.3.1 Software requirements

1. Notepad ++ -This is the platform that is used to develop the project
2. TensorFlow – This is an API that is used to help in training datasets to capture images and etc. TensorFlow is an open-source AI and deep learning library developed by Google's minds group. It is used for a wide range of tasks, with a particular emphasis on deep neural organisations.
3. OpenCV – To enable the usage of the language of python in the development of this project.
4. MediaPipe - Google's MediaPipe is a versatile AI arrangement structure. It is an open-source, multi-stage system that is extremely lightweight. MediaPipe includes some pre-programmed ML arrangements, for example, face location, present assessment, hand acknowledgment, object recognition, and so on.

3.3.2 Hardware Requirements

1. Computer – To be able to create the project and run the project
2. Webcam - To detect the images in order to translate sign language
3. High GPU – TensorFlow API requires a very high amount of GPU in order for it to open and detect images and also to run smoothly.

3.4 Functional and Non-Functional Requirements

3.4.1 Functional Requirements User

Should be able to show one of 5 different words from sign languages to the webcam. The user should be able to show one of 5 different words from the ASL Sign Language which are the words “You Rock”, ”Okay, Done”, ”We Can Do It”, ”Stop”, and “Call Me”.

3.4.2 Non-Functional Requirements

1. Detection of Sign Language

The 5 different words of the sign language which are “You Rock”, ”Okay, Done”, ”We Can Do It”, ”Stop”, and “Call Me” will be detected when the user shows it to the webcam.

2. Speed of Detection

The speed of detection solely depends on the GPU of the computer. The higher the GPU the faster and smoother the detection rate of the sign language when the users show it to the camera.

3.5 Resources

3.5.1 Hardware

Table 2- Hardware Requirement

Resources	Specification
Laptop	4GB RAM is the needed minimum to do the project
Internet	Minimum speed of 10 MBPS to use information from internet
Webcam	A camera with a lens of minimum 5 megapixel mounted on a laptop or a desktop to capture images
Hard Drive	Minimum of 100GB needed to store data
Laptop Cooler	Minimum of 2 fans to avoid overheating

3.5.2 Software

Table 3- Software Requirement

Resources	Specification
Google	Internet browser that can be used
TensorFlow	Minimum requirements of Windows 7 or above
Python IDE	Minimum requirements of Windows 7 or above
Microsoft Teams	Minimum requirements of Windows 7 or above
Google Drive	Internet browser that can be used
Media Pipe	Minimum requirements of Windows 7 or above

3.7 Skills & Knowledge

Table 4- Skill & Knowledge

Skills	How it was obtained
Artificial Intelligence	The knowledge came from the subject Intro to Artificial Intelligence. This course demonstrated me the fundamentals and cognizance of man- made thinking, for instance, methodology, how it works, and others. With these essentials, it is possible to complete the AI-related features for this structure. Moreover, there was another specialization subject Intelligent System which also taught about controlled, solo, and backing acknowledging which is the middle consent to realize this structure. It moreover supported me how AI and neural association capacities. Cleaning procedures acquired from this subject was also helpful in this endeavour.
Writing and Referencing	In any errand, alluding to and in reference is huge. Without proper alluding to, the documentation for the proposed structure will be awful. The aptitudes got for alluding to was from this subject where all the most ideal references using Harvard Referencing style were taught. With this inclination, the documentation will be maintained with fitting references and in references.
TensorFlow	From the TensorFlow tutorial website, procedures for recuperating information from a picture document will be told. From this module, it is possible to make an authentic image detection to detect hand signs which will then be translated.

3.8 Gantt Chart (FYP1 & FYP2)

Refer to Appendix 2

3.9 Key Milestone

Below are the key milestone that needs to be achieved throughout both of semester of Final Year Project 1 (FYP1) & Final Year Project 2 (FYP2).

Table 5 Key Milestone FYP 1

Milestone	Week
Project Research	3
Analysis phase	5
Analyse system requirement	9
Analyse user needs	11

Table 6 Key Milestone FYP2

Milestone	Week
Designing phase	3
Learning sign language	4
Code the user interface	8
Development	10
VIVA Presentation	15

CHAPTER 4

RESULT & DISCUSSION

4.1 Pilot Study

The most acceptable method of doing research in this area was to employ a customised questionnaire. Because the responses of the participants were completely secret, it was more likely to generate honest responses. Statistical analysis might also be done using the questionnaire's format. Additionally, it was a low-cost method of obtaining information and a fast method of receiving replies within a short time window, which were both advantages. Due to the fact that we need to determine if social media has a favourable or bad impact on society's view, we included the following questions in the questionnaire addressing social media influence.

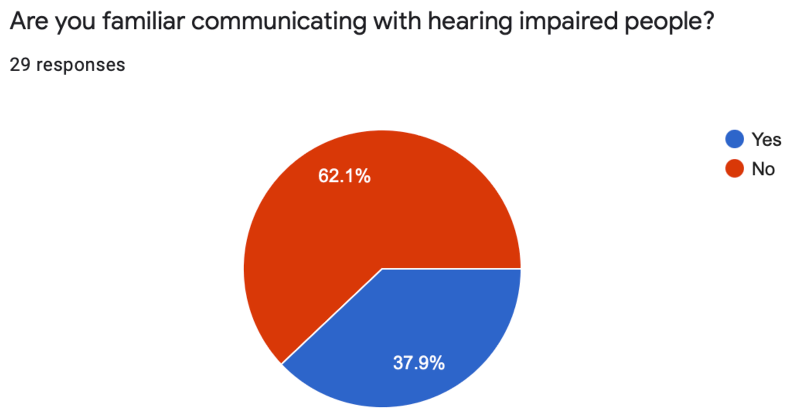


Figure 9 Question 1

The first question I wanted to ask to the respondents was, to know are they familiar on communicating with hearing impaired people. A 62.1% majority of participants replied that they either "Yes" and about 37.9% that said "No" about their familiarity of communicating with hearing impaired people. This result shows that larger number of people in Malaysia are not familiar with communicating with them.

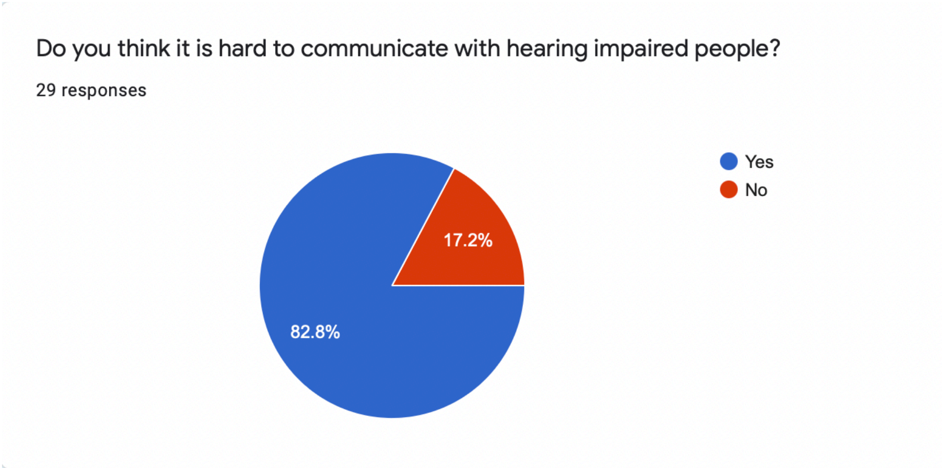


Figure 10 Question 2

Besides, the next question I asked is to know is it hard to communicate with hearing impaired people. A 82.8% majority of participants replied that they either "agree" with the question and a low amount of 17.2% said they "disagree" and they think it is easy to communicate with them. This shows that large number of respondents thinks that it is not easy to communicate with them.

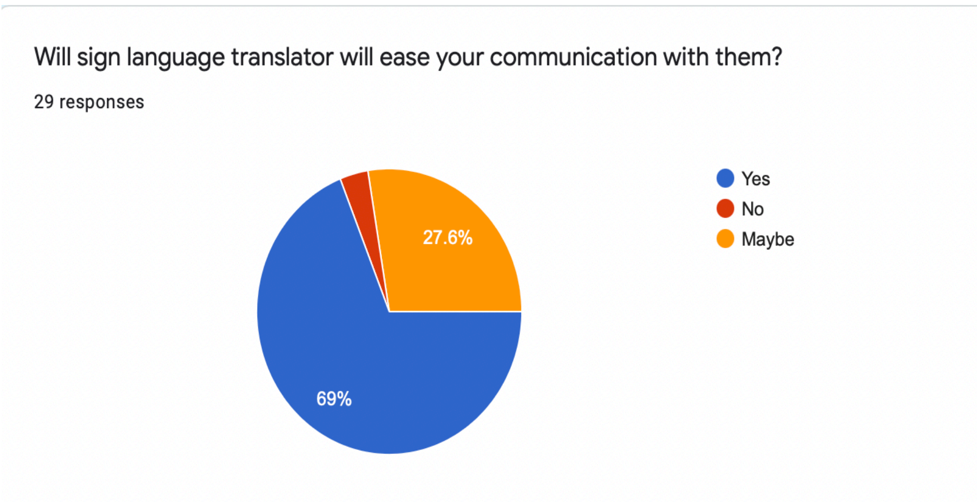


Figure 11 Question 3

Moreover, I asked this third question to investigate whether will sign language translator ease their communication. A 69% majority of participants replied that they either “agree” with the question and about 3.4% said either they’re not sure on whether they will use or no.. A low amount of 27.6% said they “disagree” to use the sign language translator to communicate with them.

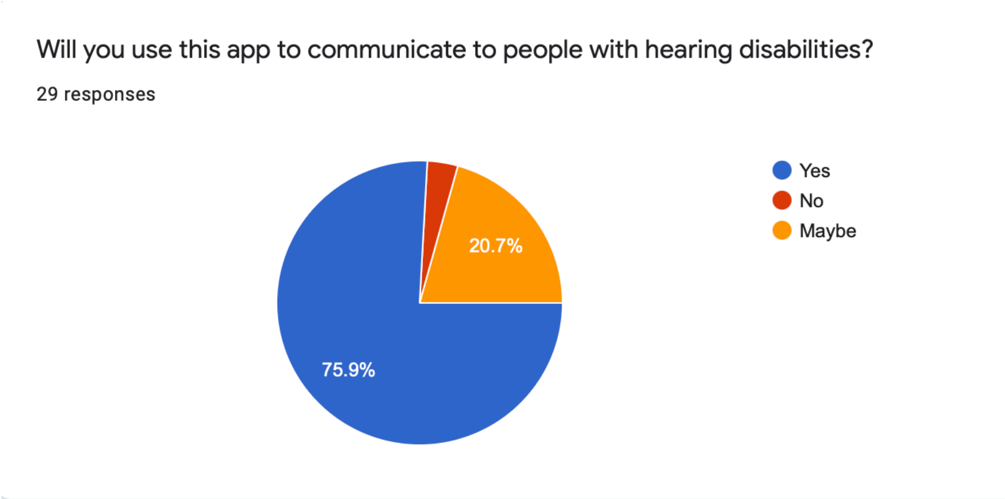


Figure 12 Question 4

Last but not least, we asked an important question where the respondent more likely would use this app against the people who are hearing impaired. Survey showed that 75.9% majority of participants replied that they either “agree” to use and a low amount of 20.7% said they “disagree” to use the sign language translator to communicate with them. This concludes that higher number of Malaysians are aware and using this platform for good purposes to help themselves.

4.2 UML Diagram

A requirement modelling is important for a software program to identify the requirements of the system and to deal with problems. There are a few types of UML diagrams and for this sign language detector project 2 of it was used. The first of it was the use case diagram. The use case diagram for this project can be seen below.

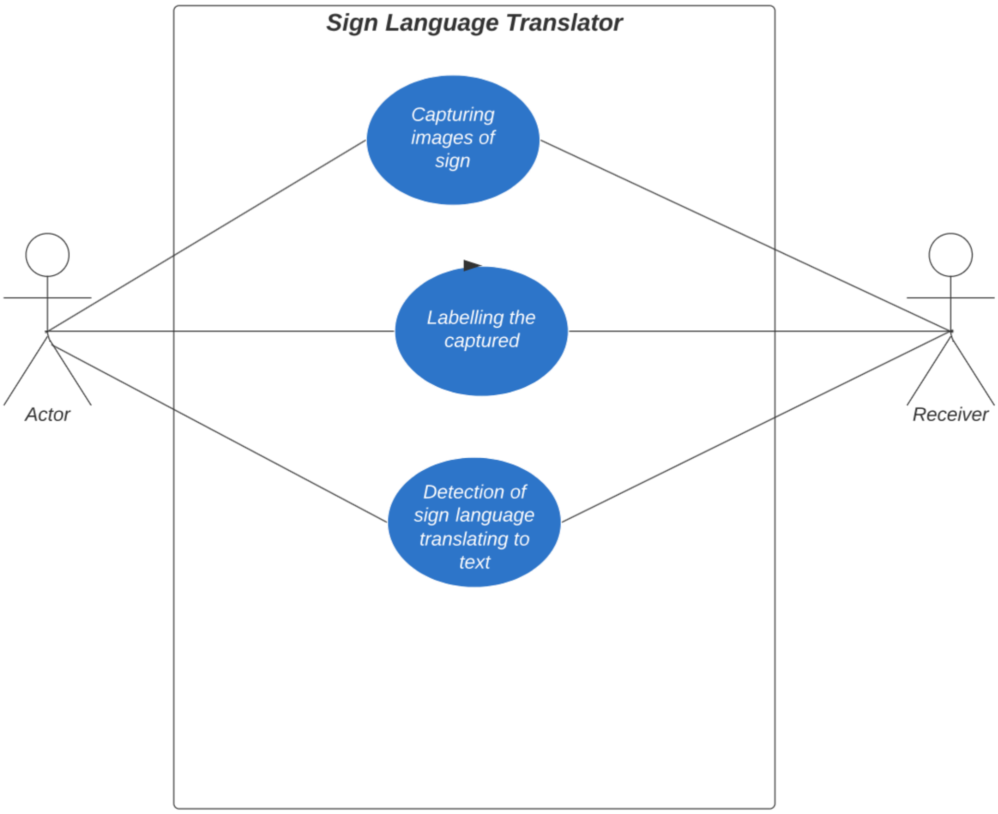


Figure 13- Use Case Diagram

Based on Figure 10, it shows the interaction between the user and ourself. It will go from capturing images and then to labelling the signs captured then finally detect the sign language and translate it to text before being shown to the user.

4.3 Activity Diagram

The second type of UML Diagram that is used in this Sign Language Translator project is the Activity Diagram as can be seen in Figure 2 below.

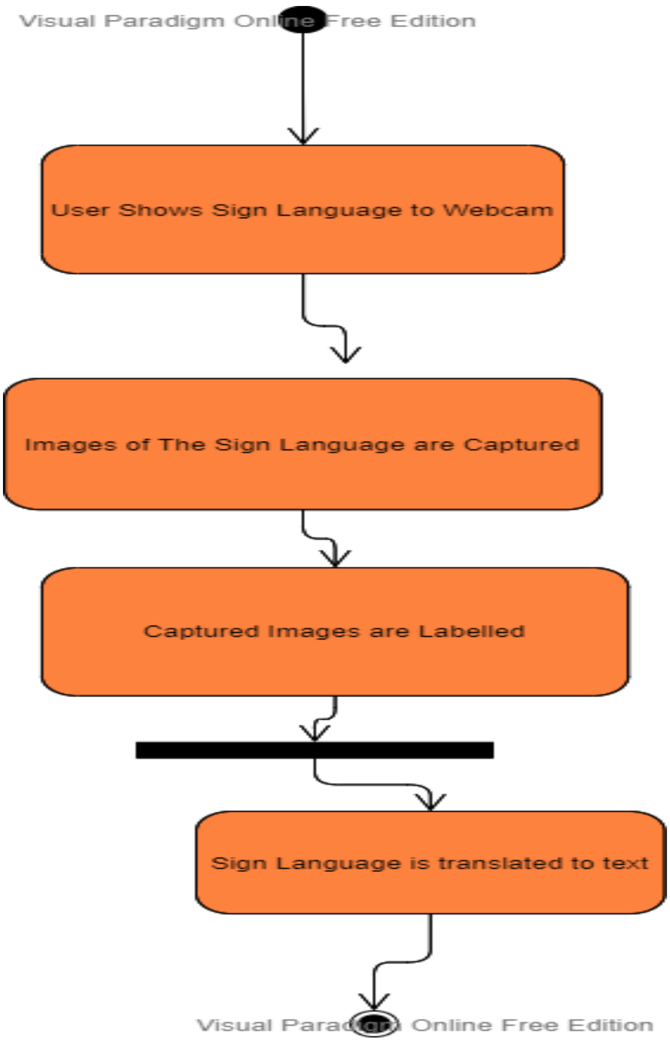


Figure 14 Activity Diagram

Figure 11 shows the flow of the project in a more detail flow. The first flow is the user will show sign language towards the webcam. Then the images of the sign language are being captured. Then the last step is that it will be then captured and translated to text.

4.4 Process Evaluation

a) Proposal and Project Initiation

I struggled at first to choose a topic since I had no idea what was required or if I could ever complete it. After conducting extensive study, I determined that I wanted to create Sign Language Translator utilising the principle of object detection. My concept was presented to my supervisor, who approved my project. The proposal and the project initiation document were both developed. The following phase began once it was filed.

b) Requirement Analysis

After the proposal, I began studying all of the essential articles, journals, and researches concerning my suggested topic in this section. This took a long time because the literature review is vital and I had to choose my sources carefully. This phase also identifies the project's functions.

c) Design

UML diagrams are developed during this phase to offer a clear picture of what the project's outcome should and should be like. This also provides a picture of the functions that are necessary as well as how the flow words work. My project was rather simple, so I didn't waste much time on this step and went on to the next.

d) Implementation

This was the most challenging time for me because it was when I first started working on the project. There were several difficulties that I encountered here. One of the most difficult obstacles I had was that my computer was incapable of supporting the project, so I had to hunt for alternatives. This was a very time-consuming task, but I had no choice but to do it. Because everything in this app is hardcoded, there were errors after errors. It was challenging for me, but I was able to conquer it with the assistance of my supervisor as well as the resources. Once this was completed, I was able to test a portion of the system before running out of time, and I began working on the project's report documentation.

e) Testing

A final set of tests were run. In this case of my project, I had tested with all the train model over and over again. This is to make sure that it detects correctly using our hand key points. The end results is as shown below.

4.5 End Product

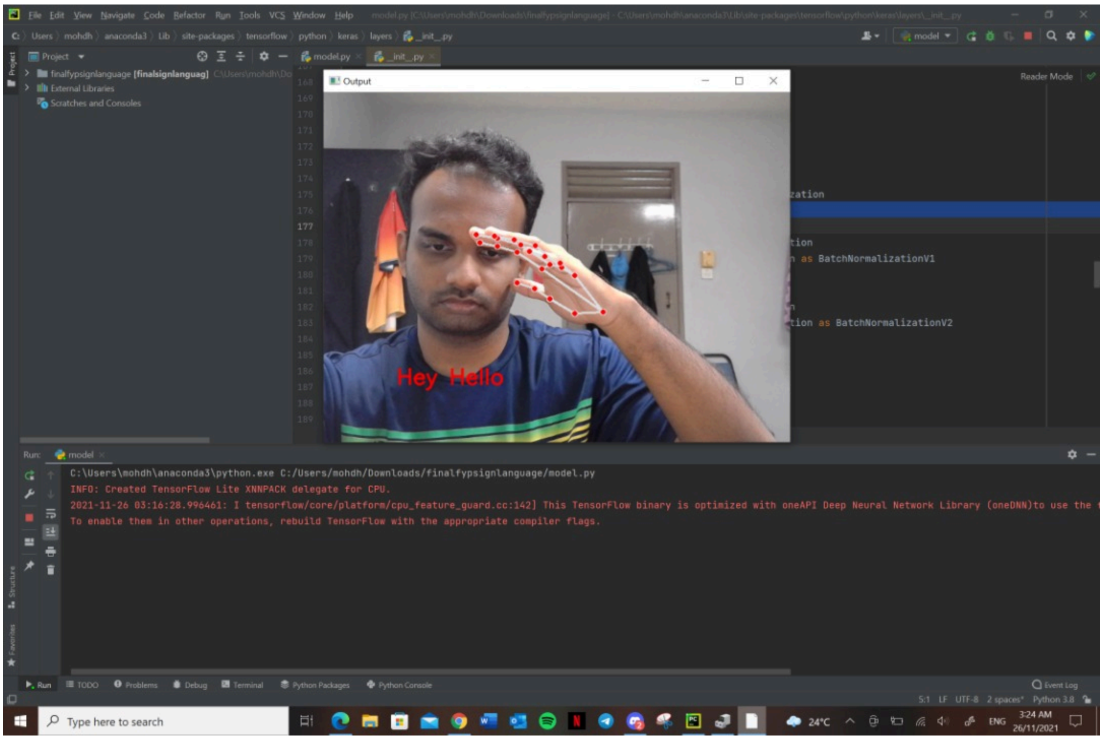


Figure 15 Hello

Example of the detection phrase “Hello”

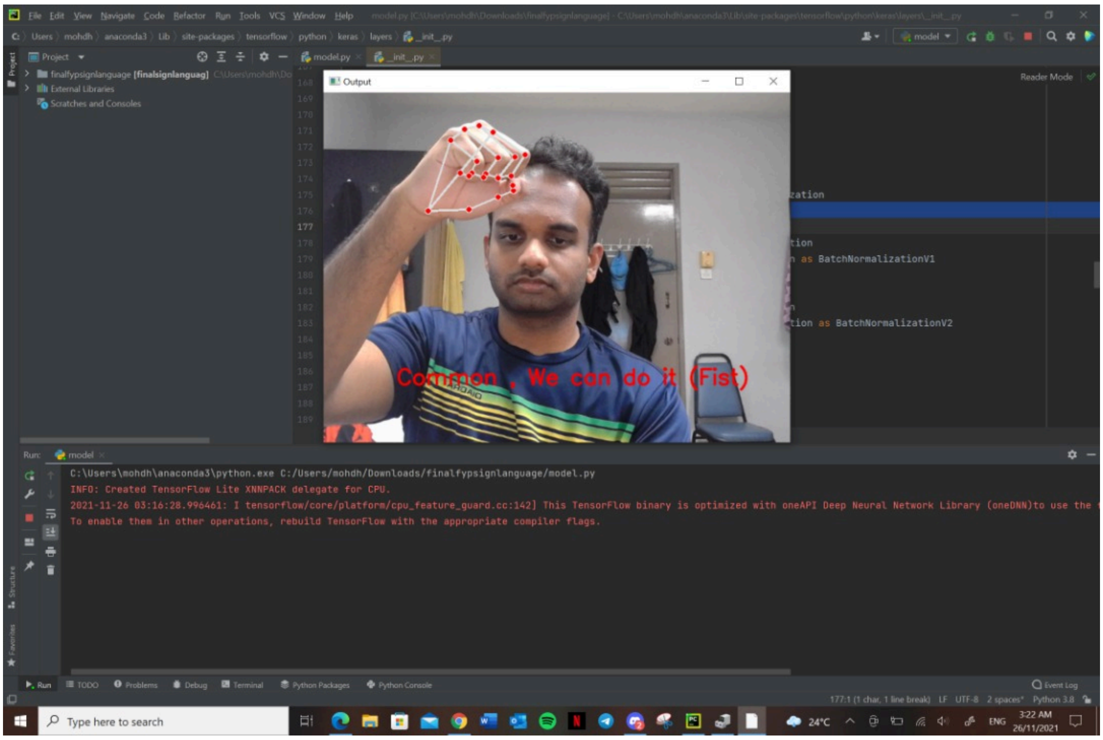


Figure 16 Common, We can do it

Example of the detection phrase “Common, We can do it”

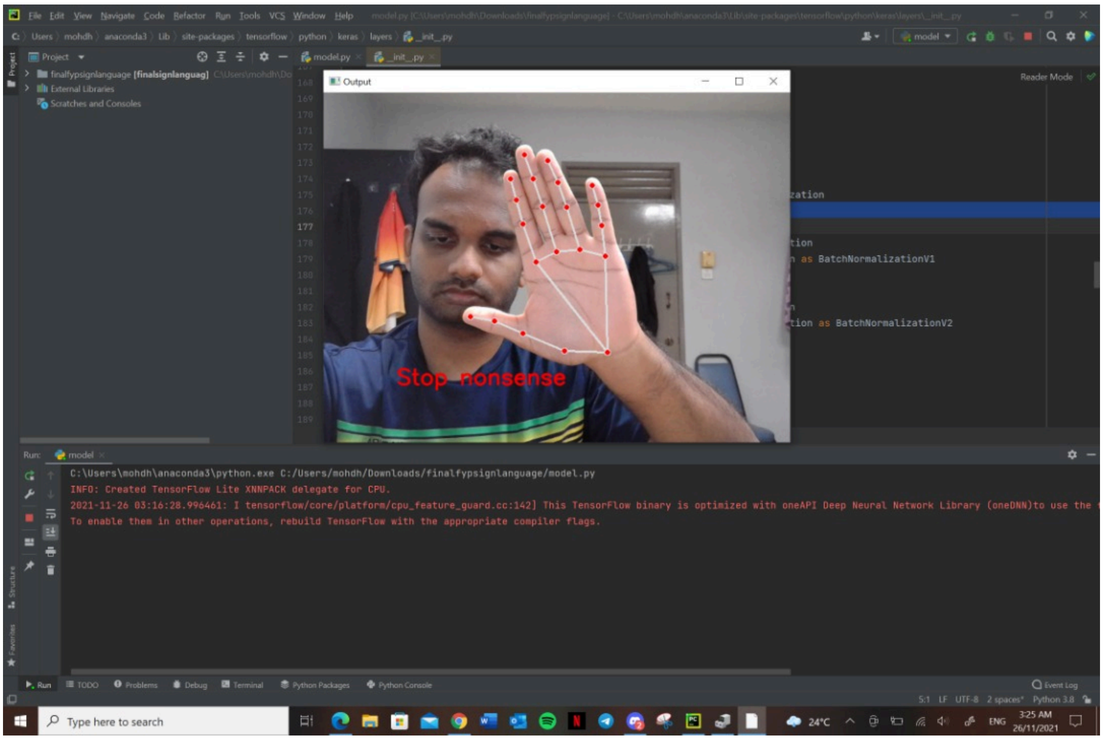


Figure 17 Stop

Example of the detection phrase for “Stop”. But in this translator, I add more words so that it will make people to understand what we’re about to tell people more.

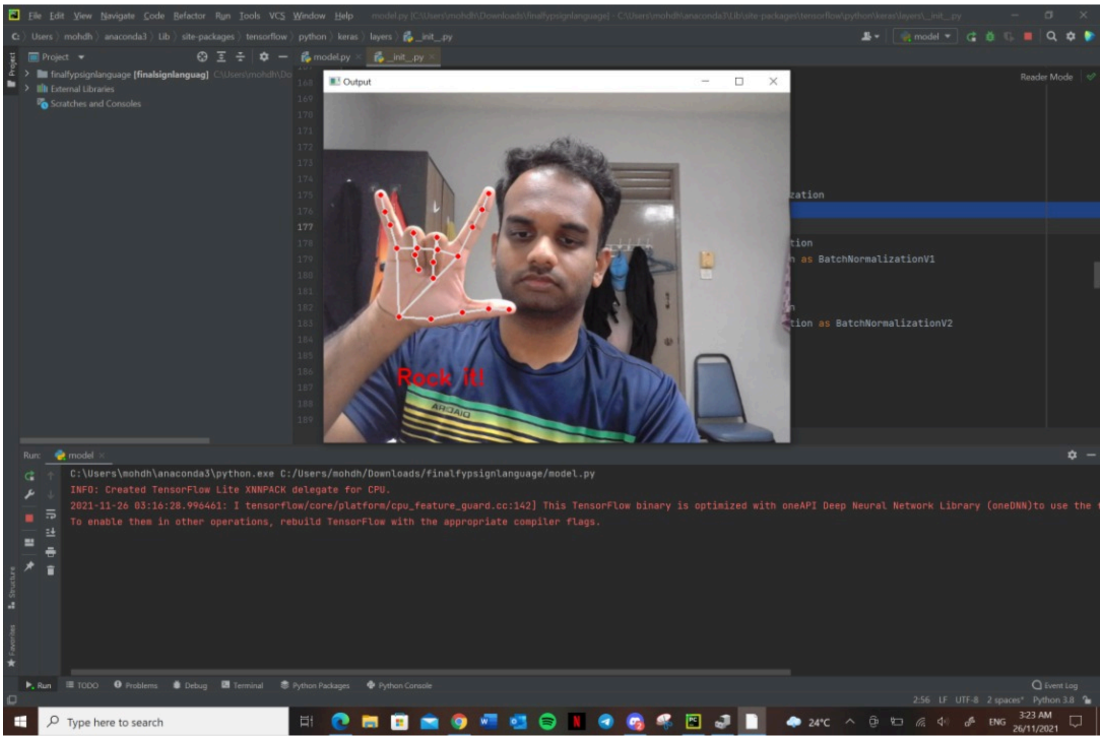


Figure 18 Rock It

Example of the detection phrase for “Rock It”

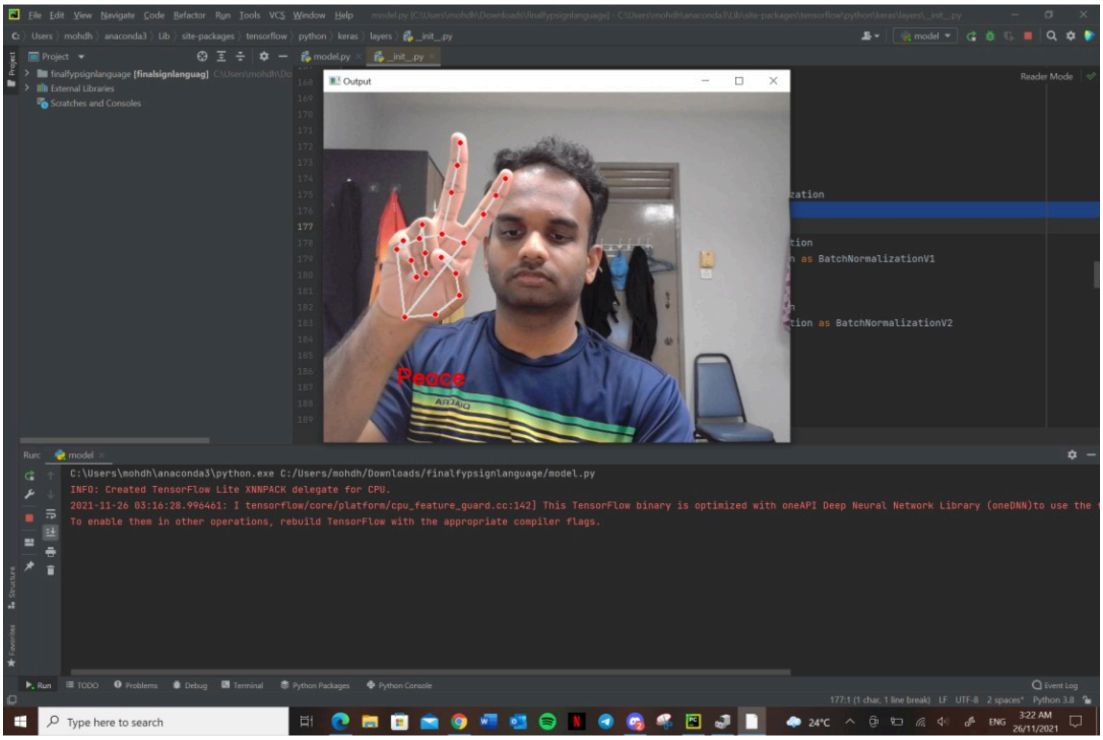


Figure 19 Peace

Example of the detection for “Peace”

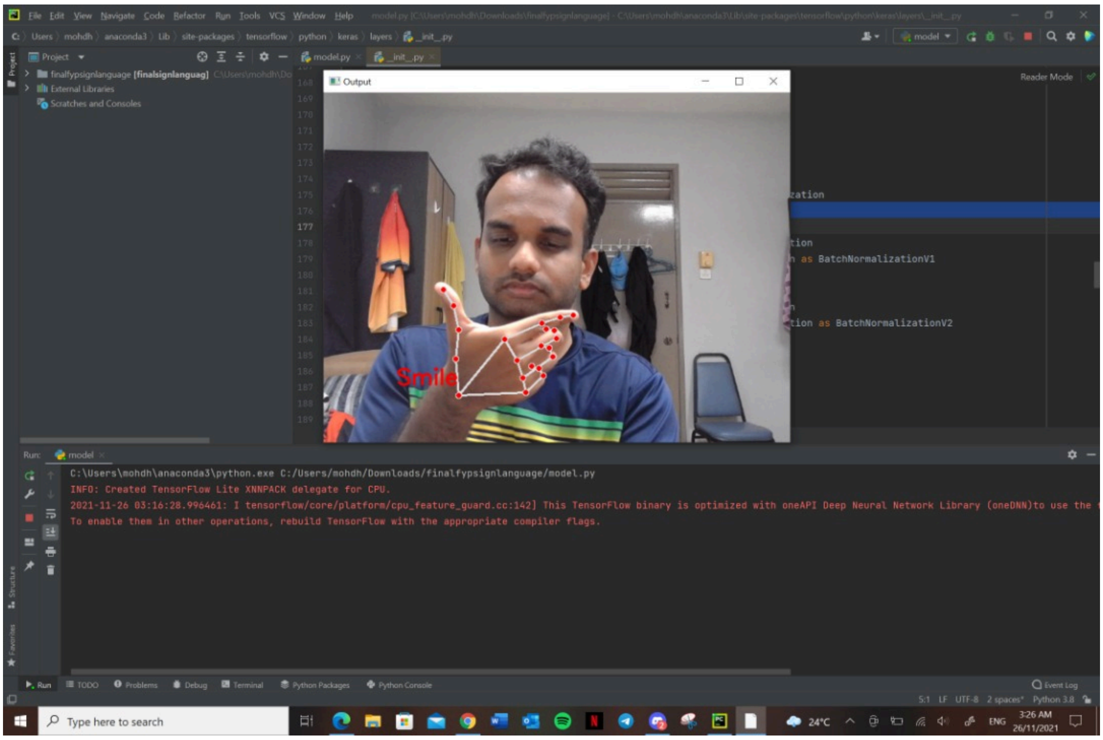


Figure 20 Smile

Example of the detection phrase “Smile”

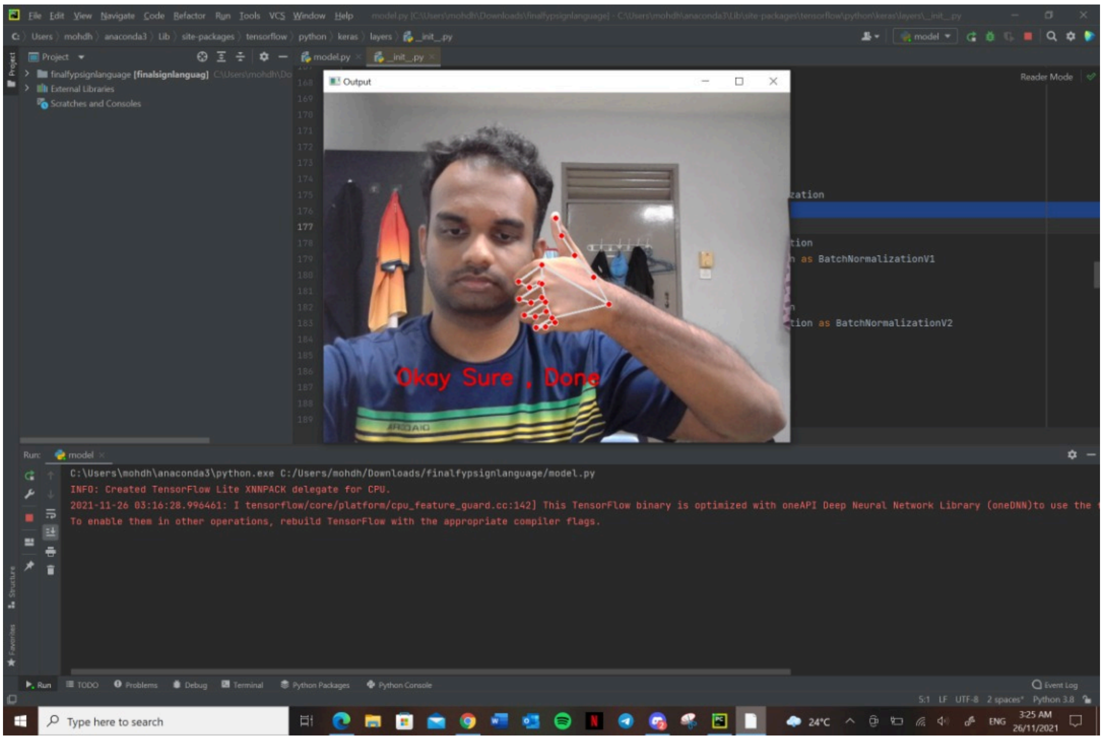


Figure 21 Okay sure, Done

Example of the detection phrase “ Okay sure, Done!”

Figure about clearly illustrates how the hand key points are discovered based on the sign language that we show before in this report. The primary goal of this research has been realised since it has identified and translated the hand gesture that we use every day. In order to properly demonstrate what I had learned when training the model that can detect our sign language by utilising our hand key point, I am adding a large amount of the output to this message.

4.6 Strength and Weakness

The complexity level of the project that was designed is its strength. Many people need to learn sign language, and with the help of this technology, some words can be recognised when shown in front of the camera. The system's user friendliness is another strength. It does not require any technical knowledge to use. The application activates the webcam, and the user only needs to demonstrate hand gestures related to American Sign Language. The project's shortcoming is that it requires a highly sophisticated computer with high technology specs if it is to be mass produced for practically every word in the ASL dictionary. This system has only one function, which is where the user points to the web camera and the hand signals are recognised. It will simply not detect if the hand signs do not match anything that was labelled and saved prior to starting the translator. The feature is simple and basic.

4.7 Usability Study

To learn more about how this sign language translator's users felt about it, we undertook usability tests and conducted a poll. This gives me a clearer picture of how this initiative has impacted their lives. Aside from these advantages, it was a low-cost and rapid technique of acquiring information, which were both beneficial. If social media influences society's perception positively or negatively, we included the following questions in the questionnaire relating to this topic. The questionnaire will include only 2 quick simple question :

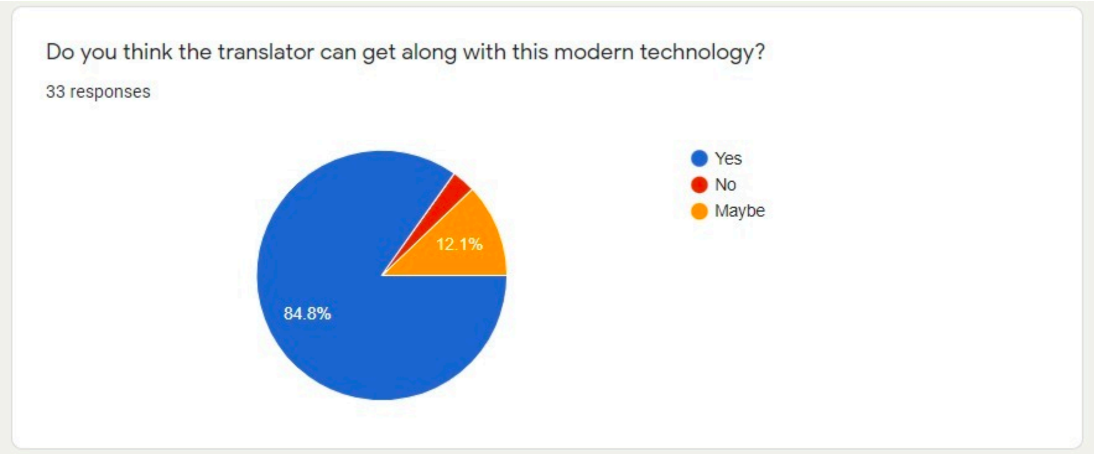


Figure 22 Usability Survey 1

How do you think the translator will fare with this new technology? That was my first query for replies. A whopping 84.8% of those polled stated "Yes," while 12.1% said "No," when asked if they thought the translator would be relevant in today's technological world. According to the results of this survey, a large majority of respondents believe that this application can benefit and will thrive in today's current technology.

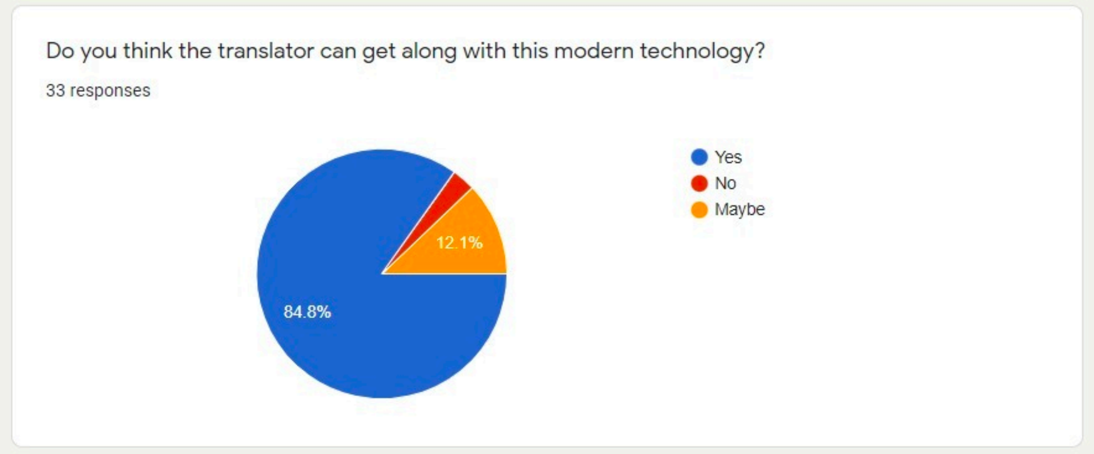


Figure 23 Usability Survey 2

In addition, I inquired as to whether or not the respondents found this sign language translator beneficial. According to the survey, 84.8 percent of interviewees answered they were either "YES" or "NO" to the question. More over half of the people polled said they prefer to utilise this rather than search for a translator on their own. This technology allows us to construct automated translation software that can be utilised everywhere, whereas in the past, individuals would employ human translators to converse with persons who are deaf or hard of hearing.

CHAPTER 5

CONCLUSION

5.1 Conclusion

To wrap things up neatly, the suggested system exists solely to attempt to break down the language barrier. Only a small fraction of persons who are not deaf can communicate in sign language. This situation, especially in this day and age, begs for a solution. There are methods that assist with normal spoken languages, so why not sign language? Instead of having to guess what one hearing impaired person is saying to another who is not, this is all possible with the help of a sign language translator. Yes, there is still time for development, but with today's technological advancements, it is possible in the very near future and people should start taking this concept seriously.

5.2 Recommendations

There are a few things that can be added into the system in the future. One of the functionalities that can be added into the future is for the sign language translator to be published in a mobile application and through online websites. This will be really helpful as hearing impaired people can just use this feature. This will be easier for people to use as it can be carried anywhere and can be used on the fly instead of asking the user to sit in front of a computer. The second thing that can be added into the system in the future is that there should be multiple languages and not just American Sign Language as this will help people from other countries too with different dialects of sign language.

REFERENCES

I. Chen , Kim, Lu H, Li Y, M, H. and Serikawa, S., (2017). “Brain Intelligence: Go beyond Artificial Intelligence,” *Mobile Networks and Applications* **23(2)** : 368-375

II. A., Haenlein, Kaplan and M, (2019). “A Brief History of Artificial Intelligence: On the Past,Present, and Future of Artificial Intelligence,”*California Management Review* **61(4)** : pp.5-14

III. Hodes C and Miailhe, N, (2017). “The third age of artificial intelligence”: *Field actions science reports*. *The Journal of Field Actions* **(17)**: pp.6-11

IV. A., Doulamis, E. Voulodimos, N. Doulamis, and Protopapadakis, (2018). “Deep Learning for Computer Vision,” *Computational Intelligence and Neuroscience* : pp.1-13.

V. P. Zheng, S. Xu and X. Wu, Z. Zhao, (2019) "Object Detection With Deep Learning: A Review," in *IEEE Transactions on Neural Networks and Learning Systems*, **30(11):** pp. 3212-3232

VI. Chen, Fieguth, Liu, L., Liu, X. Ouyang, Pietikäinen, X., and W. Wang (2020). “Deep learning for generic object detection,” *International journal of computer vision*, **128(2):** pp.261-318

VII. Ball, C., 2017. “The History of American Sign Language Interpreting,” *International Review of Studies in Applied Modern Languages*

VIII. Jaward M., Jin Cheok M., Omar, Z. (2019). “A review of hand gesture and sign language recognition techniques,” *International Journal of Machine Learning and Cybernetics* **10(1–3**)

IX. Bantupalli, K. and Xie, Y., (2018). “American Sign Language Recognition using Deep Learning and Computer Vision,” *IEEE International Conference on Big Data*

X. Ibrahim, N., Selim, M. and Zayed, H., (2018). “An Automatic Arabic Sign Language Recognition System,” *Journal of King Saud University - Computer and Information Sciences*, **30(4):** pp.470-477

XI. Bengio, Y , Hinton, G and LeCun, Y, (2015). “Deep learning,” ***521*****(7553):** pp.436-444.

XII. Bengio, Y ., Courville, A. and Goodfellow, I., (2016). “Deep learning,” **(Vol.1,No. 2)**

XIII. Armstrong, David F., and Michael A. Karchmer. William C. Stokoe. (2009). “Study of Signed Languages." *Sign Language Studies* **9(4)**: 389-97.

XIV. Correll, Robyn. (2017). “Challenges That Still Exist for the Deaf Community.” *Verywell Health*.

XV. Annelies Braffort, Christophe Collet ,Christian Vogler, Efthimiou, Eleni, Jérémie Segouat, John Glauert , Petros Maragos, Richard Bowden, Stavroula-Evita Fotinea and Thomas Hanke,(2009). “Sign Language Recognition, Generation, and Modelling: A Research Effort with Applications in Deaf Communication.” *Universal Access in Human-Computer Interaction. Addressing Diversity* **(5614):** pp21–30

XVI. Steinmetz, Katy. (2014). “This Technology Could Change the Way Deaf People Live.”

XVII. Stokoe, William. (2005). “Sign Language Structure: An Outline of the Visual Communication Systems of the American Deaf.” *The Journal of Deaf Studies and Deaf Education (***10).**

APPENDICES

Appendix 1

Suggestions to add in this application

29 responses

Try make it friendly for blind user so they also can use the application to communicate with hearing impared people .

Add in voice system

Sign translator but in animation form

Sorry. I have no any suggestions

Put some tutorial video in the apps for knowing the sign language

Prediction feature, maybe just by making one or two sign language, the application can predict the whole sentences on what the user want to say based on the sign languages.

Good for everyone

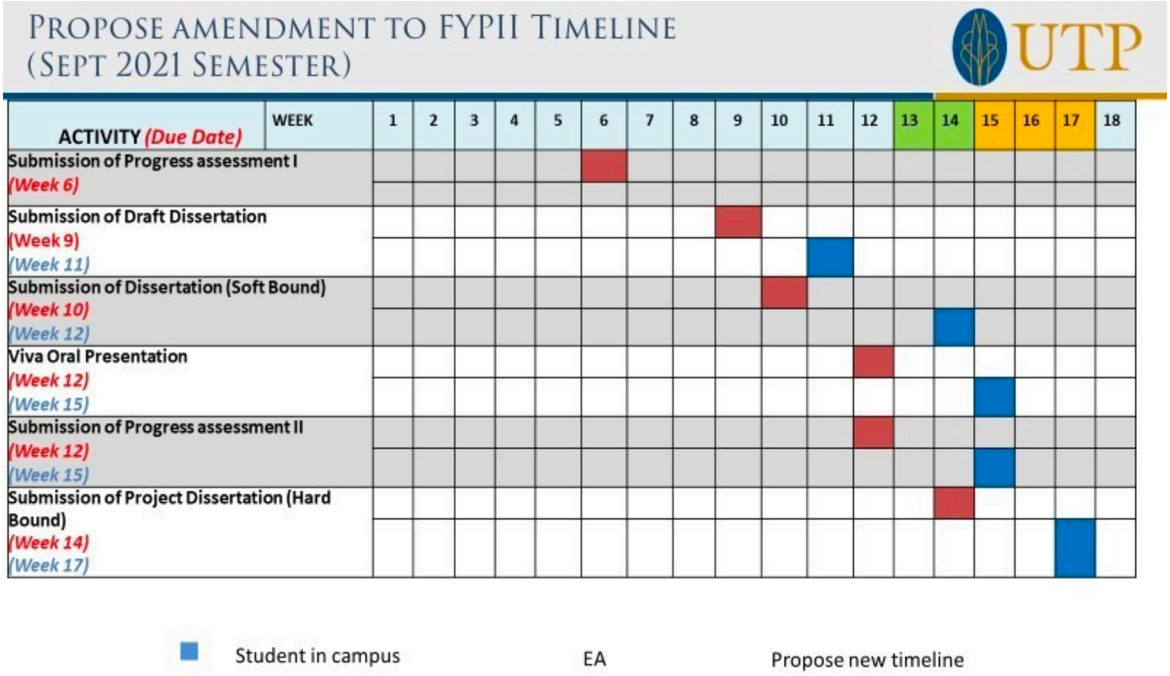
Maybe can create any app for sign language

Appendix 2

Task/Week	FINAL YEAR PROJECT 1												FINAL YEAR PROJECT 2														
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Planning Phase																											
Project title selection	■	■																									
Preliminary research work			■	■																							
Analysis Phase																											
Literature analysis					■	■	■	■																			
Submission of progress assessment 1									■	■	■	■															
Data collection & analysis							■	■	■																		
Proposal Defense								■																			
Interim Report Draft Submission										■	■	■															
Interim Report Submission												■															
Design Phase																											
Coding analysis													■	■	■	■	■										
Developer testing																		■	■	■	■						
System testing																						■	■				
Acceptance testing																							■	■			
Implementation Phase																											
Project dissertation																								■			
Presentation slide and prototype video submission																									■	■	
Viva presentation																											■

Reference	
	Completed
	Yet to be completed

Appendix 3


PROPOSE AMENDMENT TO FYPII TIMELINE
(SEPT 2021 SEMESTER)
UTP
ACTIVITY (Due Date)
WEEK
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Submission of Progress assessment I
(Week 6)
Submission of Draft Dissertation
(Week 9)
(Week 11)
Submission of Dissertation (Soft Bound)
(Week 10)
(Week 12)
Viva Oral Presentation
(Week 12)
(Week 15)
Submission of Progress assessment II
(Week 12)
(Week 15)
Submission of Project Dissertation (Hard Bound)
(Week 14)
(Week 17)
Student in campus
EA
Propose new timeline