Gesture Detection Translator Application for Converting ASL Alphabet Gesture to Text

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Abstract

The advancement of technology has paved the way for innovative solutions aimed at improving communication accessibility for individuals with hearing impairments. This study introduces an application designed to interpret American Sign Language (ASL) alphabet gestures and convert them into text using gesture recognition technology. By utilizing a dataset of ASL letter representations, the system analyzes and translates hand movements in near real-time, enhancing communication for users with little to no prior knowledge of sign language. The study employs a combination of image processing techniques and machine learning models to ensure accuracy and reliability. With an emphasis on mobile device accessibility, the application is optimized for user-friendly interaction, adapting to varying hand positions and environmental conditions. While the system focuses on static alphabet gestures rather than full ASL sentences, it lays the foundation for further developments in sign language recognition. The results of gesture-based translation tools in bridging communication gaps, demonstrating the feasibility of integrating machine learning into assistive technology solutions.

Chapter 1

The Problem and Its Settings

Introduction

Disability is no stranger to the ears and eyes of the general people. It refers to the inability of a person to fully utilize the functions of a normal human body due to several health, physical, or environmental factors. According to data fact sheets from the World Health Organization (WHO) in 2024, 1 in 6 people experience significant disability in the world which contributes to 16% of the global population amounting to an estimated number of 1.3 billion people experiencing such disabilities. As time passes and more factors affecting these people emerge, these numbers will continue to see even more growth. Based on other data statistics provided by the Philippine Statistics Authority regarding the 2020 Census of Population and Housing (2020 CPH), an estimated number of around 9% from a total of 97.60 million of the household population experiences disabilities to some extent. This amounts to around 8.5 million people aged 5 and above that are having difficulty in properly functioning using their senses. The data statistics mention that these numbers experience difficulties in performing in at least one of the six domains of functionality which are classified as: seeing, hearing, walking, remembering or focusing, self-caring, or communicating. This data was taken in reference to the released 2020 CPH in October of 2022 detailing the statistics of people with disabilities living under a Philippine housing setting which shows the population density of the disabled in a more proximate scenario.

Disabilities affect anyone regardless of age, gender, sex, religion, identity, culture, etc. Influenced by their disabilities, they continue to face more hardship as they continue on with their life. They are met with discrimination against their disability, they become subject to

peoples' abeliest and stigmatic thoughts and actions. Disabilities come in many forms based on the many other factors that contribute to it. This study in particular will be dealing more into a specific form of disability that may or may not also affect other senses as a result.

Deafness, or the loss of hearing, is one major disability that affects the population. This particular disability affects over 5% of the populace, estimated at around 430 million people including 34 million children. As it stands, the World Health Organization (WHO) expects that these numbers will further increase by 2050, with an estimate of 2.5 billion people suffering from hearing loss to a certain extent, with 700 million of those in need for proper rehabilitation. Hearing loss may be categorized into mild, moderate, or severe depending on the degree of hearing left in a person. People with such disabilities may in turn provide them with more difficulties in making use of their other senses, like their speech, depending on the time that they lost their sense of hearing. Deaf children that are born with such a disability or have contracted it in their early days, that may have no idea what the sounds of some words are, will have difficulty conveying it through speech and may need to require speech rehabilitation in order to properly communicate. Not being able to hear what you want to say is a difficulty that the deaf are experiencing at all ages, which is why you can rarely distinguish the deaf from the mute or how you can hear some deaf people emit indistinguishable sounds when conversing through sign language.

Communication is limited for these people with disabilities since practically speaking it is hard to always have to write in a piece of paper everything you would want to say. In comes the language developed in order for them to visually communicate with one another without the use of pens and papers. Bodily movements were used in communication between the deaf and mute, making use of different signs through the use of hand movements and gestures. Sign Language was used as a replacement when spoken communication was almost impossible to conduct.

Just as how language may vary from each part of the world, sign language was also interpreted differently based on some countries. Some widely known examples are the American Sign Language (ASL), British Sign Language (BSL), Chinese Sign Language (CSL), etc. The differences of these languages stem from the original differences of their national languages, such as how the Chinese alphabet may differ from those that use the Alphanumeric characters. Sign language has signs for each letter of the alphabet, with even more specific signs for each and every different word. This study in particular will be making use of a specific sign language to be incorporated into the research product which is the American Sign Language. This decision was due to several factors, such as how ASL makes use of the alphanumeric characters or alphabet, which makes it able to convey every word without making use of its unique sign but instead using letters to spell it out. ASL is also widely used throughout the US, Canada, parts of Africa, as well as some Southeast Asian Countries.

Sign language was only one step of many in the progressing endeavor of providing inclusivity to the deaf and mute community. With how fast the world is technologically advancing as seen from a plethora of sources across the web, it is only right to make use of such technologies in creating a suitable environment for the growth, development, and care of the tools needed by these people with disabilities.

Technological tools that relate closely to the use of sign languages are those that make use of gestures as data. Gestures Detection Technologies are programs that detect user input gestures which are then converted into input data for the system. Gesture recognition systems use cameras or sensors to capture these movements, machine learning algorithms then analyze the captured data, like hand position and movement, to interpret the gestures and their intended meaning. Detection technologies focusing on the hand gestures as input has been widely used as tools for several studies that want to make use of the unique gestures as

input material as seen in several scientific documents websites like IEEE Xplore, Science Direct, etc. By utilizing the gestures done through the use of sign language and the detection systems for gestures, applying it into translation systems can greatly increase the efficiency of communication. This efficiency can be associated with data from a ProZ survey where it is shown that the use of Computer-Assisted Translation (CAT) tools are prominent in the field of translations, more specifically around 88% of personnel in said field make use of such tools. Further surveys show that CAT tool users make use of such in their translation assignments, be it for the most part or some parts. These numbers show that 83% of CAT tool users do such application of the tool, with an additional 76% from them making use of more than one tool. More data regarding translation can be seen from a catalog of survey compilation provided by POEditor on their translation statistics.

Introducing this concept into a more accessible setting may create more opportunities for improvements and efficiency in already existing translation systems, as seen from findings of Alotaibi and Salamah (2023) on the impact of translation apps on translation students' performance and with how widely used mobile phones are based on data shown through the International Telecommunication Union (ITU) in 2023. According to the ITU, an approximate 78% of the world population who are of age 10 and above are in use of a mobile device or phone in the year 2023. These numbers are seen to be 11% higher than the percentage garnered by individuals who use the Internet.

This study will deal with the technological tools present that can be used in relation to the subject of sign languages. Gesture detection of different sign language letters will be incorporated into a translation system that outputs translated data from the use of gesture inputs.

Background of the Study

Disabilities not only pose difficulties to those affected with different bodily functions it also hinders them in interacting with the society in all of its different aspects. As they are different from what someone may perceive as normal, they tend to face discrimination everywhere they may go. Despite all of this some step up in helping them overcome some of said difficulties albeit lacking in resources to fully do so. Some may also be reluctant in approaching them, having no idea what to do and what not to do, as well as how to communicate properly in the first place. In order to create an environment for those with disabilities like the deaf and the mute, we need to be aware of the tools we could use in helping them communicate well with those around them, like translation systems and apps.

Translation systems in general are great solutions to the different language barriers present in the ever-expanding fields of language evolution. Although some languages have limited translation programs compared to others, more specifically Sign Language. Most translator applications focus more on a variety of languages used by hearing and speaking folks, which leaves sign language to their own devices. The limited translation application that does not cater to sign languages deter the development of it as it limits the solutions in order to overcome the language barrier present towards the deaf and mute to the hearing and speaking.

The researchers chose this path because it indeed manifests itself in the spirit of their undertaking to develop a gesture detection translator which is capable of converting the alphabet gestures of ASL into text. This research is important to the researchers because it now fulfills existing evidence in demand for accessible tools that would be able to bring the deaf and mute community within. Utilizing the detection technology would thus be a further inclusion in bringing on board ASL users and non-signers together on a platform for people interaction and contributory moves towards advances in assistive solutions.

With all the closely related research dealing with translation systems and gesture recognition systems for sign languages, many are those focused on conducting translation based on the unique signs for all the different available words in the general dictionary. This poses difficulty in establishing a fully functioning system for use despite accurate recognition results. These studies will need to continuously feed the system with countless data on the signs of different words. Questions may arise, such as how can someone communicate properly if the word they want conveyed is not yet in the system. Although the thought of such systems work, it needs a great amount of data and time to fully operate. Using these as reference in building the translation and gesture recognition systems while applying a different approach will be the distinction that separates this study from the rest. To further add, the study will be focused on mobile development as the means of implementation of the application since mobile users are rampant all around the world as seen from Facts and Figures provided by the International Telecommunication Union (ITU) in 2023 regarding mobile phone ownership worldwide.

Instead of jumping into the complicated amount of signs for each word, this study will be going back to the basics of sign language, the alphabet. Letters for the sign language alphabet are simple, with ASL having to only make use of one hand to sign the whole alphanumeric characters. These letters can be used to spell out each word in sign. In order to be a fully functioning application from the get go, this approach of letter signing is used.

This study hopes to recreate a moment in time where groups comprised of those deaf and mute as well as abled, happily engage in simple yet fun conversations despite the existing language barrier set by the proficiency in sign language, practicing and performing, and communicating with simple gestures in place of words that are unfamiliar to the abled. A happy scene that this study wishes to be done, maybe not in a bigger group, but rather a bigger scope.

Objectives of the Study:

To develop and build a translator application for sign language (ASL) that is functioning using the gesture detection technology.

Specific Objectives:

1. Evaluate the application's performance with various light settings and hand placements to ensure its strength and dependability.
2. Design an interface that meets the technical skill set of the target types of users.
3. Design and develop a software application for mobile devices that utilizes a camera for the purpose of recognizing the ASL letters in hand alphabets and a few simple ASL words both static and in motion.
4. The text should be displayed shortly after the gestures have been made, in real time or nearly real time.
5. Incorporate text to speech for ASL letters

Scope and Limitations

Considering the scope of existing research related materials where the functionality may seem great but only after inputting huge amounts of data and time. The study steps back in the scope coverage in the means of translation. Making use of exclusively letters and the most basic gestures for the foundation of the application functionality showcases both the scope and the limitation that the study is to face. The development of the prototype will mainly be focusing on its mobile applications as mobile development students. The application itself will be capable of identifying different gestures based on the amount of data that the developers will be providing. Some functions may be limited depending on the availability of the mobile functions of the users, specifically a working camera for the gesture

recognition feature. This application will cater to the translation of the letters using the gesture detection. The future researchers can use this study as a reference if they want to further explore and make advancements in the translation system. The researchers will focus on ASL and will ensure consistency and make the most of their skills. This is also a part of the researcher's learning process, and it might also help gain an in-depth understanding before exploring other tools. The researchers main focus on ASL alphabet keeps static hand shapes and not fully focused in implementing a lot of dynamic gestures, phrases, or grammatical constructions. Variations in hand shape, lighting conditions, or backgrounds may affect the accuracy of the system, and user-specific training may be required to correct the differences in signing styles. Hardware-related issues, such as camera quality and the performance of the devices, may compromise the overall reliability. Extremely poor contextual comprehension, along with the exclusion of regional ASL variations, may also limit the adaptability of the system for real-life applications on stated parameters

Significance of the Study

Respective stakeholders for this study have their own angle on the significance of the study. For the developers, the success of the study provides accomplishments on the mobile application development which are to be used as both material for grade passing and experience into their curriculum vitaes'. This study being limited with dealing in alphabetical letter translation also limits its target market that can fully use the application as means for upgrade. Entry level or beginner users in the field of sign language are the primary demographic for this study. This will help create a learning environment for them in both understanding the letters for the sign language as well as proper gestures to be made in signing. Given that this research faces its own limitations based on its scope, this research may prove to be significant material in progressing functionalities for future researchers.

dealing with related topics. Providing more data that the recognition system could use over time such as slowly incorporating gesture detection by words and not only letters, is another use of the application for future advancements in this field

Key stakeholders:

Deaf and Hard-of-Hearing Individuals: Use of applications among beneficiary groups most likely intended for effective communication with non-signers.

ASL Learners and Educators: People needing tools to learn and teach ASL might find this application appealing for practice.

Developers and Researchers: Interested in gesture recognition technology or accessibility tools may use results from this study to enhance similar systems.

General Public and Non-Signers: Such people would find the app as an important tool to bridge the gap for ASL users in their day-to-day life.

Advocacy Organizations for Deaf Communities: These organizations probably find interesting the type of impact the new application can make.

Definition of Terms

This research paper defines the following key terms and concepts to improve clarity and comprehension:

1. **Gestures:** These can be described as another form of expression used by people with their bodies and limbs.
2. **Gesture-detection technologies** usually consist of media such as cameras that allow the capturing of human gestures; then, from the recorded data, understand the meaning by machine-learned algorithms that convert the event into predefined gesture state events.

3. **American Sign Language** is the main concern of the application. ASL is a language that people express more visually than audibly—through hand shapes, hand movements, and facial expressions. The application is intended to recognize and interpret American Sign Language signs, in particular the manual alphabet, into written letters/words.
4. **Sign Language** is a medium of communication mostly fingered by the deaf and mute communities and it uses hand actions to denote words.
5. **Translator application** is a computer program that aims at transforming the input data or the gesture into an understandable output or the text and facilitates communication between two different modes.
6. **Converting** is the act or process of changing or transforming one type of data or information like the ASL sign language, into another type, also known as the words/letters.
7. **Mobile development** is the process of designing and programming mobile applications, which involves interface designs, camera usage, touch operations, as well as information displays.

Chapter 2

Literature Review

Disabilities

Disability is a widely recognized term that refers to a person's inability to fully use the functions of a typical human body, often due to health, physical, or environmental factors. Disabilities greatly affect a number of our world's population. In 2024, data from the World Health Organization (WHO) revealed that approximately 1.3 billion people worldwide, or 16% of the global population, will experience significant disability. This means that 1 in 6 individuals are affected by such disabilities. This greatly shows how prevalent disabilities are. in our society. Disabilities have no specific target as anyone can easily be subjected to its effects depending on your health, environment, and other factors. Anyone can be put in the spectrum of disability as it can be seen as a universal human experience.

Studies and statistics surrounding this particular topic don’t necessarily dive deeper. into its related topics. As said by Ciezaet al., 2018, disability as information is often divided into those that are and those that are not, limiting the knowledge for specific disabilities on its wide spectrum. Said study proceeds to highlight how existing instruments are mostly used in recording set standards for measuring disability, further backed by lack of data surrounding the levels of disability a person may have.

WHO has been making efforts in introducing aids and helps in facilitating a better environment with proper accessibility and assistance for increased functionality for said individuals. With how disabilities can be greatly affected by the environment, such actions would help create, alleviate or prevent progress of some disabilities (Ciezaet al., 2018). Addressing each part of the disability spectrum is a step that needs to be taken bit by bit in order to understand more of the different disabilities which in turn may create more

opportunities for studies that can either help heighten the existing knowledge or help create solutions and aids to specific levels of disabilities.

Sign Language

Communication is one of the key parts in our lives, being used in order to interact with one another, by this, they can learn, express their feelings and exchange their ideas (Sanaullah et al., 2022). Even with all the languages out and about, some may be rarely used by the majority making it harder to communicate with such a demographic. According to Jin et al. (2016), due to the relative lack of pervasive sign language usage within our society, deaf and other verbally-challenged people tend to face difficulty in communicating on a daily basis.

According to Yadav et al. (2021), sign language is an effective mode of conversation for persons who have difficulty speaking or hearing. There are numerous media accessible for translation or for identifying sign languages and converting those to text format, However, methods for converting text to sign language have been few and even not web-based software, owing to the scarcity of resources. These types of problems further regress the progression of sign language as well as hinder its dissemination to the masses. With the emergence of various technological advances, problems such as these may be alleviated by constructing a well planned solution with the help of technology.

Incorporating a common practice between two demographics will help in creating a middle ground of basic communication for both parties. With this taken into account, gestures come to mind. Gestures have always been an everyday occurrence for us with the simple wave of hands in greeting and goodbyes, as well as raising your hand for stopping someone or raising a concern. Gestures are a form of communication that is universally understood by the majority of people (Eswaran, 2021).

Sign language is a unique language of its own. It has its own set of vocabulary, idioms, grammar, and even slang. . According to Montoya et al. (2004), the deaf community have a harder time reading in the English language, as acquisition of it is difficult due to the several rules and nuances brought by different words or sentences. Such is the same for the problem statement stated by Soogund and Joseph (2019) which stated that studies surmise that hearing-impaired students are likely to face major difficulties in reading and comprehending written texts. This is mainly because they have limited capacity to build a fluent and efficient system of communication, which is required for attaining reading proficiency and comprehending the content presented to them.

Hearing people, on the other hand, also have the same problem when it comes to communicating with the deaf. As sign language is not a prevalent language, only a few are proficient and fluent, with most having a difficulty understanding even the alphabet. These problems cause difficulties in communication and interaction between the two communities.

One angle that this research is looking into is catering to those young ones in the field of sign language, be it the literal and the metaphorical way. Those new to these sign languages will be having difficulties processing the plethora of different sign language gestures for every single word. Not to mention that they will most likely have to get down to the basics of sign language in order to familiarize themselves with basic concepts like the letters of the alphabet. Starting from the basics and properly knowing such concepts may help aid in strengthening the foundation of new signers regarding their signing.

Translation

Interpreters are a great help for the non-hearing community to communicate with others, yet this also limits them in their interaction. Some problems may arise from this, such as how interpreters can introduce extraneous factors into the testing situation, for example,

poor or unequal translation, misunderstanding of content or intention of original test items, leading translation, interpreting by someone who is unqualified, and lack of guidance for interpreters on how to handle items that do not translate easily from one culture to another (Montoya et al., 2004). Others have also explained through surveys conducted by Soogund and Joseph (2019) that it is harder to socially interact with others and make friends when having an interpreter translate for them.

With the current technology, there were projects that made Sign Language translation possible with applications, an example of this is “Sign4PSL,” an app made under the study “A Real-Time Automatic Translation of Text to Sign Language” This study utilizes 3D models in order to convert text input into sign language by representing it with a 3D animated human doing the sign language. This application was able to achieve 100% accuracy on alphabets, digits, words, and phrases but only managed to achieve 80% accuracy on sentences. This is due to ambiguous sentences that may have double meanings, which confuse the program. The study plans to further extend this project in the future by supporting complex signs and non-manual features of sign language and adding more signs that ca be done in the application, the study has shown that there are issues with the limitations on the grammar of sign language, but the study plans to extend support for these in the future.

Other solutions from Soogund and Joseph (2019) can also be seen through their paper: *SignAR: A Sign Language Translator Application with Augmented Reality using Text and Image Recognition.* This study has shown how Augmented reality is used to provide real time translation to words detected by the system. Words were not only its source as pictures can also be detected and translated. Their findings concluded that the application provides great help in teaching both the hearing and non-hearing to learn about sign language. The study’s test respondents also provided feedback, such as how they loved the idea of such an application and could see how useful of a tool it is for its demographics’ education. Further

feedbacks are also being considered such as the user interface as well as additional features like whole sentence translation which the study aims to continue unto.

Even with all of these studies, the scope of studies for areas regarding disabilities are still stagnant. Shortage of benchmark datasets remains a primary challenge in the field. Scarcity of software and applications for sign language recognition and translation is still apparent (Alaghband et al., 2023).

Gestures and Gesture Detection Scanners

Gestures have always been an everyday occurrence for us with the simple wave of hands in greeting and goodbyes, as well as raising your hand for stopping someone or raising a concern. Gestures are a form of communication that is universally understood by the majority of people (Eswaran, 2021). They are utilized in various contexts, including interactions between deaf and deaf-mute individuals, robot control, human-computer interfaces, home automation, and medical applications. Research on hand gesture recognition has employed methods, often relying on sensing technologies and Internet vision. As a result, hand gestures can be categorized in several ways, such as by their position and movement, or by being either dynamic, stable, or a combination of both (Veluri et al.,2022).

Gesture recognition in computing technologies is the ability of a device to recognize human motion,these devices may vary from cameras to wearable devices the user can use to input data into an algorithm that analyzes the movement and recognizes gestures. A study by Sushira Mitra and Tinku Acharya titled “Gesture Recognition: A Survey“ states that the technology of gesture recognition can be applied for sign language recognition, Soft computing tools pose a promising application to static hand gesture identification. This is done via finding the similarities of a test hand shape model and then determining it based on its hand contours.

Hand gesture recognition still faces several challenges due to variations in gestures, lighting conditions, background complexity, and the diverse ways in which people perform gestures. Another issue arises in real-time gesture recognition, as the time it takes for individuals to perform gestures can vary. This makes it difficult to detect and classify gestures immediately or even before their completion, which is essential for providing rapid feedback. Additionally, leveraging new hardware capabilities and improving the recognition of previously unseen gestures are important considerations, particularly for real-time applications (Rastgoo et al., 2020). Other approaches in this field involve detection not entirely based on sensors but data sets. Studies such as that of Chen and Tian (2023), machine vision-based gesture recognition was used which did not rely on physical contact with the user or the use of extra sensors or specialized equipment. Instead, it required training on a large dataset of images to develop a highly accurate recognition model, enabling precise gesture identification.

In another study titled “Hand Gesture Recognition for Human-Computer Interaction Using Computer Vision,” the researchers were able to create an application that uses the Hand Gesture recognition technology. With this, they are able to use gestures to control the computer such as moving the mouse and adjusting the volume using predetermined gestures. With the help of computer vision and machine learning, it is made possible to create an algorithm that is able to detect the position of fingers and use these to calculate their distances and predict a gesture. The study suggests that this can aid in future Gesture recognition projects such as processing body movements of sign language, or full body tracking.

Incorporating such concepts into this study helps create a great foundation for not just the application but also the process of imparting the right knowledge to its users. Gesture detections create the means of guiding the users on how to properly do the corresponding

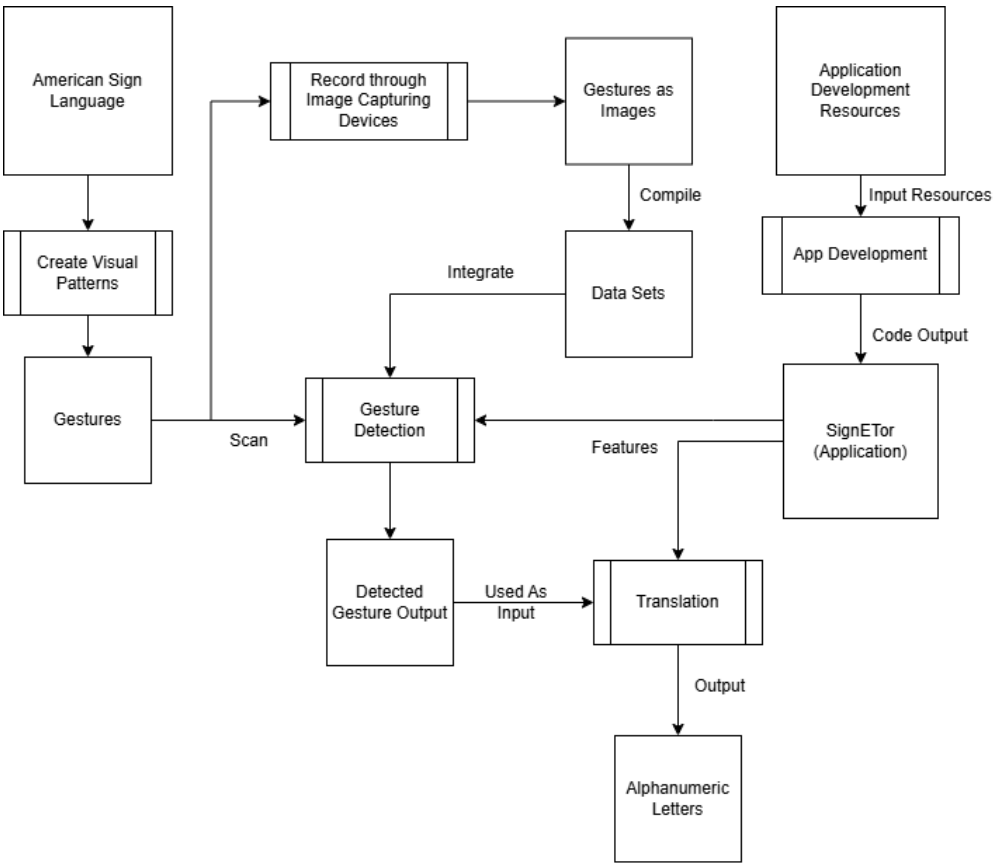
gestures for each letter, as well as being the judge on how accurately can users portray the gesture they intend to convey.

Conceptual Framework

This conceptual framework outlines a systematic approach for conducting a capstone study on the "Gesture Detection Translator Application for Converting ASL Alphabet Gestures into Text." The objective of the study is to develop an application that leverages gesture recognition and translation technologies to interpret sign language as shown in Figure 1.

Figure 1

Conceptual Framework Diagram of the Application



The conceptual framework for this study incorporates fundamental concepts that define the core operational structure of the "Gesture Detection Translator Application for Converting ASL Alphabet Gestures into Text."

Fundamentally, the application is centered around the concept of detecting gestures and applying appropriate translation for detected gestures. The application makes use of a number of images of pre set gestures as data sets for recognizing gestures. These data sets are the primary and sole basis of the application in recognizing the different gestures to be inputted by the users.

Coding the application from a working prototype to the final application comes first in this process. The early prototype will be used as a medium for testing the accuracy of the detection based on the data sets available.

The ensuing stages comprise the collection of the data sets. These data sets are gathered by the developers through the use of image capturing devices. The developers are to capture images of the different ASL alphabet letters, starting from basic signing gestures then slowly incorporating different angles while still being accurate in portraying the letters. Different angles help the application accurately recognize user gestures that may vary in position, angle, distance.

Once sufficient data sets are obtained, incorporation to the application comes next in the process. The incorporated data sets help raise the application’s accuracy in gesture recognition which greatly helps in properly recognizing the signs of similarly arranged letters.

The research converges into a presentation of the application with accurate gesture detection technology partnered with appropriate translation systems along with its other features to create a seamless translation application that makes use of gesture inputs. The

findings of this study will help the disabled community, specifically the deaf and the mute have a functional letter based translation for their communication as a whole.

Synthesis

Studies surrounding the disabled and how they interact with the society as well as incorporation of different existing technologies into providing a medium of inclusivity have been seeing more exposure. This synthesis aims to coalesce and explore such findings garnered from a variety of studies in order to fully understand all of their different perspectives and approaches in this field of study.

The Disability Spectrum

Recent studies on disabilities as of itself are low in number as most studies prefer to approach this topic as a problem-solution based research. Tackling each aspect of the disability spectrum is a gradual process that allows for a deeper understanding of the various disabilities. This, in turn, can open up more opportunities for research that either expands existing knowledge or leads to the development of solutions and assistance for specific levels of disability.

Struggles of Sign Language

With how unique sign language is, comes a lot of struggles and difficulties its users will face. As seen from several studies like that of Montoya et al. (2004) as well as Soogund and Joseph (2019), the deaf and mute community that makes use of sign language as their primary mode of communication face difficulties in understanding or expressing words and sentences. Especially in the way that the English language differs in grammar, tone, and nuances compared to the gesture based sign language. This study aims to create an

environment for said community to be able to converse with anyone without the other complications that sign language entails.

Use of Interpreters and Translation Systems

Different languages have different people with varying fluency in them, having someone with knowledge of specific languages greatly helps in interpreting when conversing with someone of said language. This type of setting may help in some cases, but its use greatly diminishes when using it in a normal and casual communication. Montoya et al. (2004) as well as Soogund and Joseph (2019) highlights the inefficiency and difficulties that comes from using interpreters as a middleman in normal day to day conversation or social interaction.

Going technological in this field for this particular topic may help as mobile translation systems provide portable and accessible services, but as highlighted by Alaghband et al. (2023), the scarcity of sign language related materials and resources hinders the progress on accessible communication within the community.

Gestures and Gesture Detection Technologies

Gestures serve as a universally recognized form of communication for most people (Eswaran, 2021). They are used in numerous contexts, including communication between deaf and deaf-mute individuals, robot control, human-computer interfaces, home automation, and medical applications. Research on hand gesture recognition has explored various approaches, often involving sensing technologies and Internet vision. Consequently, hand gestures can be classified in different ways, such as by their position, movement, or by being dynamic, stable, or a mix of both (Veluri et al., 2022).

There are several ways to tackle gesture detection, this study will make use of similar ways like that of Chen and Tian (2023) making use of gesture detection systems that focus on detection that doesn't rely solely on sensors but rather on datasets. Such a system did not require physical contact with the user or additional sensors or specialized equipment. Instead, it involved training a recognition model on a large image dataset to achieve highly accurate gesture identification.

Conclusion

In this paper, the researchers have examined a variety of studies related to the development of sign language translators and the integration of gesture detection technologies. The literature reviewed shares common themes, particularly focusing on improving communication through gestures, sign languages, and translation systems. The review highlights significant barriers between the hearing and non-hearing communities, especially regarding social interaction and communication. Several studies propose technological solutions to these issues, emphasizing that existing methods, such as interpreters, often hinder seamless social interaction.

The conceptual framework of this study aims to address these challenges by developing a "Gesture Detection Translator Application" that translates American Sign Language (ASL) gestures into text. By synthesizing the information gathered from the literature, this framework outlines a systematic approach to creating an application that utilizes gesture recognition and translation technologies. The application will be designed to detect gestures with high accuracy using pre-recorded ASL gesture datasets, collected from various angles to ensure flexibility in recognizing user inputs.

The findings from the literature review make it clear that sign language is not widely studied or understood across different demographics, which exacerbates communication

problems between the deaf and hearing communities. However, the reviewed studies also show that translation applications and technologies, like gesture recognition systems, offer promising solutions to bridge these gaps. By leveraging these technological advancements, this research aims to create a more accessible and efficient communication tool, fostering better interaction between the two communities.

Ultimately, the study emphasizes that the responsibility for improving communication between the deaf and hearing communities should not solely rest on the deaf community. It requires a collective effort from both parties to create an environment conducive to effective interaction. The development of this gesture detection translator application represents a significant step toward achieving this goal by providing a practical, accessible tool for communication.

Chapter 3

Methodology

Research Approach

The aim of this research study involves the creation of a functioning gesture detection and translation application using gesture recognition technology to convert gestures from the American Sign Language (ASL) alphabet into text. The study will investigate and learn the difference of gestures and the visual aspects involved in their successful recognition.

A qualitative research approach will be used. A qualitative study that analyzes how ASL alphabet gesture expressions are characterized and quality. Lighting, hand position, and background contrast will be different facets used in this kind of study relating to the accuracy or clarity of gesture interpretation. Insights will be taken from ASL experts regarding functionalities and interfaces based on their expertise, gathered through surveys, will help shape the app's functionality and importance. Thematic coding will highlight key visual features, guiding the creation of image datasets that reflect practical ASL use and ensure the app is both effective and culturally sensitive.

Research Design

An action based research will be used in this study in order to construct an accurate and working application. Action researches make use of a repeating process: plan, act, observe, reflect. With a lot of data needed to create a more accurate application, continuous input of data and reviewing of its accuracy will be regularly conducted. After observing if each letter is or is not easily being recognized, more data will be inputted into the application based on the specifics of the observation.

Qualitative Objective: To understand the user experience and satisfaction of the application concerning its usability and communicative effectiveness but also with

respect to hardships or limitations experienced; moreover, to investigate and analyze the most important visual and contextual factors affecting the recognition of American Sign Language (ASL) alphabet gestures as accurately as possible.

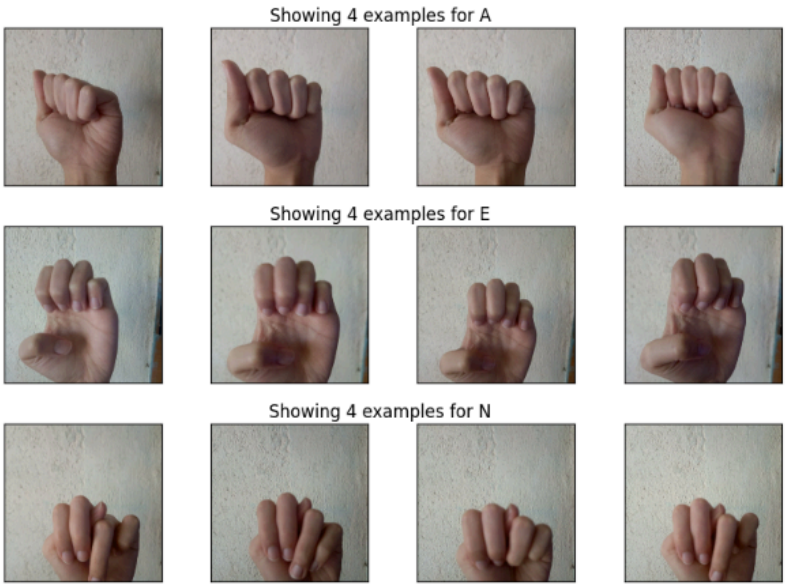
Data Collection

The data needed by the application will be exclusively coming from the developers. The data sets consist of a number of images per letter of the ASL alphabet. The data is collected by capturing images of the researchers doing the alphabet of American Sign Language. These images are then stored and organized into folders based on what letter they represent as can be seen through Figure 2 below.

Data from surveys of different experts on related fields was also made use of in order to determine the efficiency and usability of the application based on the perspective of experts that are knowledgeable in their appropriate fields such as sign language, mobile development, and UI / UX design.

Figure 2

Images of Different ASL Letter Gestures Used as Data Sets



Data Analysis

This concrete analysis would proceed into signifying basic assessment measures: accuracy, speed, and user experience. Measurements on relevant metrics would include gesture recognition measurement by calculating true positives, false positives, false negatives, and precision. An efficiency evaluation for real-time processing can be determined by measuring latency, frame rate, and processing time per gesture. An analysis that could be conducted under this category would include the types of errors that are misinterpretations, types of hand shape and position variations, and ambiguous gestures. It can also be checked through user feedback and experience users may have had concerning frequency of errors and ease of use. The comparison with other existing systems may also serve as a good measure for performance evaluation of the system; while those differences have been noted, statistical tests can be used to verify if these differences are due to a real effect. Data collected from experts will be filtered based on its feasibility and how relevant it is to the study for it to be considered. Data collection and generalization of the model will look into the learning curve as well.

Ethical Consideration

This study adheres to the ethical principles required to ensure responsible research practices, with particular attention to protecting privacy and maintaining transparency, as all data for the application will be sourced exclusively from the developers, and no user gestures will be stored or collected. Survey feedback data will also be used after garnering proper permissions from experts involved in such surveys.

The data collection side of the study will only make use of data provided by the developers in the form of image data sets of ASL alphabet letter gestures. These data sets will exclusively be used in training the application to create accurate and fast detections, taking

into account slight tilts or distance difference of gestures. The application will be operating by translating gestures from users without saving or recording any user data. This also means that the application will not retain any form of user data into the system after every use.

In the application use side of the study, the application makes use of the built in camera in the users' mobile devices. The users will be prompted permission accordingly regarding this feature.

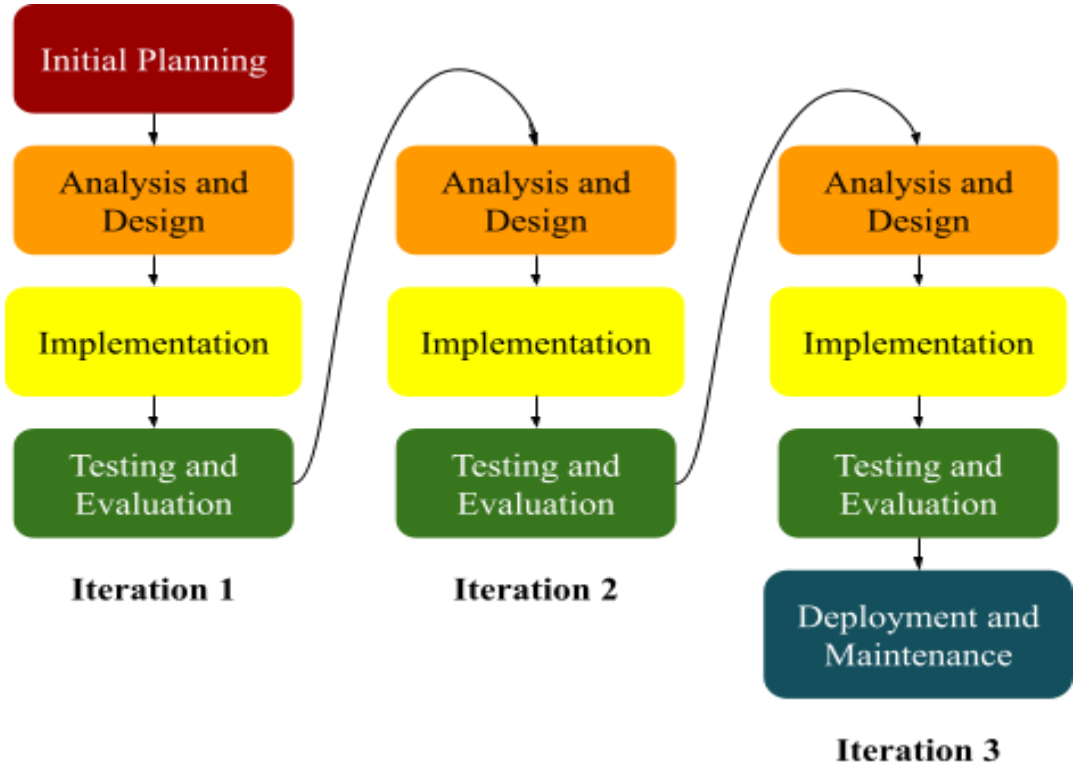
Review on the application use and efficiency will be determined from data taken from experts of certain fields after conducting surveys centered around the usability, functionality, and efficiency of the application based on its scope and limitations. Proper permission will be taken from the experts involved regarding anonymity of data gathered from them. As the data needed from these experts are only feedback regarding the application and their credibility in their respective field, any other irrelevant data can not be taken and used.

System Development Methodology

This study will mainly utilize an Iterative Methodology approach for its system development. The iterative system or model in research projects keeps on being a major approach, since it can be made flexible and used for gradual development and fine-tuning based on new understanding. It helps reduce risk as problems can be identified and dealt with at an early stage in the development of the project. This functional model also forms a basis of constant feedback and assessment, making it very suitable for projects whose requirements have experimental aims.

Figure 3

Iterative Model Diagram for Gesture Detection Translator Application



The initial planning of the project consisted of brainstorming for ideas and concepts that can be applied to the proposed application. Browsing various online studies and journals in order of relevance to the chosen topic are done separately for better field coverage. Observations on similar products were conducted to see the features, scope, and limitations of said apps. Identification of required materials were also considered as preparation for the next phase of the development cycle. This phase also included the identification of the scope such as the specific language to be used for the sign language and coding, as well as the limitations that the project will face based on the known objectives set for the project.

Planning is skipped on the first iteration as the Initial Planning phase is already conducted. The next phase is the requirements phase, wherein the identified materials to be used were briefly reviewed again for verification. The researchers then gathered said resources after the brief review. These included libraries, development resources, design

resources, as well as the data sets to be used for the gesture detection. Capturing the data sets consisted of using image capturing devices These were all the resources that the application will need and use on the first iteration.

The succeeding phases were done by analyzing the materials as well as the plan for the construction of the application, designing the backend and frontend was then considered basing on the set objectives on the features included before the implementation phase of the project. Proper quality control for the data sets also falls in this phase, as accurate data sets are required to provide output that are just as accurate.

Implementing all of these resources and design into a working application comes next in the development life cycle. The application is shaped based on the data from the planning/ initial planning phase. This is the phase where the different data sets, libraries, etc. are compiled into a proper code to create a working prototype.

Testing and Evaluation are vital phases in the development of this application. As the app's features are tested and evaluated in this phase where different factors are considered such as the flaws in the prototype to be more specific. Evaluation does not only come from the researcher as different consultations are conducted with the researchers' adviser to gather feedback on the current status of the prototype. These evaluations are then used as basis in creating another plan, identifying additional requirements such as more data sets, further analysis, implementation of the project, which would then lead to further testing and evaluation.

Objectives of the study are to be considered in each iteration, making sure that every objective is fulfilled before finally creating the final product. This final product will undergo deployment onto its target users for practical use, finally fulfilling the final objectives of the study. The data collected for training data is processed by organizing the collected images to their respective folders, these images are then imported to a Google Collab folder running a

Jupyter notebook. The Jupyter notebook installs and imports “mediapipe-model-maker” and “mediapipe” to process the data, the library helps in processing the images and training the model which results in a “.task” file which contains the processed data for recognizing gestures.

Mobile Specifications

The application itself is a very light app that almost any phone can run. An Android version of at least Android 12 is required as per the specification of the utilized APIs. The application consumes around 200-300 Megabytes of memory which almost every phone can run on with the average phone having at least 4GB of RAM in the market today. As for the CPU, mediatek A22 processor was the lowest CPU it was tested on. The MediaTek Helio A22 features a quad-core ARM Cortex-A53 CPU clocked at up to 2.0 GHz and a PowerVR GE6320 GPU, which is ideal for general use, light gaming, but not for demanding tasks. It is on the same level as the other low-end processors in the market.

Summary

Development of a gesture detection application integrated with American Sign Language (ASL) alphabet gestures and text includes a qualitative method for accuracy and for rich data. The research methodology proceeds through action research patterns of planning, acting, observing, and refining. Qualitative features focus on usability, user satisfaction, and communicative effectiveness. Investigation and analysis of the most important visual and contextual factors affecting the recognition of American Sign Language (ASL) alphabet gestures as accurately as possible. The creation and the structuring of ASL datasets by developers form the basis of data collection. Also, functionality is evaluated by means of survey feedback.

Training data are processed using "mediapipe-model-maker" and "mediapipe" libraries in a Jupyter notebook environment. Ethics only provide that the user data should not be stored. The only training data is by developers. The consent for the collection of survey feedback is anonymized. Applications use cameras on mobile devices and it uses user permission to do so. Limitations pertain to the fact focusing is on static ASL letters; that there are chances to lack accuracy owing to outside factors; that there is dependency on datasets from the developer; and that prototype application is mobile, therefore affecting the application in the wider scenario.

Chapter 4

Results and Discussion

This chapter covers the outcomes after the development and testing stages. It will also include the experts' feedback, which will be presented, interpreted, and analyzed throughout this section.

Data Description

Survey questions were distributed for the different experts depending on their field of expertise in order for the application to be reviewed and evaluated by experts in the respective fields relevant to the topics of the application.. Experts with specialized knowledge in sign language, application development and or UI/UX design were carefully selected. The specialists' feedback was based on how well the application meets its objectives based on its target demographic as well as the ease of use of the application based on their expertise.

Qualitative Findings

The responses garnered from each expert were identified and analyzed by the proponents. The reviews were focused on the functionality of the application from the point of view of application development experts as well as its functionality based on the view of sign language experts.

The first impression of the application as well as user interface and design was received fairly well for its simple design which greatly helped in navigating through the application but few recommendations on the design were still given, recommending to upgrade some aspects of the design of the application as it is too simple.

Figure 4

Sign Language Experts' Summary of Survey Answers

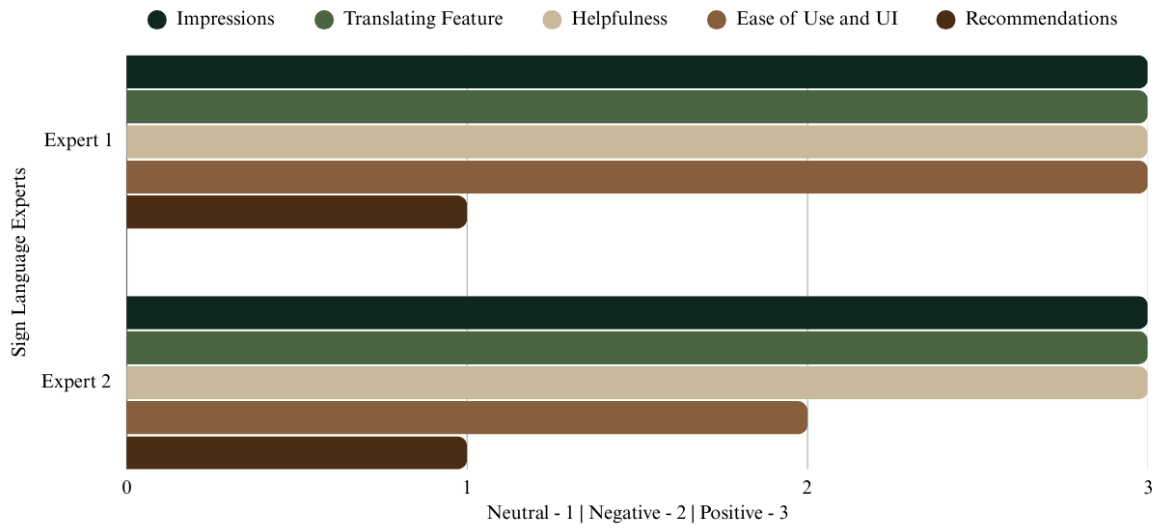
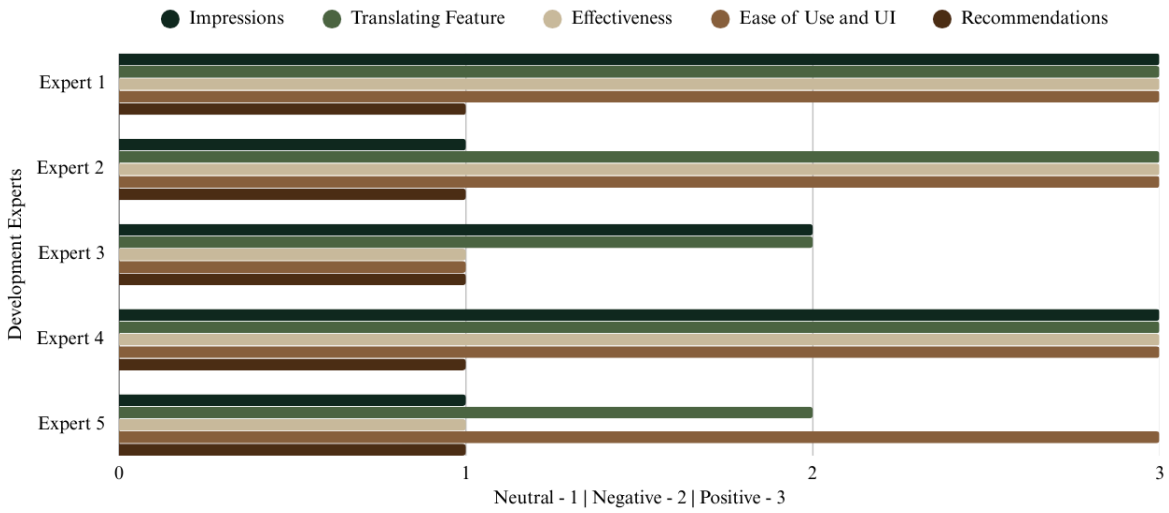


Figure 5

Application Development Experts' Summary of Survey Answers



The application's functionality and effectiveness was also tested and reviewed by the experts, citing its ease of use and speed of detection. The application was praised for its speed in detecting proper ASL alphabet letters as well as the few included simple gestures. The sign language experts in particular pointed that it can prove to be helpful towards its intended demographic which are entry-level sign language users in communicating with others. Some

points regarding the sensitivity of the detection were raised, but was still commended for creating a functioning application that fulfills its designated objectives. Recommendations on adding some more features were also given, like providing a space option to create sentences.

Comparison with other research

The proposed application is distinctive among other applications and research in a way that it highlights the importance of the basics in sign language and how it may be more helpful for those that are starting in comparison with other applications that are focused on creating translations that are based on words. The study of Amusa et al. (2022) shows a computer based translation application that only has a few gestures. This application, albeit working as intended, cannot be properly deployed with only those few gestures as it cannot provide any conversation material for its target demographic. Most existing applications and research makes use of words as basis for translation, but with the plethora of words that have their own corresponding unique sign, it is difficult to utilize it in such a way that it caters to every conversation of words possible.

This project also focuses on creating an application specifically intended for a mobile environment. As resources are scarce, studies relating to this are just as sparse. Boulares et al. (2012) presents a mobile application for signing to the deaf community. Their project, MMSSign, is a converter of textual messages to a video sequence in sign language which utilizes mobile phones. Comparing this to the researcher's study, it poses several differences such as different input data (textual vs. gestures), different translation approach which uses word or phrases in text to translate into. Other mobile applications such as the study of Jin et al. (2016), where instead of this study's skeletal detection for gestures, it utilizes a different algorithm that traces an outline for the detected gesture. This limits the application to only processing and calibrating gestures that do not require movement, which could hinder its

development when trying to process other letters in the ASL alphabet that make use of movement based signs.

This Gesture Detection Translator Application goes for a simpler and more functional approach with the use of letters. These letters also have their unique sign, but in contrast to words with differing signs for each and every word, spelling out these words using letters will make use of the corresponding signs for letters without changing anything based on the word to be translated. As ASL letters can spell out any word, additional time and resources will be saved in creating an application that focuses on the countless words that one may use.

Practical Implications

This study has made significant contributions to the advancement of sign language translation technology and mobile gesture detection. Through the assessment of experts' views on a gesture detection sign language translation application, the research has emphasized key factors like usability, accuracy, and user satisfaction. The results demonstrate the application's potential to support future research and development in this area.

The study emphasizes the significance of creating a well running application that can be fully created and utilized within the limited development time-frame. While research on this topic is few and scarce, providing more materials for future research will help in surpassing the challenges and obstacles they may face. For instance, this study highlights the use of letters for translation instead of words which may be used as a basis for similar research as they build their applications. The scarcity of relevant resources shows the ongoing problem that the disabled face, which is having accessible services in regards to their inclusivity.

Limitations of the Study

By concentrating solely on recognizing ASL alphabet letters and basic gestures, the study both defines its scope and acknowledges its limitations. The application will be capable of recognizing gestures based on data provided exclusively by the developers which includes the ASL Alphabet letters, as well as a few conversational words like yes, no, hello, etc. However, its functionality may be restricted depending on the availability of certain mobile features, such as a working camera for gesture recognition, or phone processor for quick detections. This application will primarily cater to translating individual ASL letters through gesture detection with simple conversational words included.

The study's limitations stem from several factors. First, the accuracy combined with the speed of the detection, albeit great, can cause some mishaps which can be seen whenever unintended letters are detected through letter to letter transitions. The text to speech feature is also limited to a letter based speech when using letters to form words. Time constraints are key factors in proper integration of the text to speech feature, nevertheless, the application is equipped with such features. Additionally, external variables such as hand shape variations, lighting conditions, and background interference could impact the system's ability to properly detect intended signs. The need for user-specific training to account for differences in signing styles may further limit its general applicability. Limited scope of data collection for the data sets may also affect the quality of detection as well as hardware limitations, including variations in camera quality and device performance, could also affect the overall reliability of the application.

Chapter 5

Conclusion and Recommendations

This section presents a summary of the insights gained from a thorough evaluation of the Gesture Detection Translator Application for ASL Alphabet Letters. The study explores the practicality and efficiency of letter-based translation in sign language and offers general recommendations for future research in this field.

Summary of Findings

The project aimed to create an entry level translator application for sign language users that makes use of mobile gesture detection technology. Through a process of continuous development and expert assessment, several key points were clarified.

The research showcased the practicality of effectiveness of using letter-based translation for entry level users in sign language. The application provided accurate detection and proper translation that adheres to its specified objectives. Performance-wise, the experts raised few concerns on the speed of word creation with the compiled letters but are mostly satisfied with its results as it works as intended. Moreover, proper gesture detection can be attained by having sufficient light source and proper signs. The application itself surmounted the obstacles of creating a simple and functional design as per the expert's response.

Further evaluation shows that albeit that the application has reached its desired outcomes based on the set objectives, various improvements may be implemented such as the speed and scope of the application.

Conclusion

In conclusion, the project successfully developed an entry-level sign language translator application using mobile gesture detection technology. Through iterative development and expert feedback, the application proved effective in providing accurate letter-based translations for beginner sign language users. While the experts highlighted some minor concerns regarding the speed of word creation, overall, they were satisfied with the application's performance, as it met its predefined objectives. The application demonstrated the ability to overcome challenges in design and functionality, providing a simple yet effective tool for sign language translation. Moving forward, there is potential for further improvements, such as enhancing the speed and expanding the scope, which could contribute to even greater user satisfaction, effectiveness, as well as future research in this field.

Recommendations

The researches proposes the following recommendations in regards to the findings garnered and expert evaluations conducted:

- Incorporating more fully translated words
- Exploring the feasibility to make it into an accessible app
- Adopt more translations
- Incorporate into existing language translations

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APPENDIX A: Evaluation Tools

ASL Expert Questionnaire

1. What is your first impression when first seeing the application?
2. What are your thoughts on the application's translating features, specifically its speed and accuracy in detection?
3. Would you say this application is helpful for its intended demographic (Entry-Level ASL Learners)? Why do you think so?
4. How is the application in terms of its ease of use and user interface?
5. What features of the app are the best and what are some recommendations you have for the application?

Developer Expert Questionnaire

1. What is your first impression when first seeing the application?
2. What are your thoughts on the application's translating features, specifically its speed and accuracy in detection?
3. How effective is the application in translating ASL into text?
4. How is the application in terms of its ease of use and user interface?
5. What features of the app are the best and what are some recommendations you have for the application?

APPENDIX B: Expert Feedback

ASL Expert Feedback - Expert A

1. What is your first impression when first seeing the application?
    A. It's pretty impressive for it can easily detect or scan/identify the signed letters.
2. What are your thoughts on the application's translating features, specifically its speed and accuracy in detection?
    A. The app displays accuracy as to the positions of manual letters/ alphabet at any level or position on the screen. But somehow in terms of speed, it affects the letters with unwanted and involuntary movements that can misspelled or repeated and unwanted letter are quickly flashing. A steady hand and focused perspective are necessary to complete the letters of the words correctly.
3. Would you say this application is helpful for its intended demographic (Entry-Level ASL Learners)? Why do you think so?
    A. It could be helpful for learners or individuals with hearing impairment to convey messages using only the manual alphabet. Moreover, a helpful device to communicate with the deaf and hearing using a manual alphabet.
4. How is the application in terms of its ease of use and user interface?
    A. Its accessibility, clarity of the video, and easy app download. One tap is able to 3 seconds of accessing the interface.
5. What features of the app are the best and what are some recommendations you have for the application?
    A. Match between the system with the real world- easy app and availability to users, Error prevention to signed hand letters- unnecessary movements, Recognition of letters, Universal usability

ASL Expert Feedback - Expert B

1. What is your first impression when first seeing the application?
    A. Wow! An app that translates sign language letters to the alphanumeric alphabet.
2. What are your thoughts on the application's translating features, specifically its speed and accuracy in detection?
    A. Speed is good but its detection feature needs improvements, for it detect signs that are not intended, (e.g., detecting "E" instead of "O")
3. Would you say this application is helpful for its intended demographic (Entry-Level ASL Learners)? Why do you think so?
    A. It will be helpful but the "space" feature must be included, and improve the detection feature to detect actual and intended letters.
4. How is the application in terms of its ease of use and user interface?
    A. Interface also needs improvement.
5. What features of the app are the best and what are some recommendations you have for the application?
    A. The app appears to be "foreign" to various smartphones. The phone that I use kept on blocking the download and installation of the app.

Developer Expert Feedback - Expert A

1. What is your first impression when first seeing the application?
    A. Positively, it's neat and uniform looking. Negatively, it's bland.
2. What are your thoughts on the application's translating features, specifically its speed and accuracy in detection?
    A. It is good, too good you could say. Even at the lowest setting of tracking and detection, it's too sensitive even on my small hand movements. Speed is very good, just needs working on the accuracy part.
3. How effective is the application in translating ASL into text?
    A. I can see that it is able to translate sign language pretty well even for me who didn't learn sign language. I just looked up the language online just for this app review and just mimicked the signs but I still see the translations and it is correct.
4. How is the application in terms of its ease of use and user interface?
    A. It's easy to use and the interface is very straightforward. Just the words on it are very technical so it may not suit well with the less educated people who may use the application.
5. What features of the app are the best and what are some recommendations you have for the application?
    A. Hmmmmm. Probably the speed of the translation and its detection. It is very good. I do recommend toning it down a bit or maybe adding some function to limit/lessen it. Because even when I'm transitioning from letter to letter, even the subtle movements are being translated by the app which leads to jumbled words. It may be good to add some stopping points where the app should stop

detecting so it will stop detecting movements or give the app some cooldown after each letter for better accuracy like after translating a letter, the app will stop detecting movements in a 3 seconds window or something. I would also like to suggest adding a box interface in the camera, which shows the user the area of where it is detecting the movements. I think that's it for now.

Developer Expert Feedback - Expert B

1. What is your first impression when first seeing the application?
    A. Seems normal. Not too bad, not too good either.
2. What are your thoughts on the application's translating features, specifically its speed and accuracy in detection?
    A. I think it's okay. Speed is good and also the detection.
3. How effective is the application in translating ASL into text?
    A. It's good. It just translates too fast for someone like me.
4. How is the application in terms of its ease of use and user interface?
    A. It's easy to use but I wish there were options in the interface for me to edit stuff in.
5. What features of the app are the best and what are some recommendations you have for the application?
    A. The translation. It's able to detect the signs and translate them so it is functioning. My recommendation would be more options. Something I can explore. I personally want to play around with the apps I use. This one is very straightforward.

Developer Expert Feedback - Expert C

1. What is your first impression when first seeing the application?
    A. Sorry to say it but I think it's boring. It is lacking impact, something to catch the attention of the users.
2. What are your thoughts on the application's translating features, specifically its speed and accuracy in detection?
    A. The speed is okay but the accuracy is terrible. It doesn't even wait for me to finish doing the next sign and it's already putting a lot of letters out.
3. How effective is the application in translating ASL into text?
    A. If it's just in terms of translating, it's passable.
4. How is the application in terms of its ease of use and user interface?
    A. There's not too much in the interface thus making it very easy to access.
5. What features of the app are the best and what are some recommendations you have for the application?
    A. The translation. I do wish you could spruce things up in the design and functionality. I do recommend more options like the switching of cameras for situations like if I'm talking to a mute outside, I can just point the camera towards him/her and they can just start doing the sign language.

Developer Expert Feedback - Expert D

1. What is your first impression when first seeing the application?
    A. It's really good that I find it hard to believe that a student made it.
2. What are your thoughts on the application's translating features, specifically its speed and accuracy in detection?
    A. First, the speed is excellent. It picks up on the signs quite well and there's almost no delay in between detecting the sign and the translation. The accuracy is okay, just need some small adjustments and I believe it will be great.
3. How effective is the application in translating ASL into text?
    A. It's amazing. The translation is accurate so I think the app can be used practically already.
4. How is the application in terms of its ease of use and user interface?
    A. The interface is really easy to use. There's not many functions there which helps to lessen the confusion for the people who are not used to technology like the older people.
5. What features of the app are the best and what are some recommendations you have for the application?
    A. I like the practicality of the application. The interface is very direct. What you see is what you get. If I have to recommend something, that would be to make adjustments on the accuracy of its detection and aside from that, I don't think I have anything to add.

Developer Expert Feedback - Expert E

1. What is your first impression when first seeing the application?
    A. Uhh, the app looks... like an app? I don't really know what I was expecting, but it's there. It has some buttons and things that you click on, so I guess it works.
2. What are your thoughts on the application's translating features, specifically its speed and accuracy in detection?
    A. The speed is kinda okay, but sometimes it gets the words wrong. I don't really get why it messes up, but I guess that's just how it is? It tries, though. That's something.
3. How effective is the application in translating ASL into text?
    A. Well, I think it tries to turn hand signs into words? It works sometimes, but other times it just doesn't make any sense. Like, I don't know if it's me or the app, but it's kinda confusing when it doesn't get it right.
4. How is the application in terms of its ease of use and user interface?
    A. It's not super hard to use. You click stuff and wait. The buttons are all in the places you'd expect, I guess. It's not super pretty, but it works well enough. I don't know, I don't really care too much about that.
5. What features of the app are the best and what are some recommendations you have for the application?
    A. The best part? Maybe the translations? My suggestion? Hmm, maybe just make it more accurate, I guess. It's good enough, I think.

APPENDIX C: Curriculum Vitae of Developer Experts

NEIL FRED CAÑETE

SOFTWARE DEVELOPER

PROFESSIONAL SKILLS

- Visual Studio Code
- Postgres, MongoDB, Firebase
- HTML5/CSS, Javascript, ReactJS, React Native, NodeJS, ExpressJS, NextJS, Laravel, Python, Web3
- Rest API, Axios, RTK query
- React Testing Library, Jest
- Context API, Redux
- Git, Github, Bitbucket
- Trello, Jira
- Material UI, AntD, Bootstrap, Tailwind CSS
- Adobe Photoshop, Adobe Illustrator, Figma, MS Word, Excel, PowerPoint

PERSONAL SKILLS

- Responsible
- Flexible
- Reliable and professional
- Organized
- Time management
- Team player
- Fast learner
- Motivated

CONTACT

P: +639058754655
E: caneteneilfred@gmail.com

SOCIAL

Github:
https://github.com/nonsense00027

Linkedin:
https://www.linkedin.com/in/neil-fred-canete-5424671a7/

Website Portfolio:
https://canete-portfolio.vercel.app

WORK EXPERIENCE

WAL SOFTWARE SOLUTIONS

Freelance Web & Mobile Developer
2020 - February 2021

Full Stack Web & Mobile Developer
February 2021 - April 2022

JOB RESPONSIBILITIES

- In-charge with the frontend using ReactJS and React Native
- handle state management using React Context API or Redux
- develop backend using Backend technologies (eg. Firebase, NodeJS, Express, etc.)
- create REST api
- design database structure and models using SQL or No-SQL database
- handle backend to frontend connection
- integrate modern CSS designs
- project deployment
- project maintenance
- participate in weekly progress meeting
- submit daily progress report

XURPAS INC

Mid Frontend Developer
April 2022 - Present

JOB RESPONSIBILITIES

- In-charge with the frontend using ReactJS / NextJS
- handle state management using React Context API or Redux
- established connection on the backend
- handle data fetching from a REST api
- integrate modern CSS designs
- use of version control softwares like git, github, and bitbucket
- manage tasks using project management tools (eg. Jira, Trello, etc.)
- project deployment
- project maintenance
- participate in weekly progress meeting
- submit daily progress report
- code reviews

EDUCATION

BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

University of the Immaculate Conception
2018-2022

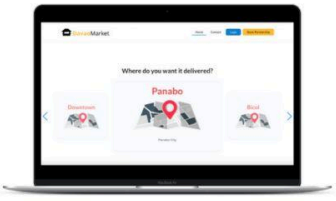
PORTFOLIO

DORSHS

is a Web-based school portal built using ReactJS and Firebase. The website serves three (3) types of users: students, teachers, and administrators. The student can enroll, login, submit required paperwork, and check for school announcements as well as their grades on the website. The teacher can access the system and enter grades for his or her students. While the administrator can see all of the students, approve or deny enrollment applications, evaluate active students' documentation, assign teachers to certain sections, and update school announcements.
dorshs.com

BLUEDRIVE

is a web-based physician order system that uses ReactJS and Firebase to allow physicians, nurses, and medical personnel to interact conveniently and efficiently. Nurses can use the website to register and update patient information, as well as look up available physicians. Physicians will be able to readily observe, evaluate, and assess patients while also keeping track of their progress. Other medical personnel can view data that is updated in real time.

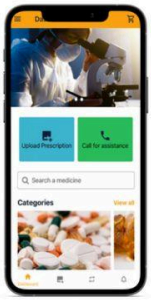


DAVAOMARKET

is a ReactJS and Firebase-based web-based e-commerce platform. The website has three (3) users: the customer, the store administrator, and the system administrator. Customers can place orders on the website, confirm their orders, and complete the checkout process. Store administrators can submit an application for their store to be able to sell their products online, as well as receive and process orders, and manage their products and sales. The system administrator is in charge of verifying store applications, monitoring day-to-day transactions, and so on. The website also makes use of location management for easy store filtering and delivery.
davaomarket.com

FTC

is a Laravel and Postgres-based web-based inventory management system. The FTC company's numerous branches use this system to keep track of their inventories. Users will be able to log in based on their roles (for example, accounting, IT, and HR), with separate functionality and pages loaded for each role. HR can enter basic information about personnel, and IT can allocate specific units (such as computers, monitors, keyboards, and so on) that will be documented in the system. Any inventory changes will be documented in a history log that can be consulted if necessary. Every division of the FTC Company has access to this system.



VIP PHARMACY

is a React Native and Firebase-based e-commerce smartphone platform. Customers can use this app to place orders for medications, process, and checkout. Customers can simply send in a photo of their receipt, and the admin will place the order for them. The customer can choose whether the medicine is for maintenance or not, and if it is, it will be saved for the next purchase. Customers can also request/call for assistance in order for the admin to assist them on their needs. The administrator has control over products, transactions, stores, and consumers.

NUTRI.IO

is a mobile application developed using React Native and Firebase. This system is designed to make it simple and quick for pregnant women to connect with RNDs (Registered Nutritionist Dietitians). Authentication (registration and login), Dietitian selection, and day-to-day communication with the appointed Dietitian via online messaging are just a few of the features. The real-time update functionality of Firebase Firestore makes updating patient data a breeze. React Context API is used to distribute data to the frontend, React Native Elements is used to design the user experience, and React Navigation is used to handle page routing.

FUZZ & BLOCKZ

is a hyper-casual endless dodge mobile game created in Unity using C#. Play as the brave White Fuzz and take on a variety of daunting challenges of varying degrees of difficulty. Tap the screen to avoid and gather energy balls as you navigate across various terrains. On each stage, there are a variety of lowpoly design maps to enjoy.

https://play.google.com/store/apps/details?id=uic.ccs.FuzzBlockz

Jaco Raven Miras

Frontend Developer

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532 A Greenhills St., DDF Village, Mandug, Davao City

WORK EXPERIENCE

Accenture
Sep 2024 - Present

Advanced App Engineering Analyst

KRZ Systems Incorporated
Mar 2023 - July 2024

Frontend Developer

Developed a web HRIS application using ReactJS and Tailwind CSS
Developed a government website and Systems that connected to the website like (Website Administrator Panel, etc.) using React JS, Tailwind

MakeInteractive Co. LTD
Aug 2022 - Dec 2022

Junior ReactJS Developer

Developed an online collaboration web application (Driff) using React and Redux which allow users to communicate internally with other employees and externally with the company clients.

EDUCATION

University of the Immaculate Conception
2018 - 2022

Bachelor of Science Information Technology

STI College Davao
2016 - 2018

TVL - Information Communication Technology

SKILLS

HTML	ANGULAR	REDUX
CSS	NODEJS	
JAVASCRIPT	NEXTJS	
TYPESCRIPT	TAILWIND	
REACT	SHADCN	

APPENDIX D: Curriculum Vitae of Sign Language Experts

EDITHA C. PEÑA

Master Teacher 2

Contact Information:

- **Address: 1912 JP Laurel St., Claro M. Recto, Angeles City**
- **Phone: 0999-565-1456**
- **Email: editha.pena001@deped.gov.ph**

Summary: Highly dedicated and accomplished Master Teacher with over three decades of experience in General Education and Special Needs Education. Proven track record of excellence in teaching, with numerous awards and recognition.

Professional Experience:

- **General Education Teacher, 1989-1993**

- Taught various subjects to students of different grade levels - Developed and implemented engaging lesson plans to promote student learning

- **Special Needs Education Teacher, Angeles Elementary School, 1994-Present**

- Designed and implemented individualized education programs for students with special needs - Collaborated with parents, therapists, and other educators to ensure comprehensive support for students Education:

- **Master of Arts in Special Education (MA SPED), Philippine Normal University, CAR- Auditory Disabilities**
- **Bachelor of Elementary Education (BEEd), Holy Angel University, 1989**

Awards and Recognition:

- **2012 Outstanding Teacher, Rotary Club and Kabu Angay Foundation**
- **2011 Outstanding Classroom Teacher, Angeles City**
- **2003 Outstanding SPED Teacher, Region III**

Community Involvement:

- **Liturgy/Mass Interpreter, Holy Rosary Parish Community**
- **Community Interpreter**

Certifications/Licenses:

- **LET – Licensed Education Teacher**
- **PRID -Phil. Registry of Interpreters for the Deaf -Member/ Licensed**

Joel V. Ocampo

EXPERIENCE

JUNE 1, 2014 – JUNE 15, 2024
Social Worker (Outreach Coordinator) • Holy Family Academy of Angeles, Pampanga, Inc. (High School Dept.)

JUNE 16, 2020 - JUNE 15, 2024
Araling Panlipunan, and Humanities and Social Sciences Teacher • Holy Family Academy of Angeles, Pampanga, Inc. (High School Dept.)

Key Responsibilities:

- As social worker: outreach coordinator (administrative)—planning, implementing, and evaluation of yearly outreach programs; conduct financial management and/or resource mobilization activities; facilitate livelihood & development activities for the indigenous people and women's association; collaborate with stakeholders, community beneficiaries, and other partner agencies/organizations/communities; prepare and update reports as need arises.
- As teacher: lesson planning and delivering efficient instruction in social science subject, assessing and monitoring student progress, and providing individualized support and intervention as needed.

EDUCATION

- Systems Plus College Foundation
  Bachelor of Science in Social Work (2010-2014)
- Holy Angel University
  18 Units of Professional Education Courses (2015-2016)
- De La Salle University Manila
  Certificate in Teaching Religion (2021-2023)

ELIGIBILITY

- Board Passer – Social Worker Licensure Examination (June 2014)
- Board Passer – Licensure Examination for Professional Teachers (September 2016)