OLIVAREZ COLLEGE
Dr. Arcadio Santos Avenue, San Dionisio, Parañaque City

# WLVocGenArg:
# Development of a Wireless Voice-Generating Arduino Gloves For The Deaf People Used For Virtual Communication

An Undergraduate Thesis
Presented to the
Faculty of the College of Computer Studies
Olivarez College

In Partial Fulfillment
Of the Requirements for the Degree
Bachelor of Science in Information Technology

By

**JERICHO GERALD C. BALUYOT**
**ERICKA MAE B. RODILLO**
**JOHN SYTE L. TIOPES**

2024

**APPROVAL SHEET**

This thesis hereto entitled:

**WLVocGenArG: DEVELOPMENT OF A WIRELESS VOICE-GENERATING GLOVES FOR THE DEAF PEOPLE USED FOR VIRTUAL COMMUNICATION**

Prepared and submitted by **JERICHO GERALD C. BALUYOT**, **ERICKA MAE B. RODILLO**, and **JOHN SYTE L. TIOPES** in partial fulfillment of the requirements for the degree of Bachelor of Science in Information Technology (BSIT) has been examined and is recommended for acceptance and approval for Oral Examination.

**RICKY G. TABLANDA**
Adviser

It was approved by the Committee on Oral Examination with a PASSED grade on April 24, 2024.

**DR. ESTELLA GARCIA**
Chairman

**Dr. LYSSANDER RODAN C. DELA CRUZ, CPA, DBA**
Member

**DENNIS M. QUINTO**
Member

Accepted in partial fulfillment of the requirements for the degree of Bachelor of Science in Information Technology (BSIT)

**Dr. LYSSANDER RODAN C. DELA CRUZ, CPA, DBA**
Dean, CCME

## ABSTRACT

**Title** : **WLVocGenArg: Development of a Wireless Voice-Generating Arduino Gloves For The Deaf People Used For Virtual Communication**

**Author/s** : Jericho Gerald C. Baluyot
Ericka Mae B. Rodillo
John Syte L. Tiopes

**Adviser** : Ricky G. Tablanda

**Course** : Bachelor of Science in Information Technology

**Year** : 2023-2024

Sign Language is the means for deaf people to communicate - they are more visually oriented people since most are deprived of the ability to hear and consequently, to speak in return. However, most non-deaf or ordinary people are incapable of communicating and understanding sign language. This study aims to develop wireless voice-generating gloves using Arduino that aid the deaf in communicating with normal people by translating signs and gestures into synthetic speech. In being able to do

feedback, a normal person's voice is transcribed into text as he/she presses the microphone button on the MIT App Inventor-developed mobile application named "FSL" before he/she speaks and then the text will display on the glove's attached 20x4 LCD Screen for the deaf user to be able to receive the former's response - two-way communication. The study envisions bridging the gaps in similar previous innovations for the beneficiary to benefit from the project fully. Through the quantitative method in the lens of the Technology Acceptance Model by Fred Davis(1989), a survey on Perceived Usefulness(PU) and Perceived Ease of Use(PEU) is administered to 20 respondents - Grade 7 and 8 deaf students of Parañaque National High School - Special Education Department(SPED), as well as Grades 5 and 6 deaf students of Las Piñas Elementary School Central - SPED. In the findings, to be able to perform in class better(e.g., assignments and projects) is the highlighted PU with the level of "Quite Likely," while the PEU level is also "Quite Likely" due to the newness of the technology to the students, which underlines that there is still some perceived difficulty in using it. The core purpose of this intervention is to aid young deaf individuals in seeing the bigger horizons they ought to see and to make them feel that they are never isolated or treated as outcasts in today's world equipped with technology.

*Keywords*: Arduino, MIT App Inventor, Deaf people, Sign Language, two-way communication

## ACKNOWLEDGMENT

The researchers give God the glory for leading this study. It is Him, the Author of Life, who has given the researchers strength, patience, and understanding that has allowed them to carry out the study and acquire the information they needed.

The researchers express gratitude and appreciation to the Computer Studies department for their guidance, knowledge, perspective, and professionalism, which will serve as their source of courage throughout this process. The researchers also want to extend their appreciation to Olivarez College Parañaque for allowing approval and giving them the tools they needed for this study.

The researchers want to take this opportunity to thank the students who participated in this research. Mainly the participants from Parañaque National High School in coordination with Mr. Gerry Lumaban, Principal IV, and Ms. Amy Alibangbang, LPT, as well as from Las Piñas Elementary School Central, in coordination with Mr. Joseph De Leon, Principal IV, and Mr. Eddie Valleta, LPT for their consideration and cooperation. Special thanks to Mrs. Tiopes, who accommodated the researchers in their humble abode; to the lead programmer of this project, John Syte L. Tiopes, and his father, Mr. Syte Tiopes, who have worked

together on building the device even when under pressure, and to the Co-researcher for helping one another out whenever a member is struggling with the task. With everybody's assistance and dedication, the researchers made the product by sharing efforts.

The researchers are grateful to their thesis adviser, Mr. Ricky G. Tablanda, and technical advisers, Mr. Francis Peñafuerte and Mr. Jayson Sariol, MIT, for their help and recommendations on the manuscript and the product. They have presented discussions and teachings that serve as a starting point for this investigation. The researchers also acknowledge the valuable input and effort of Mr. Jerry C. James, DPRO-SHS Assistant Principal, and our school statistician for being one of the validators for the betterment of the survey questionnaire, as well as to the untiring support given by Mr. Michael B. Caducoy, MBA, SPBE, our Quality Assurance Director for giving statistical treatment so as for this research to be validly presented in the research colloquium. Working and learning under their supervision was a great privilege. Additionally, The researchers would also want to extend their sincere appreciation to the panelists, Dr. Lyssander Rodan C. Dela Cruz, CPA, DBA, Dr. Estella G. Garcia, EdD, RN, MAN, LPT, and Mr. Dennis M. Quinto, MBA for their expertise,

feedback, insights, suggestions and contribution that will strengthen this study.

The researchers thank their classmates, families, and peers for their encouragement. They have given the researchers the courage, support, and determination required to finish this investigation.

**TABLE OF CONTENTS**

**Page**

## LIST OF APPENDICES

# LIST OF TABLES

# LIST OF FIGURES

## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| WLVocGenArG | Wireless Voice-Generating Gloves |
| FSL | Filipino Sign Language |
| TAM | Technology Acceptance Model |
| PU | Perceived Usefulness |
| PEU | Perceived Ease of Use |
| DepEd | Department of Education |
| PNHS-MAIN | Parañaque National High School-MAIN |
| LPESC | Las Piñas Elementary School Central |
| PSD | Philippine School For the Deaf |
| SPED | Special Education Department |
| OSA | Office of Student Affairs and Services |
| UX | User Experience |
| SD | Standard Deviation |

# Chapter 1

## INTRODUCTION

Verbal communication is the most used medium for the human person to connect, to society and the world. It is a basic skill and ability a person must have. Still, unfortunately, not all are given the capability, rather the "luxury" to communicate as a human being ought to be, thus making the human person co-exist with his fellow – verbally disabled people.

However, many research and development ventures are pursued in order to arrest the situation of the verbally disabled being virtually isolated from society – on how to easily translate gestures and signs to the language commonly understandable by non-disabled people.

Not so many "able" people are learning to communicate with sign language. By its nature, it is not easy to learn and to be received on both ends – learning sign language to communicate with the verbally disabled and reception of messages from normal people brings a hard time to the deaf and mute.

Most of the time, on occasions where public speech is delivered like the State of the Nation Address, homilies given by priests, or lessons given by teachers, the verbally disabled and auditory-impaired audience

are overlooked. Some of those events have people on their big screens to translate the words said by the host and the speaker into sign language and gestures.

However, the most effective solution is an apparatus that can act both as sender and receiver of a verbal message – a speaker that will translate sign language to speech, and a microphone that will translate spoken words into text, which will allow the verbally disabled to communicate effectively and clearly, by using a pair of intelligent gloves equipped with Arduino technology.

**Background of the Study**

In the capstone research entitled "Wireless Voice-Generating Arduino Gloves for Deaf People Used for Virtual Communication", the researchers are to develop a wireless pair of gloves that will serve both as a microphone for verbally-able people and as a keyboard and speaker for the verbally-disabled person.

Sign language is the way the deaf can communicate, even though some deaf people can understand through lip reading, most of them are incapable. To speak with fellow people, they would use sign language. In that aspect, each country and culture differ from one another. Concerning differences, verbally capable people, in turn, are to learn how to

communicate in sign language to socialize with the verbally disabled, which is quite an effort for the latter, that's why most of them opt not to, resulting in isolation for most of the deaf population.

Verbal disability is an absolute barrier to communication, and most non-disabled people are not adept at communicating through sign language. Somehow, people treat verbal disability as an avenue to make fun of the disabled without the latter's knowledge. In turn, they could not express themselves aside from writing and using sign language. At schools, churches, and establishments, there is a level of difficulty that exists for the deaf. Most deaf students rely on visual aids, lip reading, interpreter-aided instruction, and in particular, sign language practicing teachers. In turn, the deaf cannot fully express their emotions and thoughts – they are virtually isolated from society because of their impediment - which deters their ability to socialize.

To arrest those scenarios, these wireless voice-generating gloves are designed with additional features, such as signs and gestures-to-speech, and speech-to-text. Using Arduino Uno R3 with motion sensors, the gestures and signs – Filipino Sign Language will be translated to English speech, and as the non-disabled person gives feedback, his/her speech that was captured by the mini-microphone attached to the

membrane will be transcribed to text, which will be displayed at the screen near the membrane.

These functions will ensure effective and efficient communication that will give the verbally disabled a fair share of participating in the usual communication process without any barrier – making them communicable members of society.

Nowadays, just as how the lame can walk with robotic legs, this capstone project will give speaking abilities to the deaf and voiceless. This intelligent glove will be a new doorway for verbally disabled people to express and feel emotions just like any other human beings do – they can communicate, live life fully, and have the opportunity to study, work, and do things that can make a difference to the world.

**Review of Related Literature**

This is the presentation of related studies and articles that have similar concepts and research included in the study. The study focuses on the conceptualization of developing a wireless voice-generating glove using Arduino Uno for both input(sign language to speech) and output(speech-to-text) functions both as sender and receiver of verbal messages. Most of these related articles are data gloves that require devices to be connected but are the basis of the WVocGenArG.

***Impact of Deafness***

Being impaired in the most important and inborn tool that humanity uses to communicate can severely impact one's everyday life. According to a technical review by Ahmed, Zaidan, et. al(2018), the absence of speech and/or hearing ability can have significant psychological and social ramifications for the individual(s) affected, primarily stemming from communication challenges. This impediment causes a certain degree of alienation towards deaf people because it deters what is normally done in a person's routine – oral communication. Thus, the impediment itself becomes a barrier for them in the main social circle.

Likewise, seconded by the research of Baktash, Mohammed, and Farooq(2021), loss of hearing and/or speech is sometimes caused by car/work accidents, or some diseases or disorders. Psychological effects of the loss of function are imminent and can have a great effect on someone's well-being if left unaided. Speech and hearing mediums when it comes to relating to society, and loss of it can be a disaster to a person's social life.

According to the World Health Organization (WHO), unaddressed hearing loss incurs an annual expenditure of approximately US$ 980 billion, encompassing healthcare (excluding hearing devices),

educational support, productivity losses, and societal expenses—notably, a significant portion of these costs, approximately 57%, burden-low, and middle-income countries.

***Related Technological Interventions***

This kind of technology is new, yet has already been attempted and is always subject to experimentation, research, and innovations worldwide. Anggrellanggi and Sari (2023) demonstrated that educators instructing individuals with hearing impairments require the advancement of augmented reality (AR) enabled Digital Classroom Presentation and Support Resources (DCPSR) media that is user-friendly and accessible, such as smartphones equipped with enhanced features for audio, visuals, subtitles, and prompts. These mentioned aids are the mostly tapped ones for those people impeded in speech and hearing, which is vital for their education, awareness, and inclusion to the benefit of common knowledge.

On the other hand, Jensen, Chambers, and Wilson (2023) proposed that an examination of the significance of sound, and consequently, the impact of deafness in the field of tourism studies can result in a more sophisticated and discerning perspective on the diverse sensory abilities engaged in travelers' experiences of journeys. The researchers determined that in traveling, even devoid of having the senses

from mouth and ears, the deaf are to be aided to harness the fullness of their learning from the experience.

According to research by Rogers, Lovell, and Young (2023), deaf communities that use sign language encounter disparities in accessing healthcare services and achieving positive health outcomes. The implementation of telemedicine interventions could potentially serve as a remedy to mitigate these inequalities in mental health and other health-related services. Hearing disability is an absolute communication barrier, which can jeopardize the healthcare service catered to them as members of the patient population. Telemedicine can also be aided in many ways, and one of them is, of which, the goal of this study.

***Global Initiatives***

Sign language translation devices have also been tried in different parts of the world. An innovation by Barbour, Bitar, Alzamzami, et al. (2022), the foundation of this kind of project lies in an information technology(IT) intervention: a sophisticated two-way communication system known as Intelligent Gloves (IG). This innovative device is composed of a pair of gloves featuring flex sensors, an Arduino microcontroller, a screen with an integrated microphone, a micro-speaker, and an SD Card module. To establish connectivity with external devices

such as laptops, smartphones, and desktops, an Arduino HC-05 Bluetooth Module is incorporated. This integration allows the verbally impaired user to utilize the gloves as both a microphone for translating sign language into voice and a receiver that displays textual feedback from virtual meetings on the glove's screen.

However, the notable limitation of this prototype is its wired nature as a pair. The gloves are reliant on a single membrane, meaning that the other glove is dependent on its pair, which incorporates the membrane. Despite this limitation, it is crucial to acknowledge that the device's constraints serve as the core inspiration and theoretical framework of this study.

In the device made by Yudhana, Rahmawan, and Negara (2018), the flex sensor is a transducer that gauges the degree of curvature. Specifically, the flex sensor used in this project produces an output resistance value proportionate to its flexibility. The MPU6050, functioning as a gyroscope and accelerometer sensor, captures measurements related to Earth's gravity. Integrated into the gloves, these sensors play a pivotal role in detecting finger and hand movements and generating responses. It is through the collective input from these sensors that the system determines the translation of specific letters and numbers into speech.

Additionally, Katti, Sirsi, et. al.(2021) emphasized that a set of sensors attached to each finger on both hands enables the transmission of all gestures and motions to the gloves through sensor orientation. This comprehensive sensor setup facilitates accurate and nuanced interpretation of the user's hand movements, enhancing the overall effectiveness of the Intelligent Gloves.

In a similar intervention, Singh, Sahai, Lodhi, and Chaudhary (2023) briefly reviewed smart gloves equipped with sensors like the flex sensor, MPU6050 gyroscope and accelerometer, and touch sensor each designed to detect various sign language gestures. Flex sensors, positioned on the fingers, gauge finger bending in response to specific gestures. An accelerometer, situated on the palm, records the hand's location along the X, Y, and Z axes. Touch sensors, placed between the fingers, determine whether there is any contact between them. The information collected by these sensors is transmitted to an Arduino UNO board for processing, and then the data is sent to an Android phone via a Bluetooth module. The received data is in text format, which is subsequently converted into speech using the Google Text-to-Speech converter.

***Local Innovations***

In 2022, researchers at the Mapua Institute of Technology conducted a study to create the initial version of a glove capable of converting Filipino Sign Language into text through the utilization of the K-Nearest Neighbor (KNN) algorithm. This prototype is portable and relies on an Android device to showcase real-time translations of gestures captured by the glove's technology.

In 2021, the Central Asian Journal of Mathematical Theory and Computer Sciences published a journal about a real-time web-based sign language-to-text converter application named “Speak the Sign” developed by 5 high school students in Kalibo, Aklan. This application aimed for the non-deaf to learn Filipino sign language and to know its importance as well as to understand it more in an excellent fashion.

In 2021, 7 Electrical Engineering students from Camarines Sur Polytechnic Colleges wrote a thesis titled "Voice Conversion from Filipino Sign Language," introducing a pair of gloves that can be trained to interpret Filipino sign language and transform it into spoken words. The first of its kind in the Philippines, yet, the limitation is that it is also dependent on a mobile phone/laptop which is included in the input-

process-output (IPO) of the device for it to display the output(sound and text) from the translation and transcription.

***Future Directions***

These breakthroughs can lead in a direction where all researchers are to be fully capable of aiding the speech and hearing impaired to communicate effectively, becoming such in living their lives whether in school, career, or opportunities that may come. The Sign-IO gloves are equipped with sensors on each of the five fingers, enabling the detection of finger movements, including the degree of finger bending. Those gloves are linked through Bluetooth to an Android application, also created by Allela (2019), which employs a text-to-speech feature to transform the captured gestures into spoken words.

Zaki (2023) developed a glove outfitted with sensors to recognize diverse sign language gestures. The information from these sensors is transmitted to an Arduino and then transferred to an Android phone through Bluetooth. In that project, a typical Android phone is employed for translating sign language to voice and vice versa.

A 2023 editorial of Education and Information Technologies featured that sign language serves as the innate mode of communication for individuals with speech and hearing impairments. As written by R.

Sreemathy, Mousami Turuk, Isha Kulkarni, and Soumya Khurana from the Pune Institute of Computer Technology, India, the utilization of an Indian Sign Language (ISL) interpretation system enables those with hearing impairments to engage in interactions with individuals who have normal hearing through the aid of Human-Computer Interaction (HCI).

In a study by Yeratziotis, Achilleos, Koumou, et.al (2023), the "Accessible System and Social Media Mobile Application for Deaf Users (ASM4Deaf)" facilitates the integration of deaf individuals into social media platforms. This was accomplished through: 1) the creation and implementation of the ASM4Deaf system, featuring the Connect Deaf mobile application that enables the use of Sign Language Alphabet keyboards in social media applications supporting 17 different sign languages, and 2) the assessment of Low- and High-Fidelity prototypes designed to improve the app's design and functionality. This includes the capability to browse, search, and edit animated videos/GIFs in American Sign Language (ASL) using the face-swapping feature.

Most of these IT interventions are dependent on mobile devices and applications, limited in their scope of functionalities, though all of them are already aiding the deaf to communicate effectively and have the same quality of life enjoyed by the non-deaf.

In spite of advancements in hearing technology and the availability of research findings and early intervention guidelines, Clark, Cue, and Delgado (2020) stated that deaf children often do not reach language milestones corresponding to their age. This discrepancy in language development underscores the existing disparities between research findings and practical application. Recent studies indicate that implementing bimodal bilingual early interventions to identify deafness can establish language foundations for children, potentially yielding more favorable outcomes. Children are the most vulnerable members of the population, that's why one of the primary goals of this project is to improve the young deaf people's quality of life. Moving forward, there is a need for continued research and development in the field of assistive communication technology. By exploring new methodologies, improving existing solutions, and fostering collaboration among stakeholders, we can work towards creating a more inclusive society where individuals with verbal and auditory disabilities can fully participate and thrive.

***Acceptance of New Technologies***

According to Marikyan and Papagiannidis(2023), Fred Davis proposed the Technology Acceptance Model in 1989 to project future technological behavior and provide a theoretical justification for practical

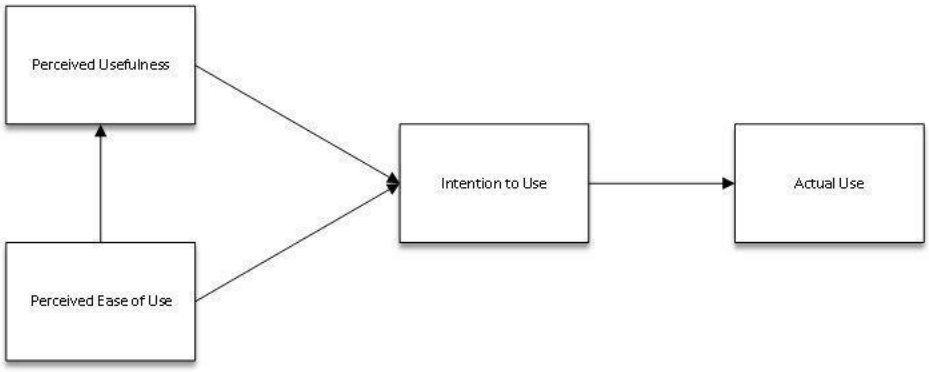
implementation. This is for supporting future innovations brought forth, especially by technology to different types of people and sectors of society.

According to a comparison made by Dr. James R. Lewis, Ph. D. (2019), the TAM used a seven-point answer scale, from "Extremely Likely" to "Extremely Unlikely," organized from left to right, to measure the likelihood of technological adoption. To capture user experience (UX), these items were changed from assessing likelihood to measuring agreements. Using one of four questionnaire variants, 546 respondents evaluated their experience with IBM Notes in the poll made by Lewis' comparison of 4 TAM formats.

In response to the shift to virtual education prompted by the COVID-19 pandemic, Silvestre, Miranda, and Gutierrez conducted a study in 2022 to identify the key factors influencing students' intention to use virtual classrooms. The study was based on Park's modified 2009 Technology Acceptance Model, incorporating factors such as Attitude, Perceived Usefulness, Perceived Ease, Virtual Self-Efficacy, Subjective Norm, and System Accessibility. They surveyed 1260 students from 13 universities in the Dominican Republic.

## Theoretical Framework

***Figure 1. Technology Acceptance Model***




The researchers used the first model of the *Technology Acceptance Model* by Fred Davis(1989) for this study. The technology acceptance model breaks a project into stages to determine its user's intention for actual use. It solicits development progress and continuous consultation and tests with the respondents. The cycle of planning, testing, and evaluation will begin as certain tasks of this project commence, with due collaboration with the respondents.

The main goal of TAM was to illuminate the mechanisms that support the adoption of technology, to forecast the actions, and to offer a theoretical rationale for the effective integration of technology, by determining the user experience(UX). Upon gathering the UX, the

researchers will be able to discuss the Attitude towards Use and the Behavioral Intention to Use to enhance the device to be fit for actual use.

In support of this developmental study, acceptance of the technology is vital when it comes to innovations, interventions, and developments especially when it involves people who will use it on a regular basis. Wireless Voice-Generating gloves are still considered a novelty, and even the deaf population has different opinions on using such technology.

The technical theory with regards to the device is the innovation of Babour, Bitar, et. al. (2023), where both modules - sign language-to-speech translation and speech-to-text transcription are designed to work hand-in-hand with each other in one device(as shown in Figure 2), controlled by a mobile phone via Bluetooth.

To address the common inefficiency where doubt on this kind of technology arises, the primary aim of this study is towards the development of wireless voice-generating gloves for the deaf where the following technical problems/limitations are to be solved:

1) How will the deaf people receive the message from the non-deaf?

2) How can the wireless voice-generating glove function without being connected to a device (e.g. desktop, laptop, or phone) first unless for online meetings and calls?
3) Microphone and screen for transcribing the non-deaf's speech – what module can be used for that?

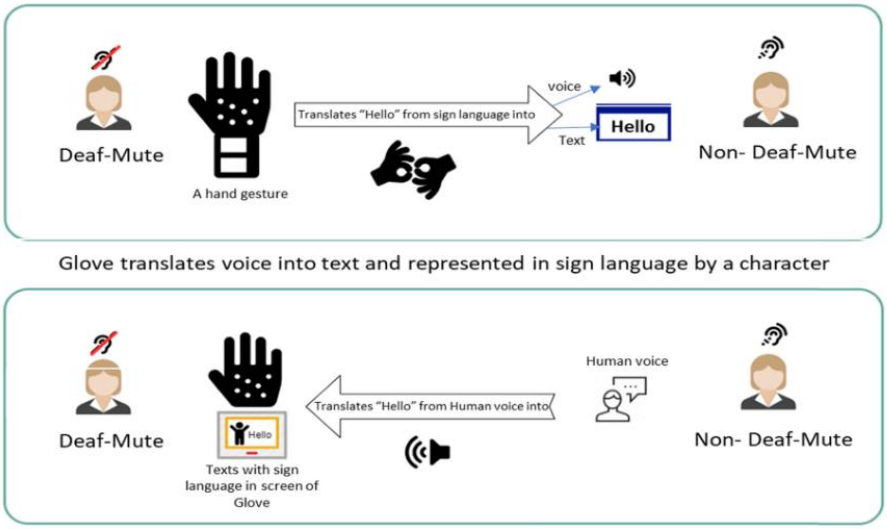
Whereas, those technical gaps once bridged, are to address the following problems of the deaf:

1. How can wireless voice-generating Arduino gloves effectively address the communication challenges faced by deaf and mute individuals in virtual communication environments?
2. What are the technical specifications and components required to develop these gloves, and how can they be optimized for usability and affordability?
3. Why is a wireless solution preferable for these gloves in virtual communication?

## Conceptual Framework

***Figure 2***

***Concept Diagram***

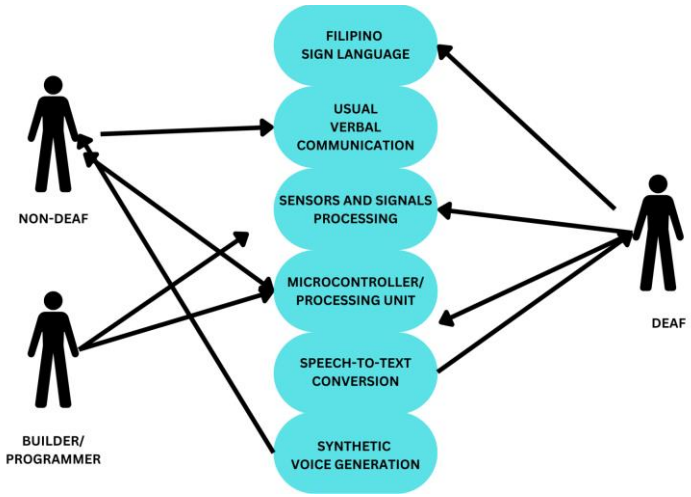



The study is rooted in the recent intervention brought forth by Barbour, Bitar, et. al. (2023) on the first device with considerations on two variables in technology when it comes to communication – text-to-speech,(TTS) and speech-to-text technology. However, sign language is the primary means of deaf communication, which was added by the former to the technological intervention of Babour – Sign language-to-speech and Speech-to-text Transcription.

According to Barbour, Bitar, et. al(2023), deaf individuals communicate through sign language gestures, translated into audible voices and sentences for non-deaf individuals using a specialized tool. This enables interaction between both groups, as non-deaf individuals can speak into the device, which then converts their speech into on-screen text and sign language movements via an avatar. Both parties can initiate conversations at any time, and the device promptly displays the corresponding output as shown in Figure 2.

***Figure 3***

***Use Case Diagram***

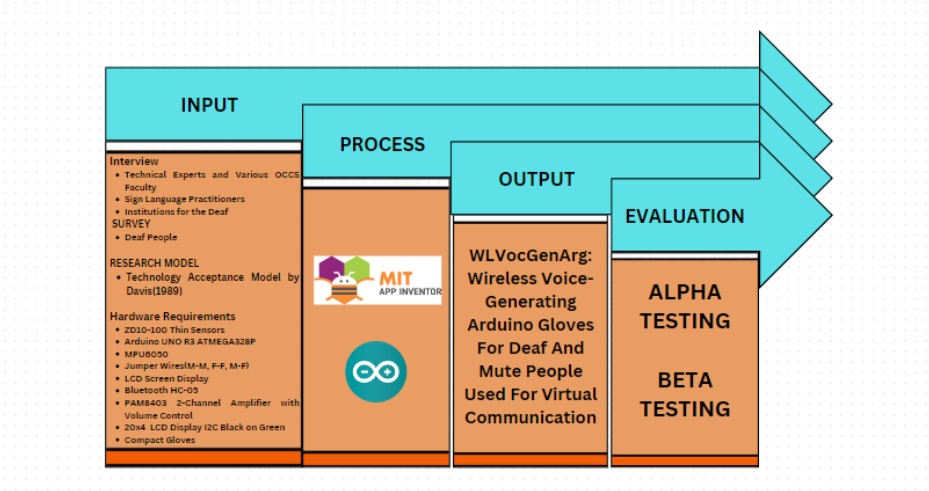



This diagram shows the actors: The user (deaf, on the right), and the non-deaf(left), where only verbal communication is his tool for the

function of speech-to-text conversion to make feedback possible once the user takes on the gloves, do Filipino Sign Language, then the gloves generate a voice, which is the verbal translation of the former. Beforehand, the builder/system architect and programmer have made all the features of the device(eg. Speech-to-text conversion and Sign Language translation to speech) built-in on the Arduino R3 microcontroller.

**Figure 4**

**Input-Process-Output Model**




The input-process-output (IPO) model is used as the study's guide to build and construct Wireless Voice-Generating Arduino Gloves specifically designed to allow its user(deaf) to input sign language to be

translated to English speech, and on the non-deaf end, to input speech and to be transcribed into text on the screen attached, with the application made from MIT App Inventor to be the reception and feedbacking control of the device.

The visual representation of the research, methods, software, hardware, and knowledge prerequisites that the researchers have to acquire to develop the system are included in Figure 4.

**Statement of the Problem**

The Wireless Voice Generating Arduino Gloves for Deaf and Mute People Used for Virtual Communication are to answer the following statement(s):

1. Demographic profile:

   -School

   -Grade Level

   -Means of communication, information access, and how they understand the lesson during instruction sessions

   -Use of Speech-to-text services?

2. Determine the target user's level of Perception of Usefulness(PU) on the Wireless Voice-Generating Arduino Gloves upon beta testing.

2.1. Does this technology help facilitate better involvement in class activities such as recitation and discussion?

2.2. Do you think using this technology enables you to participate in individual/group reporting better?

2.3. Do you find this technology helpful in facilitating better communication with your classmates and teachers?

2.4. Does using this technology promote proficiency in doing homework or projects?

2.5. Do you believe this technology helps you to boost your confidence as a person and student?

3. Determine the target user's level of Perception of Ease of Use(PEU) on the Wireless Voice-Generating Arduino Gloves upon beta testing.

3.1. Is learning to use this technology easy for you?

3.2. Does using this technology feel effortless to you when it comes to communication?

3.3. Can you become skilled at using this technology without much difficulty in understanding and clarity of its use?

3.4. Would you easily remember how to use this technology?

3.5. Does using this technology feel mentally challenging or easy for you?

4. Evaluate the Wireless Voice-Generating Arduino Gloves by its users under beta testing to determine whether the system meets the main objective – the user's intention for actual use.
5. Enhance the Wireless Voice-Generating Arduino Gloves based on the users' feedback for the device to be fit for actual device use.

**Scope and Limitations**

***Scope***

The scope of the study is carried out at Olivarez College during the school year 2023-2024, the participants are deaf students from Parañaque National High School(PNHS) and Las Piñas Elementary School Central. The device, which has a 20x4 LCD screen, connected to a mobile phone application(FSL) via Bluetooth will perform both sign language translation to speech and speech transcription that will effectively aid both the deaf person and the non-deaf counterpart in the ordinary communication process. This device has the feature of

translating the alphabet(A-Z), and 10-20 words and phrases commonly used in everyday communication in school and home.

***Limitation***

The device's limitations are that (1)the gloves are to be connected to a mobile phone via Bluetooth, (2)there is a certain distance(maximum social distance: 4ft) of the speaking person to the device in order to transcribe his/her words, (3)can only translate into speech around 10-20 words, can be more than that words but not more than 30, and not the whole English dictionary is included for the speech translation, (4) Filipino Sign Language is only translated into American English speech, and (5) the accelerometer and gyroscope(MPU6050) can only read the hand movements, not facial expressions. Due to the invincible complexity of the subject for Grades 4 and lower levels, only Grades 5 and 6 are to be the respondents of this research at the elementary level.

**Significance of the Study**

The purpose of this device is to use Arduino to aid both the non-deaf and, above all, the deaf people in participating in the communication process effectively. Also, to prevent the communication barriers between the non-deaf and the deaf. Without any other device, this can conveniently

be used by a verbally/hearing impaired anytime, anywhere – school, home, or work, like non-deaf people.

**Local Government**

This breakthrough can help local government units to find suitable solutions not just for the deaf, but also for other people afflicted with various disabilities(eg. blindness, ALS, etc.). Thus, provide more funding for this venture for the welfare of this particular group of PWDs (persons with disabilities).

**Students**

Once implemented and tested by deaf students from Parañaque National High School and the Philippine School For The Deaf, this can be a tool for them to do better in school, especially in performance tasks.

**Deaf People**

This can be a tool for opportunity that can be used by all deaf people nationwide. It will help many deaf people at least in MuntiParLas(Muntinlupa, Parañaque, Las Piñas).

**Special Education Teachers**

The device can aid the teachers, especially for the deaf, to facilitate the learning of these students better and boost their excellence not just in

class, but also in their communication skills which will contribute to one's overall well-being.

**Researchers**

This can be the first of its type in the institution, and the study can expand both their experience in information technology and in addition social sciences.

**Future Researchers**

Once finished, researchers not just from IT but from the social sciences and education department can make this study a reference, especially if any involves the youth in Special Education(SPED) sector.

**Definition of terms**

The following terms are defined in this study:

***Arduino IDE***

- an open-source IDE software used to program Arduino boards

***Arduino UNO R3***

- a microcontroller board based on ATmega328P

***Battery 9-volt***

- a rectangular dry cell differentiated with its 48.5mm x 26.5mm x 17.5mm dimensions and one-sided clasp terminals.

***Breadboard***

- Plastic block holding a matrix of electrical sockets of a size suitable for securing jumper wires, other component wires or the pins of transistors and integrated circuits (ICs). The sockets are connected inside the board, usually in rows of five sockets.

***Deaf person***

- a person who is usually verbally and/or auditory impaired; unable to hear and/or speak

***Jumper Wires***

- wires that have connector pins at each end, making them usable to connect two points without soldering

***Non-deaf***

- normal people who can speak, hear, and communicate ordinarily

# Chapter 2

# METHODOLOGY

The research method of Wireless Voice-generating Arduino Gloves For Deaf People Used For Virtual Communication is based on the Technology Acceptance model by Davis(1989). The technical part, which is the development phase, is divided into two parts: hardware architecture and system integration.

## Research Design

The researchers used quantitative, descriptive and developmental research designs. The survey questionnaire to be distributed after the device's demonstration is the quantitative part. The developmental aspect is that the researchers built a device and an application from MIT App Inventor for speech recognition and FSL translation. The descriptive aspect - concerning the Technology Acceptance model is that the researchers will demonstrate the device to the students, and the results from the survey will be the description of their level of acceptance of the demonstrated product. The initial feedback will be used for the betterment of the device during the duration of the study in determining the Wireless Voice-Generating Gloves' functionality on reception and feedbacking, as well as the experience(UX) of the respondents with the device.

**Population and Sampling**

Purposive sampling is the researchers' approach to get samples under these 3 inclusion criteria: 1) impaired in hearing, but not in speech; 2) impaired in speech, but not in hearing; and 3) impaired in both hearing and speech – generally referred to as the deaf.

This will help the researchers to obtain a representative sample of the target population, which will be the overall beneficiaries and users of the wireless voice-generating Arduino gloves. The samples will be obtained from locales of Philippine School For the Deaf and Parañaque National High School which made the ages between 11-12 and 13-18 as a sample criterion which will gauge the effectiveness of the device for all ages.

**Respondents**

The primary participants are around 20 deaf students of Parañaque National High School and a total of 5 Grades 5 and 6 deaf students from Las Piñas Elementary School Central. Other possible participants from the Philippine School for the Deaf are to be added as the research continues.

**Table 1**

*Total Enumeration Count for Deaf Students of Parañaque National High School - Special Education Department*

| Grade Level | Number of Deaf Students |
|---|---|
| Grade 7 | 6 |
| Grade 8 | 9 |
| Grade 9 | 2 |
| Grade 10 | 0 |
| Grade 11 | 1 |
| Grade 12 | 2 |
| Total No. Of Respondents | **20** |

**Table 2**

*Total Enumeration Count for Grades 5 and 6 Deaf Students of Las Piñas Elementary Central - Special Education Department*

| Grade Level | Number of Deaf Students |
|---|---|
| Grade 5 | 2 |
| Grade 6 | 3 |
| Total No. Of Respondents | **5** |

**Research Instrument**

Researchers primarily used the questionnaire based on the Technology Acceptance Model by Fred Davis(1989) which determined the perceived usefulness and ease of use for the WLVocGenArG as the device, as well as the participants to go on with the study and the further development of the device. Demographic profiles, particularly on their Grade Level and School, including an inquiry into the prior IT interventions. The survey part of the questionnaire is divided into two categories, following Davis' 1989 model:

- *Perceived Usefulness(PU)* - the level/degree to which a subject believes utilizing a proposed product/technology would benefit.

- *Perceived Ease of Use(PEU)* - the level/degree on which a subject perceives using a proposed product/technology will not be complicated.

**Alpha Testing**

The essential part of any development process in technology is called alpha testing. This is an important procedure where a proposed system/prototype is assessed on its performance and to identify room for improvement. In this capstone project, alpha testing involved presenting the Wireless Voice-Generating Gloves to some IT instructors and professors for review. They were to evaluate the device, starting from functionality to design. Through their input, the external design of the Gloves is made better and to make the end user comfortable and efficient in using it.

**Data Gathering Procedure**

The researchers will communicate with the point personnel Philippine School For the Deaf(OSA) and Parañaque National High School(SPED Faculty) followed by sending a permission letter to the School Heads to gather information and constant communication with the selected students - together with a parental consent form - for the study – testing, evaluation, and enhancement. Evaluation(survey) is done through

the TAM questionnaire to be filled up with at least ¾ of the majority of participants from the target population from each school after the device is demonstrated to them and had an experience of using it. This TAM study is divided into two categories, and Likert scale-like responses between “Extremely Likely” and “Extremely Unlikely”.

**Data Analysis**

For the responses, PU and PEU are made into a Likert scale to be the framework rate. These are the tools utilized for analyzing the data the researchers gathered:

1. **The Likert Scale** is utilized following the recommendations of the questionnaire validators for better analysis of data. Through this, the subject responds to the questions on a scale of 1 to 7.
2. **The weighted mean** is the average derived from the responses of the subject per question and per category. Here is the weighted mean formula:

$$W = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i}$$

Where:

$W$ = weighted average

$n$= no. of terms to be averaged

$w_i$ = weight applied to values $X_i$

$X_i$ = raw data values

3. **SPSS(Statistical Package for Social Sciences)** is used for faster data computation and analysis. SSPS is a software platform that has features which researchers use to extract information from raw data. It performs vast and advanced statistical analysis on raw data in files, particularly Excel files.

# Chapter 3

## PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

Here presented is the result from both beta testing and the survey proper, wherein all data from the questionnaire is displayed and represented. This representation is divided into two parts: visual interpretation of the results of beta testing and visual interpretation of the results of the survey proper, though the results are the same.

### Beta Testing

Beta Testing is the final round of testing where the target end user population uses a proposed product to uncover any technical issues or bugs before a product launch, thesis defense, or general release. Beta tests are either open for anyone to use, or closed for limited user(s). For this beta test/survey proper, the researchers conducted closed testing, where only one subject from the population is selected to use the product in front of the audiences, who are also the target population.

### Survey Proper

The survey proper was conducted in the Special Education Department of the Parañaque National High School, attended by 15 deaf students - six(6) Grade 7 students and nine(9) Grade 8 students, as well

as in the same Department of Las Piñas Elementary School Central, attended by 5 total deaf students from Grades 5-6.

**Representation of Respondents in Survey Proper**

**Table 3.**

*Demographic Profile of the Respondents*

| **Profile of Respondents** | **Full Sample** | |
|---|---|---|
| | n | % |
| ***School*** | | |
| Parañaque National High School | 15 | 75.0 |
| Las Piñas Elementary School Central | 5 | 25.0 |
| ***Grade Level*** | | |
| Grade 5 | 2 | 10.0 |
| Grade 6 | 3 | 15.0 |
| Grade 7 | 6 | 30.0 |
| Grade 8 | 9 | 45.0 |

| | | |
|---|---|---|
| ***Means of communication, and information access*** | | |
| Sign Language (FSL/ASL) | 7 | 35.0 |
| Cued speech supported by lip reading | 1 | 5.0 |
| Uses hearing aid/ear implants to hear spoken language | 7 | 35.0 |
| Lip Reading, along with other communication approaches | 3 | 15.0 |
| Using Mobile Phone | 1 | 5.0 |
| Other | 1 | 5.0 |
| ***How do they understand the lesson during instruction sessions?*** | | |
| Wears hearing aid/ear implants all the time | 4 | 20.0 |
| Visual aids provided by the instructor/speaker. Videos have CC (closed captions) | 7 | 35.0 |
| The teacher interprets/has an interpreter by his/her side. | 3 | 15.0 |
| Lip-reading | 1 | 5.0 |
| Sign Language and remembering them | 3 | 15.0 |
| Focuses on the Instructor | 1 | 5.0 |
| Others | 1 | 5.0 |

| ***Use of Speech-to-text-services*** | | |
|---|---|---|
| Yes | 17 | 85.0 |
| No | 3 | 15.0 |

*Note: N=20*

Here in Table 2, shows the demographic profile of the respondents. Most respondents were from Paranaque National High School (75.0%). Most were Grade 8 students (N=9; 45.0%). When asked about their means of communication and information access, 7 (35.0%) reported that they used sign language; when asked how they understand the lesson during instruction sessions, (N=7, 35.0%) reported visual aids are provided by instructors or speakers and videos have closed captions. Lastly, most answered yes (85.0%) regarding speech-to-text services. According to a document published by the University of Florida in 2017, residual hearing and spoken English that is received via the ear is known as auditory communication. This ability to understand sound is frequently improved with the use of a cochlear implant or hearing device.

Here is also shown that the majority of the population relies on the visual aids provided by their instructor, and the videos being played during room discussions have closed captions(CC). According to a document produced by Auburn University, Alabama, it is advisable to use

visual aids whenever possible because deaf students rely on focusing directly on what is the subject in front of them and it doesn't allow them to look away, let alone take down notes. In an article written by Julian(2020), a Secondary School Teacher III of Bataan National High School, the teachers of SPED can provide the course digitally or virtually, or they can utilize a PowerPoint presentation to explain the material. modules, or even worksheets, charts, and other visual aids that will call for more reading comprehension than listening. Teachers of students with hearing impairments must set up the chairs in a circular pattern so that their students may better understand the lesson and view all of their peers face to face. For these pupils, one-on-one or tailored training is the most beneficial approach. However, the majority of teachers who work with students who have this kind of handicap are required to complete sign language training, which can be very beneficial to both the teacher and the pupils.

All of the respondents also stated that they have used speech-to-text services, but didn't specify which kind of service they have used.

**Table 4**

**Likert Scoring Range**

| Scale | Mean Range | Remarks |
|---|---|---|
| **7** | **6.17 - 7.02** | **Extremely Likely** |
| **6** | **5.31 - 6.16** | **Quite Likely** |
| **5** | **4.45 - 5.30** | **Slightly Likely** |
| **4** | **3.59 - 4.44** | **Neither** |
| **3** | **2.73 - 3.58** | **Slightly Unlikely** |
| **2** | **1.87 - 2.72** | **Quite Unlikely** |
| **1** | **1 - 1.86** | **Extremely Unlikely** |

The formula for this mean range is:

x - y = z

z / x = a

y(lowest value) + a = $Y_a$(first higher limit)

$Y_a + 0.01 = Y_{ba}$ (next lower limit)

$Y_a + a = Y_{bb}$ (next higher limit)

The process repeats until the highest value limit

Where:

x = highest value

y = lowest value

z = range

a = range/highest value(total number of values)

**Table 5**

**Standard Deviation Scoring Range**

| SDI value | Interpretation |
|---|---|
| **0.0** | Perfect comparison with a consensus group |
| **lower than or equal to 1.25** | Acceptable |
| **1.25 - 1.49** | Acceptable to marginal performance. Some investigation of the test system may be required. |
| **1.5 - 1.99** | Marginal performance. Investigation of the test system is required. |
| **greater than or equal to 2.00** | Unacceptable. Remedial action is usually required. |

*Reference: Standard deviation index (SDI). (n.d.). https://unityweb.qcnet.com/Documentation/Help/UnityWeb/399.htm*

**Table 6**

*Respondents' Level of Perception on Usefulness*

| Indicators | Mean | Verbal Interpretation |
|---|---|---|
| **Perceived Usefulness** | **5.77** | **Quite Likely** |
| 2.1.1 Technology helps facilitate better involvement in class activities such as recitation and discussion | 6.00 | Quite Likely |
| 2.1.2 Technology enables to participate in individual/group reporting better | 5.90 | Quite Likely |
| 2.1.3 Technology helps facilitate better communication with classmates and teachers | 5.40 | Quite Likely |
| 2.1.4 Technology promotes proficiency in doing homework or projects | 6.05 | Quite Likely |
| 2.1.5 Technology helps to boost confidence as a person and student | 5.50 | Quite Likely |
| *Note. 7.02-6.17 – Extremely Likely, 6.16-5.31 – Quite Likely, 5.30-4.45 – Slightly Likely, Neither – 4.44-3.59, Slightly Unlikely – 3.58-2.73, Quite Unlikely – 2.72-1.87, Extremely Unlikely – 1.86-1.00* | | |

Table 2 shows the respondents' perception of the usefulness of the wireless voice-generating Arduino gloves during beta testing. The overall mean score for perceived usefulness is 5.77, interpreted as "Quite Likely,"

which confirms that the respondents perceived the gloves as useful for their involvement, participation, and better communication in class activities.

Here are also shown the responses on PU, which as the researchers observed, as diverse when it comes to their perception of the product, which will reflect on how they intend to use it - proficiency in doing their homework, projects, and overall performance tasks in school. The PU's mean overall mean score is 5.77, which matches to Quite Likely, while the overall standard deviation score is 1.058. This result agrees with Marikyan and Papagiannidis'(2023) theory on Fred Davis' TAM in the field of information systems. The table's projection above, it is shown that they perceived that the product will aid the students on a personal aspect and has a significant level of effectiveness on academic variables, except for its central function - better communication. As concluded by Rodriguez-Correa, et. al(2023), several studies on inclusive technologies conducted in the last few years have looked into how oral communication skills are developed. Consequently, a significant number of technologies that support speech rehabilitation, lip movement detection, and hearing enhancement are based on cochlear implants and other devices. Given the significance of learning processes at this stage of life following what

Flórez, Aristizábal et al. (2017) noted that there is an obvious need to carry out more research and develop new technologies that encourage the use of sign language and ICTs in educational contexts, especially for young people.

**Table 7**

*Respondents' Level of Perception on Ease of Use*

| **Indicators** | **Mean** | **Verbal Interpretation** |
|---|---|---|
| **Perceived Usefulness** | **5.70** | **Quite Likely** |
| 3.1.1 The technology is easy to use | 5.85 | Quite Likely |
| 3.1.2 The technology feels effortless when it comes to communication | 5.90 | Quite Likely |
| 3.1.3 Using the technology can become skilled without much difficulty | 5.30 | Quite Likely |
| 3.1.4 Using the technology makes easily to remember to use | 5.55 | Quite Likely |
| 3.1.5 The technology feels mentally challenging | 5.90 | Quite Likely |
| *Note. 7.02-6.17 – Extremely Likely, 6.16-5.31 – Quite Likely, 5.30-4.45 – Slightly Likely, Neither – 4.44-3.59, Slightly Unlikely – 3.58-2.73, Quite Unlikely – 2.72-1.87, Extremely Unlikely – 1.86-1.00* | | |

Table 3 shows the respondents' perception of ease of use of the wireless voice-generating Arduino gloves during beta testing. The overall

mean score for perceived ease of use is 5.70, interpreted as “Quite Likely,” which confirms that the respondents perceived the ease of use of this technology, feels effortless, and can make them skilled.

In this table, the researchers observed that there is a significant diversity, especially in the understanding, clarity, and remembering how to use and operate the proposed product, which proves Fred Davis(1993) the fact that “even though perceived ease of use does not directly affect the use behaviour, it underpins perceived usefulness”, which supports and justifies the level of usefulness perceived by the population.

The limitations on the number of respondents are due to the high heat index and suspensions of face-to-face classes in Pasay City, which hindered both the researchers and respondents from the Philippine School For the Deaf in conducting a survey demonstration, where the majority of the population is present. However, the communication of the researchers with PSD-OSA is continuous. Another 5 respondents from Parañaque National High School didn’t attend the session on the day of the survey and demonstration.

**Discussion**

In brief, the population's perception of the usefulness of the WLVocGenArG varies from person to person, depending on their awareness and knowledge of technology, as well as their ability to adapt to new technologies that could potentially help them or make it more difficult for them. They particularly believe that the product will benefit them when it comes to homework, and projects, which comprise overall performance tasks a student must accomplish at school.

According to Marikyan and Papagiannidis(2023), perceived usefulness is the individual's perception of a proposed technology's capacity to improve his/her performance, which matches their belief that the product can help them in their school work. On the other hand, the population's perception of ease of use also varied from person to person, and some, of the researchers observed that it looked quite easy to understand and remember how to use it. Also, they believed that the product could feel effortless for them when it comes to communication.

This reflects that whenever a new technology is introduced to a certain population, it is also implied that if an application/product is anticipated to be easy to use, the more likely it is that it will be considered

useful for them and the more chances that this will stimulate acceptance of the technology(Davis, 1989; Davis, 1993).

In response to the conclusion of the intervention proposed by Barbour, et. al (2023), which is a pair wired to each other, the researchers made it to a single-hand, where the screen and the Arduino R3 microcontroller are integrated, while the speech recognition is integrated to the MIT App Inventor-made “FSL” mobile application where the sign language is translated into voice and text appearing to the phone app, while on the non-deaf’s end, translating his/her spoken language into text transcript that will appear on the 20x4 LED Screen on the gloves. Furthermore, other interventions have their limitations, such as sign language to text transcription with a phone but without a voice(Linsangan, et. al., 2022) and using only single-hand gloves, like this product. All in all, in this intervention, the Wireless Voice-Generating Gloves are designed to be effective for two-way communication, comfortable, convenient, effective and easy to use.

# Chapter 4

## SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The ability to communicate is an essential practical skill a person can have to ensure a better life and to be successful in his/her endeavours. Many technological interventions have arisen to address these impediments, but there are still some limitations on which the majority of the deaf population relies on - two-way communication. Others are experiencing difficulties in using these technologies such as the price or their adaptation to a new device, which defeats the purpose of making things simple and convenient. However, no product/application can fully supplement the ability to speak and hear but can assist them in speaking and hearing what is said to them. Wireless Voice-Generating Gloves aim to make it easy to use, and comfortable, and to make it useful for everyday life.

### Findings

1. In the survey proper, the researchers had a total of 20 respondents - six(6) Grade 7 and nine(9) Grade 8 deaf students of PNHS

Main-SPED, two(2) Grade 5 and three(3) Grade 6 deaf students of LPESC-SPED.

2. In the survey proper, the majority of the respondents answered that they have used speech-to-text services.

3. Most of the respondents used hearing aids/ear implants to hear spoken language.

4. Most of the respondents believed that WLVocGenArG would be useful for their homework and projects(which comprises Performance Tasks in the DepEd Grading System), getting the highest mean score of 6.05 in the Perceived Usefulness.

5. WLVocGenArG's Perceived Usefulness(PU) overall mean Score is 5.77, with an SD of 1.058, which interprets "Quite Likely".

6. WLVocGenArG's Perceived Ease of Use(PEU) overall mean score is 5.70, with an SD of 1.264, which interprets "Quite Likely".

7. An effective app that facilitates two-way communication is a necessity for this kind of technology - Can translate the recognized speech into text accurately.

**Conclusions**

1. The faculty members who helped facilitate our survey stated that the deaf students of PNHS MAIN SPED needed the gloves.

2. There are varied perceptions of this kind of technology, especially regarding usefulness, understanding, clarity, and remembering how to use it.

3. Most of the respondents wore hearing aids/ear implants.

4. Younger deaf people are open and curious about this new kind of technology, which made them anticipate that this could be useful and, when learned how to use it, would be effortless when used in communication.

5. The goal of the product is to make communication two-way for the deaf - to be able to translate sign language into gestures and be able to transcribe spoken words, being controlled by a mobile phone application via Bluetooth.

6. The overall perception of the deaf students on this technology varies depending on their adaptability to technology as well as on their sole purpose of using the Wireless Voice-Generating Gloves.

**Recommendations**

The following recommendations and suggestions are made after a thorough examination, consideration, and conclusion:

1. The device can possibly be integrated into one - a louder but smaller speaker/amplifier and Arduino microphone may be attached for future modifications by the next researcher.
2. More institutions are to be reached by this technological intervention, but using the same model(TAM) is advised.
3. Mobile applications can be developed for the Wireless Voice-Generating Gloves so that they can be controlled better and make communication easy for the end user, especially the speech recognition feature.
4. Future developers can add more features such as machine learning, where a device can recognize an object via pattern recognition, which will automatically create a dictionary for every gesture the end user makes.
5. Instead of Arduino R3 which makes the gloves bulgy and big, modifications to be made by the researchers can use ESP8266 WiFi module and Arduino Nano, with Bluetooth HC-06 for faster device connection, in order for the device to look smaller and more

convenient, can connect to wifi, and can connect easily to any mobile device(eg. Phone, Laptop, PC) that has a Bluetooth Module, making it more portable and handy.

## REFERENCES

ABS-CBN News (2021) Gloves na Kayang Mag-convert NG PH Sign Language SA Boses, Binuo ng Ilang Estudyante, ABS-CBN News. Available at: https://news.abs-cbn.com/news/07/02/21/sign-language-gloves-students-camsur (Accessed: 29 February 2024).

Ahmed, M. A., Zaidan, B. B., Zaidan, A. A., Salih, M. M., & Lakulu, M. Mb. (2018). A review on systems-based sensory gloves for sign language recognition: State of the art between 2007 and 2017. Sensors, 18(7), 2208. https://doi.org/10.3390/s18072208

Anggrellanggi, A., & Sari, E. K. (2023). Opportunity To Provide Augmented Reality Media For The Intervention of Communication, Perception, Sound, and Rhythm for Deaf Learners Based Cultural Context. Pegem Journal of Education and Instruction, on 13(4), 158-163.

Babour, A., Bitar, H., Alzamzami, et al. (2023). Intelligent Gloves: An IT Intervention for Deaf-Mute People. Journal of Intelligent Systems, 32(1), 20220076.

Baktash, A., Mohammed, S., & Farooq, H. (2021, June 1). Multi-Sign Language Glove-based Hand Talking System. IOP Conference Series: Materials Science and Engineering, 1105(1), 012078. https://doi.org/10.1088/1757-899X/1105/1/012078

Chandra, K.R. (2021). Smart Glove for Sign Language Translation Using Arduino.

Clark, M. D., Cue, K. R., et al. (2020). Early Intervention Protocols: Proposing a Default Bimodal Bilingual Approach for Deaf Children. Maternal and Child Health Journal, 24, 1339-1344.

Comparison of Four TAM Item Formats*: Effect of Response Option Labels and OrderJUS*. (n.d.). Uxpajournal.org. https://uxpajournal.org/tam-formats-effect-response-labels-order/

Creating a deaf and hard-of-hearing friendly classroom. (n.d.). https://cws.auburn.edu/shared/content/files/1931/deaffriendly.pdf

Jensen, M. T., Chambers, D., & Wilson, S. (2023). The Future of Deaf Tourism Studies: An Interdisciplinary Research Agenda. Annals of Tourism Research, 100, 103549.

Julian, R. R. (2020, August 7). *Strategies in teaching deaf students*. SDO Balanga City. https://deped.cityofbalanga.gov.ph/publications/latest-news-1/2020/august/strategies-in-teaching-deaf-students

Katti, S. N., Sirsi, S. S., Prakash, V., Vinith Raj, B. U., & Jha, V. (2021). Talking Gloves: Sign Language to Speech Conversion for Deaf and Mute Person. J Univ Shanghai Sci Technol, 23(9).

Lewis, J. (2019, August 30). Comparison of Four Tam Item Formats: Effect of Response Option Labels and Order - jux. JUX - The Journal of User Experience. https://uxpajournal.org/tam-formats-effect-response-labels-order/

Linsangan, N. B., Calites, J. V., et al. (2022). Filipino Sign Language to Text Converter Using K-nearest Neighbor Algorithm. 2022 IEEE 14th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM). https://doi.org/10.1109/hnicem57413.2022.10109512

Marikyan, D. & Papagiannidis, S. (2023) Technology Acceptance Model: A review. In S. Papagiannidis (Ed), TheoryHub Book. Available at https://open.ncl.ac.uk / ISBN: 9781739604400 https://open.ncl.ac.uk/theories/1/technology-acceptance-model/

Murillo, S. C. M., Villanueva, M. C. A. E., Tamayo, K. I. M., Apolinario, M. J. V., Lopez, M. J. D., & Edd. (2021). Speak the Sign: A Real-Time Sign Language to Text Converter Application for Basic Filipino Words and Phrases. *CENTRAL ASIAN JOURNAL OF MATHEMATICAL THEORY AND COMPUTER SCIENCES*, *2*(8), 1-8. Retrieved from https://cajmtcs.centralasianstudies.org/index.php/CAJMTCS/article/view/92/74

National Deaf Center on Postsecondary Outcomes. (2017). *Communicating with deaf individuals*. University of South Florida. https://www.usf.edu/student-affairs/student-accessibility/documents/com-deaf-individuals.pdf

Revelli, Vanessa. 2019. "Technically Speaking." Tech Directions 79(3): 2. https://search.ebscohost.com/login.aspx?direct=true&db=ofm&AN=140819877&site=ehost-live.

Rodríguez-Correa, P. A., Valencia-Arias, A., Patiño-Toro, O. N., Oblitas Díaz, Y., & Teodori De la Puente, R. (2023, March 15). *Benefits and development of assistive technologies for Deaf People's Communication: A systematic review*. Frontiers. https://www.frontiersin.org/articles/10.3389/feduc.2023.1121597/full

Rogers, K., Lovell, K., & Young, A. (2023). What is the Efficacy and Effectiveness of Telemedicine Intervention for Deaf Signing Populations in Comparison to Face-to-Face Interventions? A Systematic Review. BMC Health Services Research, 23(1), 1-7.

Silvestre, E., Montes Miranda, A., & Figueroa Gutiérrez, V. (2022, March 18). Validation of a TAM Technology Acceptance Model in Dominican University Students. *Educación*, *31*(60), 113–136. https://doi.org/10.18800/educacion.202201.005

Singh, E. S., Sahai, A., Lodhi, A. K., & Chaudhary, A. (2023). Brief Review Paper on Smart Gloves for Speech-Impaired People Using IOT and Embedded Systems.

Standard deviation index (SDI). (n.d.). https://unityweb.qcnet.com/Documentation/Help/UnityWeb/399.htm

Tatnall, A. (2023). Editorial for EAIT Issue 5, 2023. Education and Information Technologies, 28(5), 4819-4830.

World Health Organization. (n.d.). Deafness and hearing loss. Retrieved from https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss

Yeratziotis, A., Achilleos, A., et al. (2023). Making Social Media Applications Inclusive for Deaf End-Users with Access to Sign Language. Multimedia Tools and Applications, 1-31.

Yudhana, A., Rahmawan, J., & Negara, C. U. P. (2018, September). Flex Sensors and MPU6050 Sensors Responses on Smart Glove for Sign Language Translation. In IOP Conference Series: Materials Science and Engineering (Vol. 403, No. 1, p. 012032). IOP Publishing.

ZAKI, A. K. B. M. (2023). SMART GLOVE SIGN LANGUAGE.

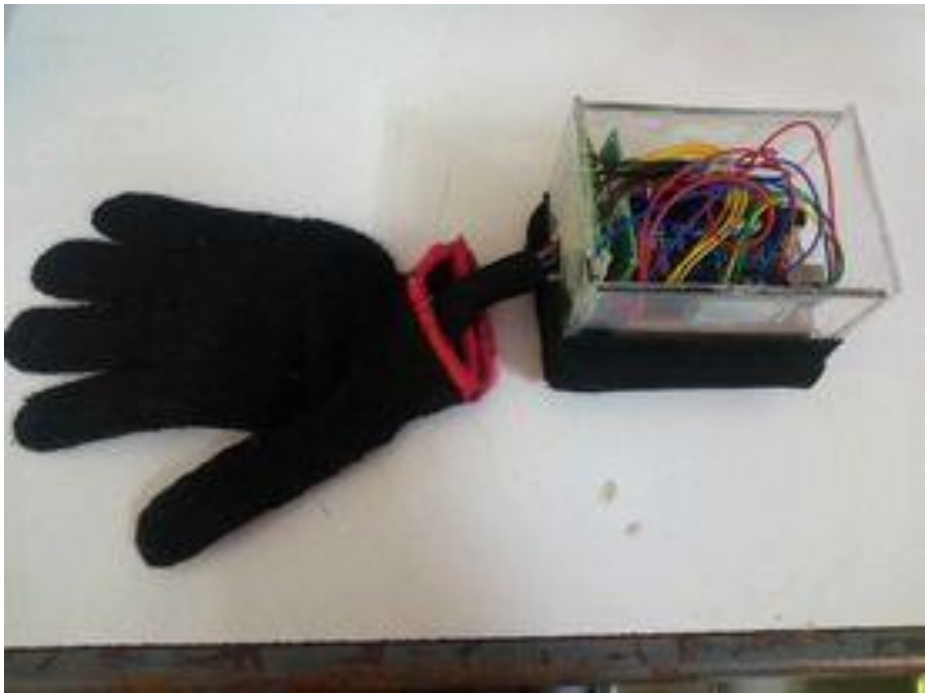
# APPENDICES

## Appendix A

## OUTPUT


**FSL Control Application for the Wireless Voice-Generating Gloves**

**made and designed by MIT App Inventor**



**The Wireless Voice-Generating Gloves**

# Appendix B

## SURVEY QUESTIONNAIRE

OLIVAREZ COLLEGE

**WLVocGenArG**
**Development of Wireless Voice-Generating Gloves for the Deaf Used for Virtual Communication**
**Olivarez College SY 2023-2024**
**Survey Questionnaire for Technology Acceptance**

**Team Members:**
Baluyot, Jericho Gerald C.
Rodillo, Ericka Mae B.
Tiopes, John Syte L.

**Demographic Profile:**

Name(Optional): _____

School: _____

Grade/Level(eg. Grade 6, Grade 12, etc.): _____

How do you communicate/access information at home, school, with friends and in the community?

_____

What helped you to understand what is being said during instruction and lectures?

_____

Have you used speech-to text services?

__ Yes, I used (eg. CART, C-Print, TypeWell, etc.) _____

__ No, Sign language/pen and paper are used by people to communicate with me.

**Directions: Please answer all the questions honestly and without any mental reservations by ticking the respective boxes.**

**In compliance with the Data Privacy Act of 2012(Republic Act 10173) requires that participants in this survey agree to answer the questions and how the information gathered here will be used. This consent is necessary for us to ensure that participants understand the purpose of their participation.**

☐ **AGREE** ☐ **DISAGREE**

OLIVAREZ COLLEGE
Dr. A. Santos Ave., Brgy. San Dionisio, Parañaque City, Philippines 1700
Tel. No.: (02) 8290750 or 8257119 Fax: (02)8258712
www.olivarezcollege.edu.ph

**Survey**

**Directions: Please put a check(✓) on the respective box of your response to each question.**

| WIRELESS VOICE-GENERATING GLOVES | | | | | | | |
|---|---|---|---|---|---|---|---|
| PERCEIVED USEFULNESS | LIKELY | | | | UNLIKELY | | |
| | Extremely (7) | Quite (6) | Slightly (5) | Neither (4) | Slightly (3) | Quite (2) | Extremely (1) |
| 1. Does this technology help facilitate better involvement in class activities such as recitation and discussion? | | | | | | | |
| 2. Do you think using this technology enables you to participate in individual/group reporting better? | | | | | | | |
| 3. Do you find this technology helpful in facilitating better communication with your classmates and teachers? | | | | | | | |
| 4. Does using this technology promote proficiency in doing homework or projects? | | | | | | | |
| 5. Do you believe this technology helps you to boost your confidence as a person and student? | | | | | | | |

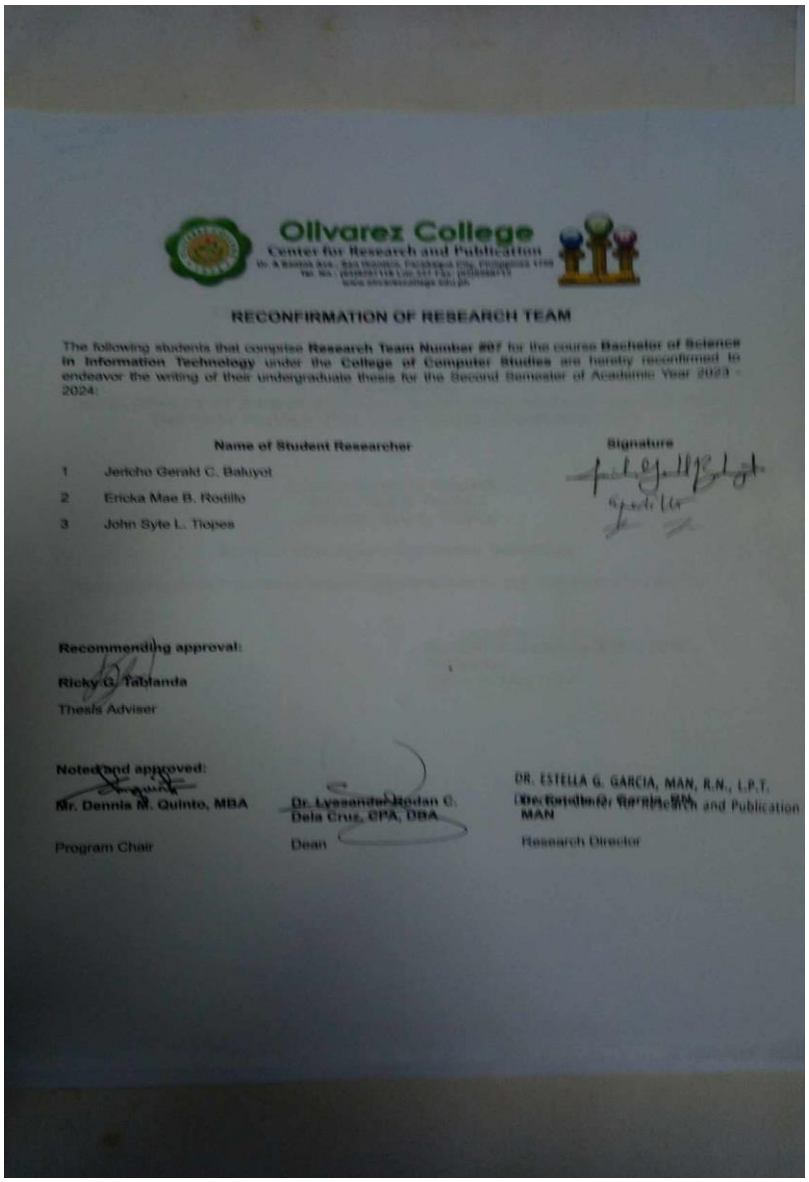
OLIVAREZ COLLEGE
Dr. A. Santos Ave., Brgy. San Dionisio, Parañaque City, Philippines 1700
Tel. No.: (02) 8260750 or 8257119 Fax: (02)8258712
www.olivarezcollege.edu.ph

| WIRELESS VOICE GENERATING GLOVES | | | | | | | |
|---|---|---|---|---|---|---|---|
| PERCEIVED EASE OF USE | LIKELY | | | | UNLIKELY | | |
| | Extremely (7) | Quite (6) | Slightly (5) | Neither (4) | Slightly (3) | Quite (2) | Extremely (1) |
| 6. Is learning to use this technology easy for you? | | | | | | | |
| 7. Does using this technology feel effortless to you when it comes to communication? | | | | | | | |
| 8. Can you become skilled at using this technology without much difficulty in understanding and clarity of its use? | | | | | | | |
| 9. Would you easily remember how to use this technology? | | | | | | | |
| 10. Does using this technology feel mentally challenging or easy for you? | | | | | | | |

## Appendix C

## LETTERS, ENDORSEMENTS, AND

## PARENTAL CONSENT FORMS



Olivarez College
Center for Research and Publication

**RECONFIRMATION OF RESEARCH TEAM**

The following students that comprise **Research Team Number #07** for the course **Bachelor of Science in Information Technology** under the **College of Computer Studies** are hereby reconfirmed to endeavor the writing of their undergraduate thesis for the Second Semester of Academic Year 2023 - 2024:

| | Name of Student Researcher | Signature |
|---|---|---|
| 1 | Jericho Gerald C. Baluyot | |
| 2 | Ericka Mae B. Rodillo | |
| 3 | John Syte L. Tiopes | |

**Recommending approval:**

**Ricky G. Tablanda**
Thesis Adviser

**Noted and approved:**

**Mr. Dennis M. Quinto, MBA**
Program Chair

**Dr. Lyssandra Nadan C. Dela Cruz, CPA, DBA**
Dean

**DR. ESTELLA G. GARCIA, MAN, R.N., L.P.T.**
**MAN**
Research Director

Olivarez College
Center for Research and Publication
Dr. A Santos Ave., San Dionisio, Parañaque City, Philippines 1700
Tel. No.: (02)8257119 Loc.227 Fax. (02)8258712
www.olivarezcollege.edu.ph

## AUTHORIZATION TO CONDUCT THE STUDY

25 November 2024

**Mr. Gerry A. Lumaban**
**Principal IV**
**Parañaque National High School - MAIN**

**Dear Mr. Lumaban,**

We, the third year students from BS Information Technology in Olivarez College Inc. Parañaque, are writing to request permission to conduct a study with the **deaf students of Parañaque National High School MAIN** for our capstone research in partial fulfillment of the requirements for the degree of Bachelor of Science in Information Technology for the Academic Year 2023-2024.

Our capstone research is entitled **WLVocGenArG: Development of a Wireless Voice-Generating Arduino Gloves for the Deaf to be Used for Virtual Communication.**

In regard with this, we would like to perform the study in **Parañaque National High School**. May we also administer the technology acceptance questionnaire to the deaf students as our respondents.

The data of the study will remain absolutely confidential and to be used for developmental and experimental purposes only.

Your approval to conduct the study will be highly appreciated. Thank you very much.

Very yours truly,

Jericho Gerald C. Baluyot
Ericka Mae B. Rodillo
John Syte L. Tiopes

Mr. Ricky G. Tablanda
**Thesis Adviser**

**Noted by:**

Mr. Dennis M. Quinto,
MBA
**Program Chair,**
**College of Computer Studies**

Dr. Lysander Rodan C. Dela Cruz,
CPA, DBA, DPA
**Dean,**
**College of Corporate Management Education**

Dr. Estella G. Garcia,
EdD, RN, MAN, LPT
**Director,**
**Olivarez College Center For Research and Publication**

**CONFORME:**

_____

Olivarez College
Center for Research and Publication
Dr. A Santos Ave., San Dionisio, Parañaque City, Philippines 1700
Tel. No.: (02)8257119 Loc.227 Fax. (02)8258712
www.olivarezcollege.edu.ph

**REQUEST FOR PILOT TESTING**

25 November 2024

**Dr. Joel T. Torrecampo, CESO VI**
**School Division Superintendent**
**Division of City Schools - Pasay City**
**P. Zamora St. Pasay City**

**Dear Dr. Torrecampo,**

We, the third year students from BS Information Technology in Olivarez College Inc. Parañaque, are writing to request permission to conduct a study with the **selected grades 5 and up students of Philippine School For the Deaf** for our capstone research in partial fulfillment of the requirements for the degree of Bachelor of Science in Information Technology for the Academic Year 2023-2024.

Our capstone research is entitled **WLVocGenArG: Development of a Wireless Voice-Generating Arduino Gloves for the Deaf to be Used for Virtual Communication.**

In regard with this, we would like to perform the **pilot testing** in **Philippine School for the Deaf**. May we also administer the survey questionnaire to the deaf students as our respondents, as well as to have a SL interpreter to assist us in facilitating the testing of our prototype, which will require us to video record it. In addition, we would like to have some picture documentation which will also be included in the appendix of our thesis paper.

The data of the study will remain absolutely confidential and to be used only in testing of our methodology.

Your approval to conduct the study will be highly appreciated. Thank you very much.

Very yours truly,

**Jericho Gerald C. Baluyot** - jerichogerald.baluyot@olivarezcollege.edu.ph
**Ericka Mae B. Rodillo** - erickamae.rodillo@olivarezcollege.edu.ph
**John Syte L. Tiopes** - johnsyte.tiopes@olivarezcollege.edu.ph

Mr. Ricky G. Tablanda
**Thesis Adviser**

**Noted by:**

Mr. Dennis M. Quinto,
MBA
**Program Chair,**
**College of Computer Studies**

Dr. Lyssander Rodan C. Dela Cruz,
CPA, DBA, DPA
**Dean,**
**College of Corporate Management Education**

Dr. Estella G. Garcia,
EdD, RN, MAN, LPT
**Director,**
**Olivarez College Center For Research and Publication**

**CONFORME:**

_____

Olivarez College
Center for Research and Publication
Dr. A Santos Ave., San Dionisio, Parañaque City, Philippines 1700
Tel. No.: (02)8257119 Loc.227 Fax. (02)8258712
www.olivarezcollege.edu.ph

**AUTHORIZATION TO CONDUCT STUDY**

25 November 2024

**Dr. Joel T. Torrecampo, CESO VI**
**School Division Superintendent**
**Division of City Schools - Pasay City**
**P. Zamora St. Pasay City**

**Dear Dr. Torrecampo,**

We, the third year students from BS Information Technology in Olivarez College Inc. Parañaque, are writing to request permission to conduct a **pilot testing** with the **grades 5-6 elementary and grades 7-12 high school students of Philippine School For the Deaf** for our capstone research in partial fulfillment of the requirements for the degree of Bachelor of Science in Information Technology for the Academic Year 2023-2024.

Our capstone research is entitled **WLVocGenArG: Development of a Wireless Voice-Generating Arduino Gloves for the Deaf to be Used for Virtual Communication.**

In regard with this, we would like to perform the **study in Philippine School For The Deaf.**. May we also administer the survey questionnaire to the deaf students as our respondents, as well as to have a SL interpreter to assist us in facilitating the testing of our prototype, which will require us to video record it. In addition, we would like to have some picture documentation which will also be included in the appendix of our thesis paper.

The data of the study will remain absolutely confidential and to be used only in testing of our methodology.

Your approval to conduct the study will be highly appreciated. Thank you very much.

Very yours truly,

**Jericho Gerald C. Baluyot** - jerichogerald.baluyot@olivarezcollege.edu.ph
**Ericka Mae B. Rodillo** - erickamae.rodillo@olivarezcollege.edu.ph
**John Syte L. Tiopes** - johnsyte.tiopes@olivarezcollege.edu.ph

Mr. Ricky G. Tablanda
**Thesis Adviser**

**Noted by:**

Mr. Dennis M. Quinto,
MBA
**Program Chair,**
**College of Computer Studies**

Dr. Lyssander Rodan C. Dela Cruz,
CPA, DBA, DPA
**Dean,**
**College of Corporate Management Education**

Dr. Estella G. Garcia,
EdD, RN, MAN, LPT
**Director,**
**Olivarez College Center For Research and Publication**

**CONFORME:**

_____

***Parent's Consent Form given to the Respondents for the Initial Survey***

OLIVAREZ COLLEGE

**WLVocGenArG**
**Development of Wireless Voice-Generating Gloves for the Deaf Used for Virtual Communication**
**Olivarez College SY 2023-2024**

**Parental Consent**

I, [Parent/Guardian Name]_____, hereby give consent for my deaf child, [Child's Name]_____, to participate in the **Pilot Testing for the thesis entitled "Development of a Wireless Voice-Generating Gloves for the Deaf Used for Virtual Communication.**

I understand that this program aims to **develop an Arduino-programmed wireless Gloves for the deaf that translates Filipino Sign Language to American English Speech and also transcribes both Tagalog and English into text.**

I acknowledge that my child's participation in this program may involve activities such as **testing the device, and answering a survey questionnaire afterwards regarding their experience with the device and the device' usefulness and ease of use.**

I understand that the program organizers will take necessary precautions to ensure the safety and well-being of all participants, including providing appropriate accommodations for my child's communication needs.

I agree to inform the program staff of any changes to my child's medical condition or special requirements that may affect their participation in the program.

I have read and understand the terms of this consent form, and I consent to my child's participation in the Device Testing and Survey program this April/May _ 2024.

Parent/Guardian Signature: _____

Date: _____

***Parent's Consent Form given to Jeizaville C. Ocang from Parañaque National High School - SPED, deaf Grade 7 participant for the Final Defense.***

OLIVAREZ COLLEGE
Dr. A. Santos Ave., Brgy. San Dionisio, Parañaque City, Philippines 1700
Tel. No.: (02) 8260750 or 8257119 Fax: (02)8255712
www.olivarezcollege.edu.ph

**Parental Consent for Final Defense**

I, [Parent/Guardian Name]_____, hereby give consent for my deaf child, [Child's Name]_____, to participate in the **Final Thesis Defense to be our live demonstrator to be held at Olivarez College.**

I understand that this event aims to **propose the Wireless Voice-Generating Gloves to be deployed and used widely by demonstrating to the panelist the functionality of the aforementioned device.**.

I acknowledge that my child's participation in this program may involve activities such as **being photographed/video recorded as he/she uses the device in front of the panelists, with an interpreter that practices Filipino Sign Language.**.

I understand that the program organizers will take necessary precautions to ensure the safety and well-being of my son/daughter, including providing appropriate accommodations for my child's communication needs.

I agree to inform the program staff of any changes to my child's medical condition or special requirements that may affect their participation in the program.

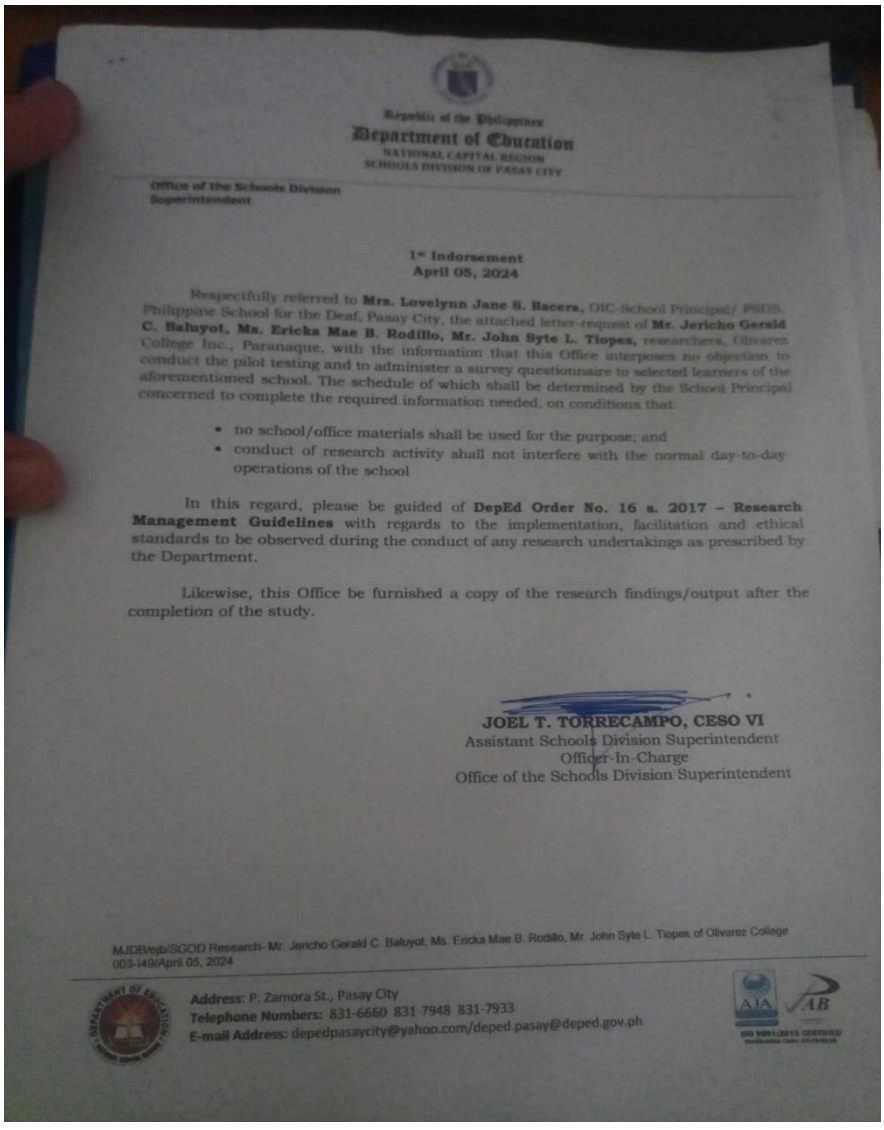
I have read and understand the terms of this consent form, and I consent to my child's participation in the **Final Thesis Defense this coming April 24, 2024**.

Parent/Guardian Signature: _____

Date: _____

***Endorsement by Dr. Joel T. Torrecampo, CESO VI***

***Schools Division Superintendent, Division of City Schools, Pasay City***



Republic of the Philippines
**Department of Education**
NATIONAL CAPITAL REGION
SCHOOLS DIVISION OF PASAY CITY

Office of the Schools Division Superintendent

**1st Indorsement**
**April 05, 2024**

Respectfully referred to **Mrs. Lovelynn Jane S. Bacera,** OIC-School Principal/ PSDS, Philippine School for the Deaf, Pasay City, the attached letter-request of **Mr. Jericho Gerald C. Baluyot, Ms. Ericka Mae B. Rodillo, Mr. John Syte L. Tiopes,** researchers, Olivarez College Inc., Paranaque, with the information that this Office interposes no objection to conduct the pilot testing and to administer a survey questionnaire to selected learners of the aforementioned school. The schedule of which shall be determined by the School Principal concerned to complete the required information needed, on conditions that:

- no school/office materials shall be used for the purpose; and
- conduct of research activity shall not interfere with the normal day-to-day operations of the school

In this regard, please be guided of **DepEd Order No. 16 s. 2017 – Research Management Guidelines** with regards to the implementation, facilitation and ethical standards to be observed during the conduct of any research undertakings as prescribed by the Department.

Likewise, this Office be furnished a copy of the research findings/output after the completion of the study.

**JOEL T. TORRECAMPO, CESO VI**
Assistant Schools Division Superintendent
Officer-In-Charge
Office of the Schools Division Superintendent

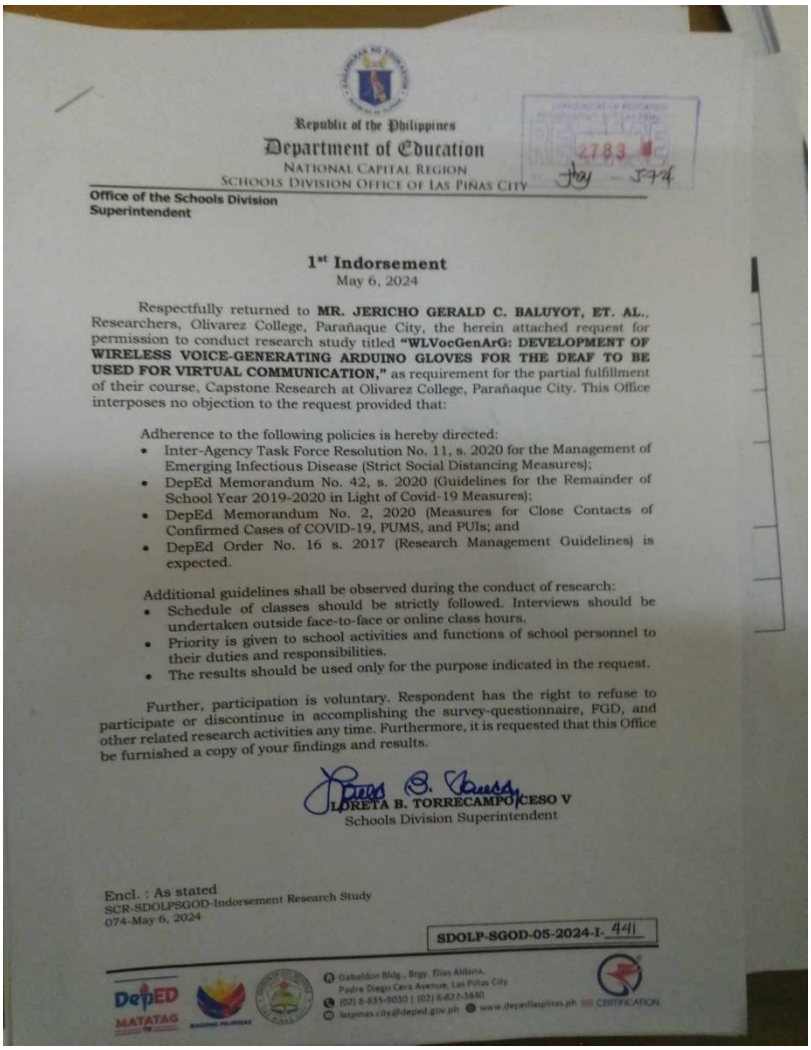
MJDB/ejb/SGOD Research- Mr. Jericho Gerald C. Baluyot, Ms. Ericka Mae B. Rodillo, Mr. John Syte L. Tiopes of Olivarez College
003-149/April 05, 2024

**Address**: P. Zamora St., Pasay City
**Telephone Numbers:** 831-6660 831-7948 831-7933
**E-mail Address:** depedpasaycity@yahoo.com/deped.pasay@deped.gov.ph

***Endorsement by Dr. Loreta B. Torrecampo, CESO V***

***Schools Division Superintendent, Division of City Schools,***

***Las Piñas City***



Republic of the Philippines
Department of Education
NATIONAL CAPITAL REGION
SCHOOLS DIVISION OFFICE OF LAS PIÑAS CITY

2783
May - 574

**Office of the Schools Division Superintendent**

**1st Indorsement**
May 6, 2024

Respectfully returned to **MR. JERICHO GERALD C. BALUYOT, ET. AL.**, Researchers, Olivarez College, Parañaque City, the herein attached request for permission to conduct research study titled **"WLVocGenArG: DEVELOPMENT OF WIRELESS VOICE-GENERATING ARDUINO GLOVES FOR THE DEAF TO BE USED FOR VIRTUAL COMMUNICATION,"** as requirement for the partial fulfillment of their course, Capstone Research at Olivarez College, Parañaque City. This Office interposes no objection to the request provided that:

Adherence to the following policies is hereby directed:

- Inter-Agency Task Force Resolution No. 11, s. 2020 for the Management of Emerging Infectious Disease (Strict Social Distancing Measures);
- DepEd Memorandum No. 42, s. 2020 (Guidelines for the Remainder of School Year 2019-2020 in Light of Covid-19 Measures);
- DepEd Memorandum No. 2, 2020 (Measures for Close Contacts of Confirmed Cases of COVID-19, PUMS, and PUIs; and
- DepEd Order No. 16 s. 2017 (Research Management Guidelines) is expected.

Additional guidelines shall be observed during the conduct of research:

- Schedule of classes should be strictly followed. Interviews should be undertaken outside face-to-face or online class hours.
- Priority is given to school activities and functions of school personnel to their duties and responsibilities.
- The results should be used only for the purpose indicated in the request.

Further, participation is voluntary. Respondent has the right to refuse to participate or discontinue in accomplishing the survey-questionnaire, FGD, and other related research activities any time. Furthermore, it is requested that this Office be furnished a copy of your findings and results.

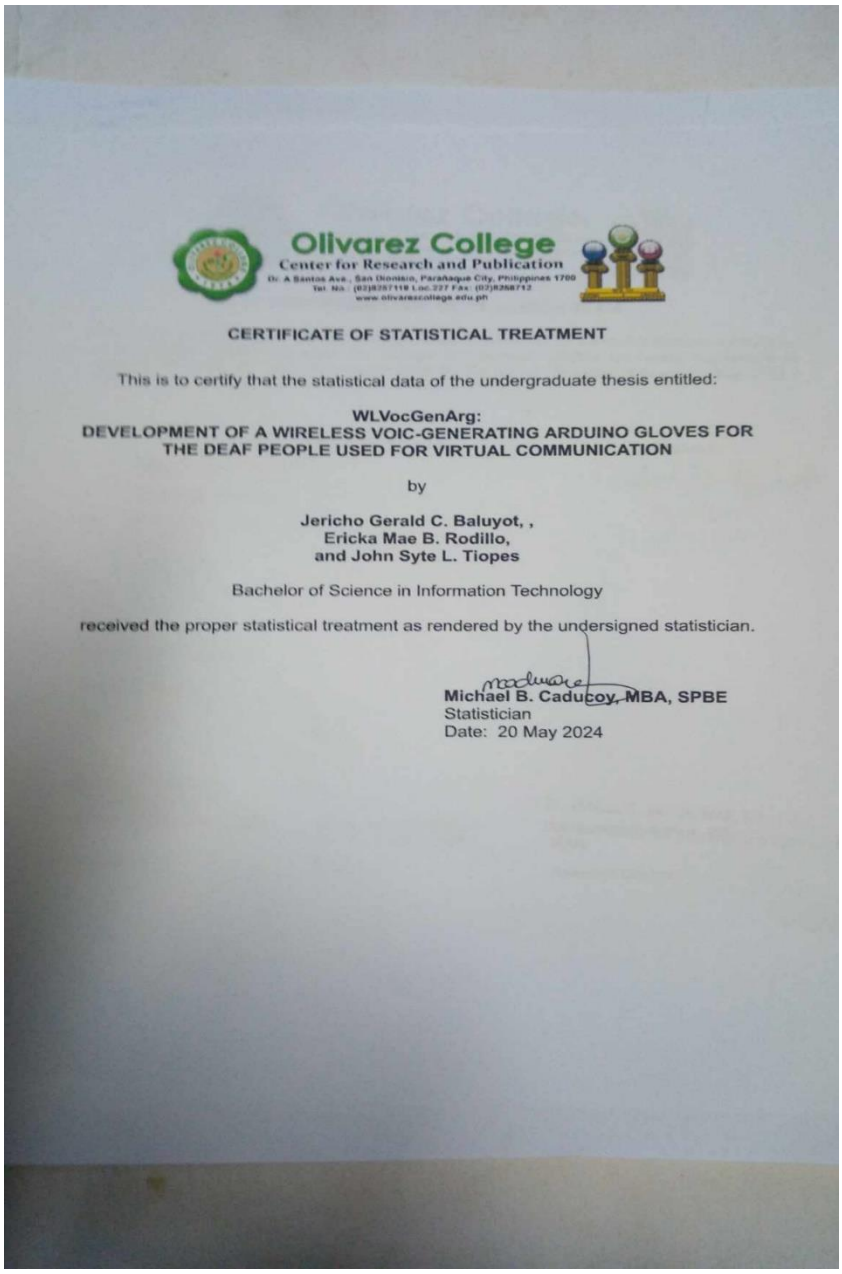
**LORETA B. TORRECAMPO, CESO V**
Schools Division Superintendent

Encl. : As stated
SCR-SDOLPSGOD-Indorsement Research Study
074-May 6, 2024

SDOLP-SGOD-05-2024-I-441

Gabaldon Bldg., Brgy. Elias Aldana, Padre Diego Cera Avenue, Las Piñas City
(02) 8-835-9030 | (02) 8-822-1840
laspinas.city@deped.gov.ph www.depedlaspinas.ph CERTIFICATION

## *Certificate of Statistical Treatment City*



Olivarez College
Center for Research and Publication

**CERTIFICATE OF STATISTICAL TREATMENT**

This is to certify that the statistical data of the undergraduate thesis entitled:

**WLVocGenArg:**
**DEVELOPMENT OF A WIRELESS VOIC-GENERATING ARDUINO GLOVES FOR THE DEAF PEOPLE USED FOR VIRTUAL COMMUNICATION**

by

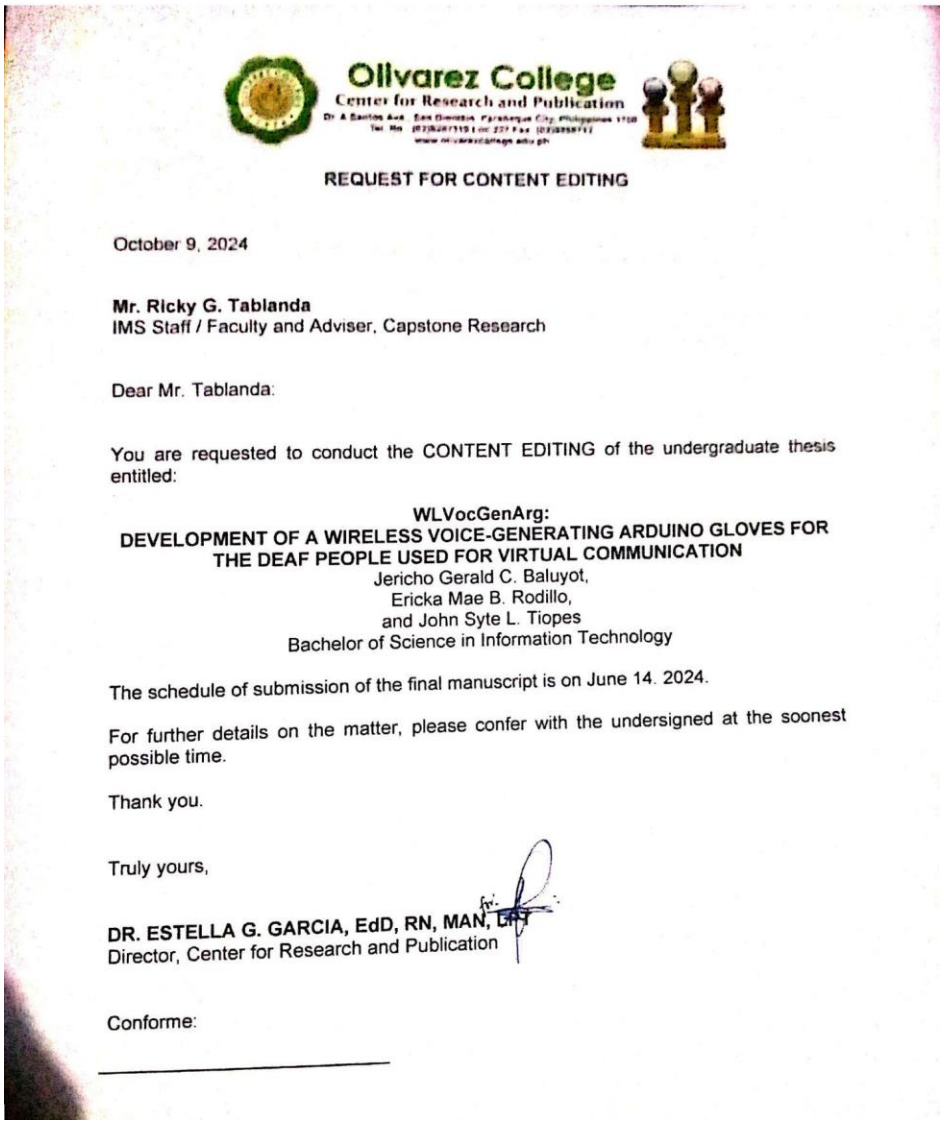
**Jericho Gerald C. Baluyot, ,**
**Ericka Mae B. Rodillo,**
**and John Syte L. Tiopes**

Bachelor of Science in Information Technology

received the proper statistical treatment as rendered by the undersigned statistician.

**Michael B. Caducoy, MBA, SPBE**
Statistician
Date: 20 May 2024

***Request for Content Editing***



Olivarez College
Center for Research and Publication

**REQUEST FOR CONTENT EDITING**

October 9, 2024

**Mr. Ricky G. Tablanda**
IMS Staff / Faculty and Adviser, Capstone Research

Dear Mr. Tablanda:

You are requested to conduct the CONTENT EDITING of the undergraduate thesis entitled:

**WLVocGenArg:**
**DEVELOPMENT OF A WIRELESS VOICE-GENERATING ARDUINO GLOVES FOR THE DEAF PEOPLE USED FOR VIRTUAL COMMUNICATION**
Jericho Gerald C. Baluyot,
Ericka Mae B. Rodillo,
and John Syte L. Tiopes
Bachelor of Science in Information Technology

The schedule of submission of the final manuscript is on June 14. 2024.

For further details on the matter, please confer with the undersigned at the soonest possible time.

Thank you.

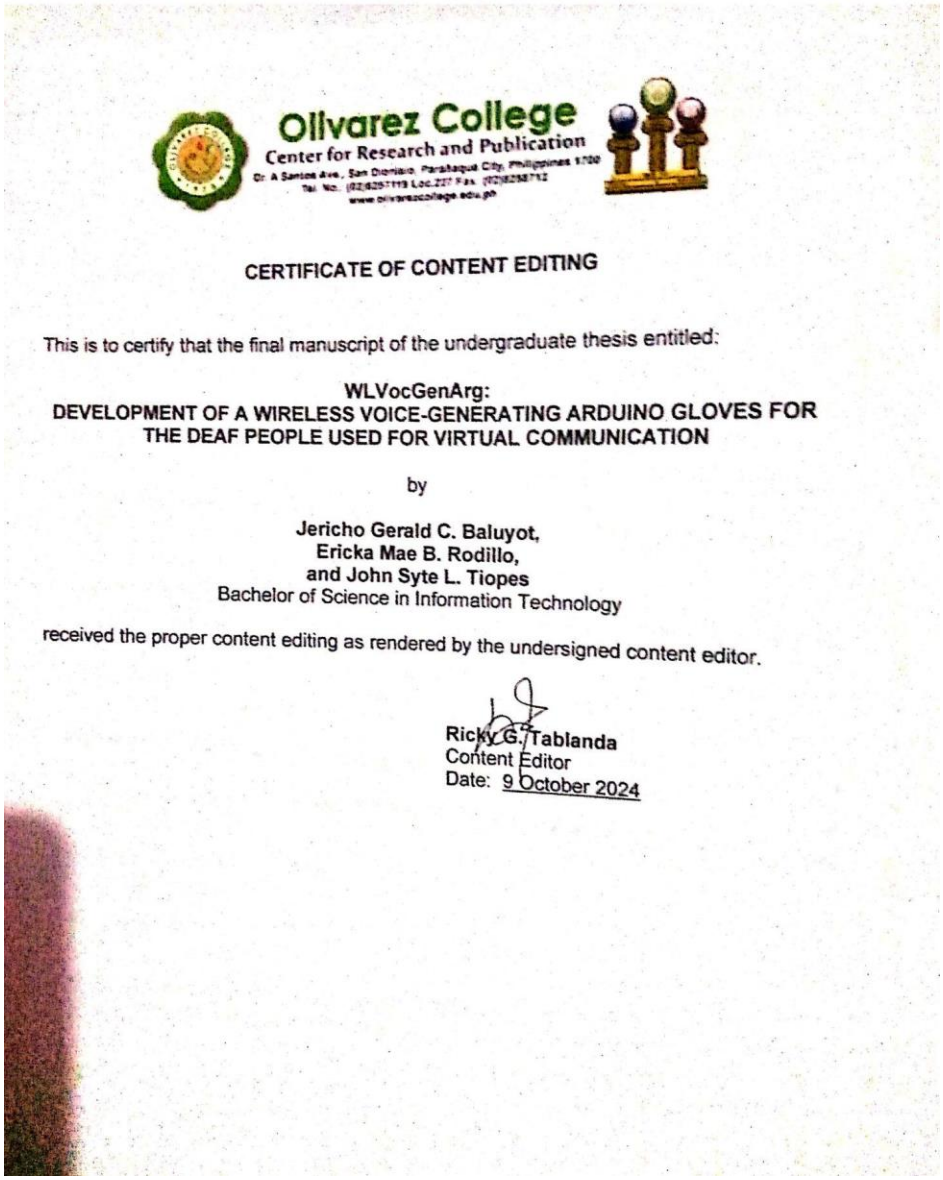
Truly yours,

**DR. ESTELLA G. GARCIA, EdD, RN, MAN, LPT**
Director, Center for Research and Publication

Conforme:

_____

## *Certificate of Content Editing*



Olivarez College
Center for Research and Publication
Dr. A Santos Ave., San Dionisio, Parañaque City, Philippines 1700
Tel. No.: (02)8297119 Loc.227 Fax: (02)8258712
www.olivarezcollege.edu.ph

**CERTIFICATE OF CONTENT EDITING**

This is to certify that the final manuscript of the undergraduate thesis entitled:

**WLVocGenArg:**
**DEVELOPMENT OF A WIRELESS VOICE-GENERATING ARDUINO GLOVES FOR THE DEAF PEOPLE USED FOR VIRTUAL COMMUNICATION**

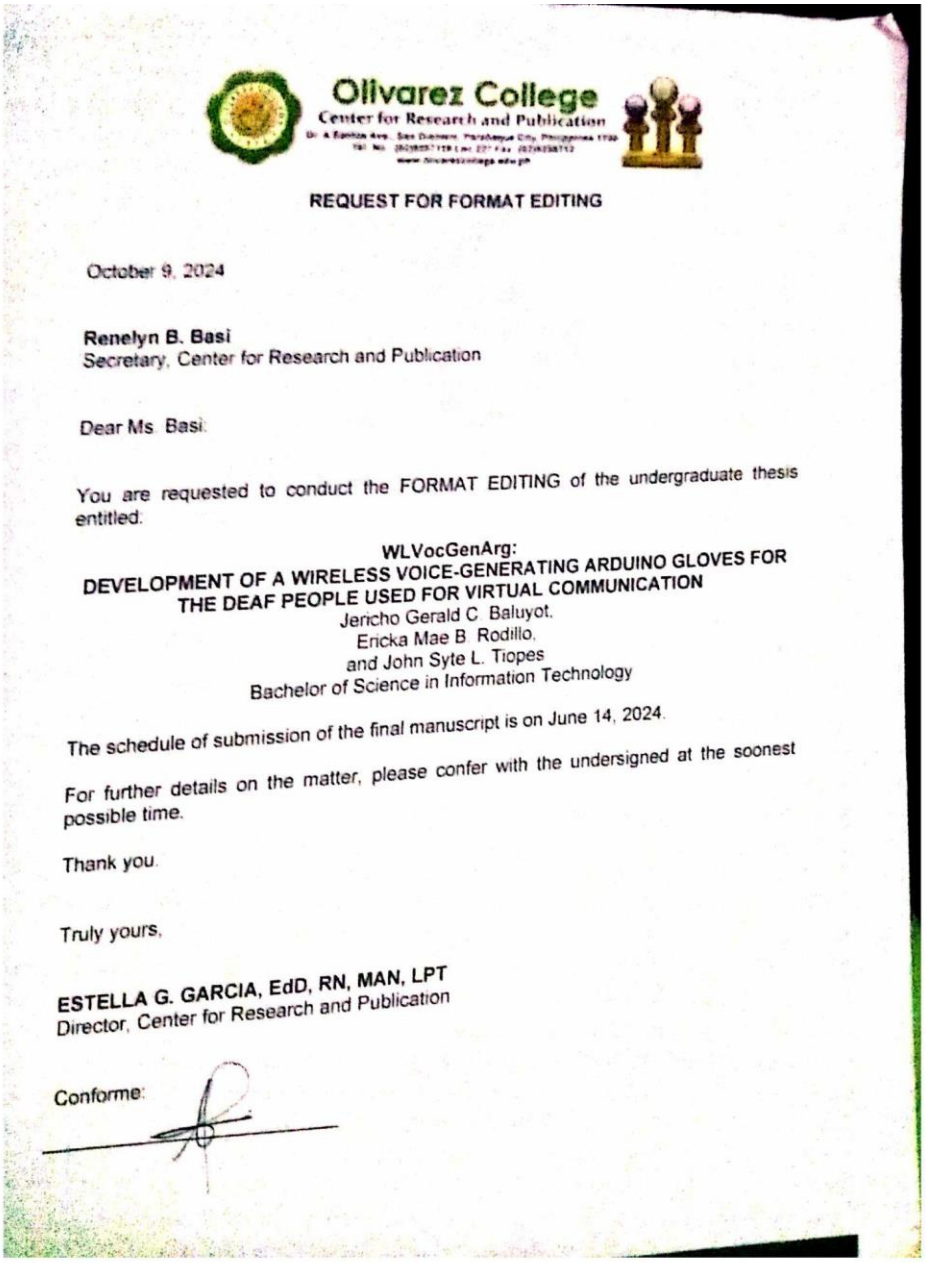
by

**Jericho Gerald C. Baluyot,**
**Ericka Mae B. Rodillo,**
**and John Syte L. Tiopes**
Bachelor of Science in Information Technology

received the proper content editing as rendered by the undersigned content editor.

**Ricky G. Tablanda**
Content Editor
Date: 9 October 2024

***Request For Format Editing***



Olivarez College
Center for Research and Publication

**REQUEST FOR FORMAT EDITING**

October 9, 2024

**Renelyn B. Basi**
Secretary, Center for Research and Publication

Dear Ms. Basi:

You are requested to conduct the FORMAT EDITING of the undergraduate thesis entitled:

**WLVocGenArg:**
**DEVELOPMENT OF A WIRELESS VOICE-GENERATING ARDUINO GLOVES FOR THE DEAF PEOPLE USED FOR VIRTUAL COMMUNICATION**
Jericho Gerald C. Baluyot,
Ericka Mae B. Rodillo,
and John Syte L. Tiopes
Bachelor of Science in Information Technology

The schedule of submission of the final manuscript is on June 14, 2024.

For further details on the matter, please confer with the undersigned at the soonest possible time.

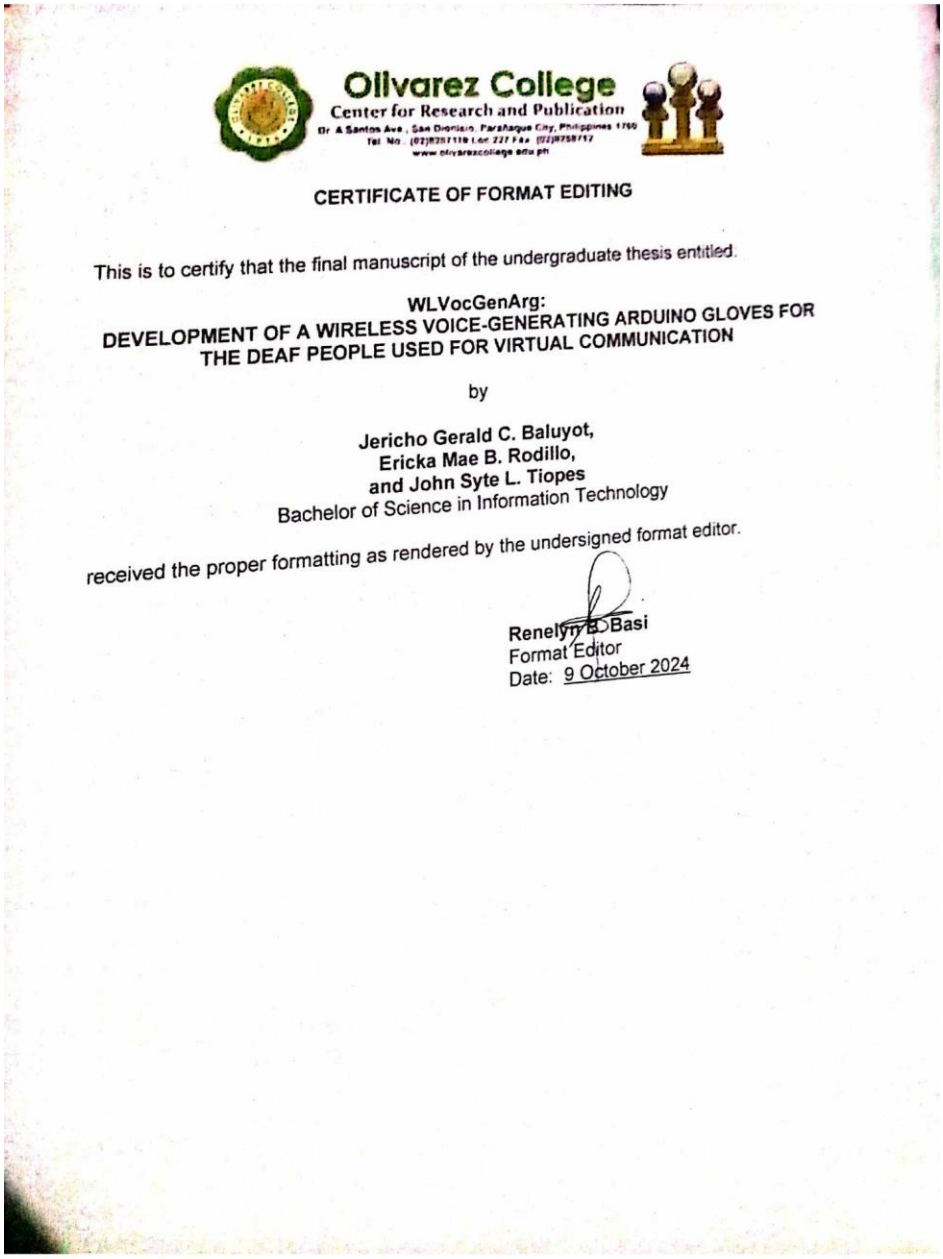
Thank you.

Truly yours,

**ESTELLA G. GARCIA, EdD, RN, MAN, LPT**
Director, Center for Research and Publication

Conforme:

## *Certificate of Format Editing*



Olivarez College
Center for Research and Publication
Dr. A Santos Ave., San Dionisio, Parañaque City, Philippines 1700
Tel. No.: (02)8257119 Loc. 227 Fax: (02)8758712
www.olivarezcollege.edu.ph

**CERTIFICATE OF FORMAT EDITING**

This is to certify that the final manuscript of the undergraduate thesis entitled:

**WLVocGenArg:**
**DEVELOPMENT OF A WIRELESS VOICE-GENERATING ARDUINO GLOVES FOR THE DEAF PEOPLE USED FOR VIRTUAL COMMUNICATION**

by

**Jericho Gerald C. Baluyot,**
**Ericka Mae B. Rodillo,**
**and John Syte L. Tiopes**
Bachelor of Science in Information Technology

received the proper formatting as rendered by the undersigned format editor.

**Renelyn B. Basi**
Format Editor
Date: 9 October 2024

***Certificate of Grammarly***

# Chapter 1

by Ricky Tablanda

## General metrics

| 29,236 | 4,352 | 207 | 17 min 24 sec | 33 min 28 sec |
|---|---|---|---|---|
| characters | words | sentences | reading time | speaking time |

## Score

84

This text scores better than 84% of all texts checked by Grammarly

## Writing Issues

| 168 | 1 | 167 |
|---|---|---|
| Issues left | Critical | Advanced |

## Writing Issues

2 **Clarity**
2 Wordy sentences

1 **Delivery**
1 Incomplete sentences

1 **Correctness**
1 Comma misuse within clauses

***Certificate of Grammarly***

# Chapter 2

by Ricky Tablanda

## General metrics

| 5,846 | 897 | 65 | 3 min 35 sec | 6 min 54 sec |
|---|---|---|---|---|
| characters | words | sentences | reading time | speaking time |

## Score

85

This text scores better than 85% of all texts checked by Grammarly

## Writing Issues

| 37 | 1 | 36 |
|---|---|---|
| Issues left | Critical | Advanced |

## Writing Issues

1 **Correctness**

1 Comma misuse within clauses

1 **Engagement**

1 Word choice

1 **Clarity**

1 Wordy sentences

***Certificate of Grammarly***

# Chapter 3

by Ricky Tablanda

## General metrics

| 12,788 | 1,968 | 140 | 7 min 52 sec | 15 min 8 sec |
|---|---|---|---|---|
| characters | words | sentences | reading time | speaking time |

## Score

87

This text scores better than 87% of all texts checked by Grammarly

## Writing Issues

| 67 | 5 | 62 |
|---|---|---|
| Issues left | Critical | Advanced |

## Writing Issues

| | | |
|---|---|---|
| 7 | **Correctness** | |
| 1 | Confused words | |
| 2 | Improper formatting | |
| 1 | Misspelled words | |
| 2 | Comma misuse within clauses | |
| 1 | Mixed dialects of english | |

***Certificate of Grammarly***

# Chapter 4

by Ricky Tablanda

## General metrics

| 4,202 | 651 | 28 | 2 min 36 sec | 5 min 0 sec |
|---|---|---|---|---|
| characters | words | sentences | reading time | speaking time |

## Score

83

This text scores better than 83% of all texts checked by Grammarly

## Writing Issues

| 31 | 1 | 30 |
|---|---|---|
| Issues left | Critical | Advanced |

## Writing Issues

1 **Correctness**

1 Mixed dialects of english

1 **Clarity**

1 Wordy sentences

## *Certificate of Turnitin*

PAPER NAME

**WLVocGenArG-Group-7-Manuscript (FINISHED) .docx**

| | |
|---|---|
| WORD COUNT | CHARACTER COUNT |
| **10049 Words** | **56620 Characters** |
| PAGE COUNT | FILE SIZE |
| **98 Pages** | **8.8MB** |
| SUBMISSION DATE | REPORT DATE |
| **Oct 23, 2024 12:12 PM GMT+8** | **Oct 23, 2024 12:13 PM GMT+8** |

**19% Overall Similarity**

The combined total of all matches, including overlapping sources, for each database.

- 15% Internet database
- 8% Publications database
- Crossref database
- Crossref Posted Content database
- 16% Submitted Works database

## THE SOURCE CODES

## ARDUINO CODE - WIRELESS VOICE-GENERATING GLOVES

```
//Libraries
#include "Wire.h"
#include "LiquidCrystal_I2C.h"
#include "SoftwareSerial.h"
#include "MPU6050.h"
#include "I2Cdev.h"

//SCL-> A5 SDA-> A4
MPU6050 mpu;
int16_t ax, ay, az;
int16_t gx, gy, gz;

//LCD Display 20x4
LiquidCrystal_I2C lcd(0x27, 20, 4);

//bluetooth
SoftwareSerial BT(10,11);

//Multiplexer Pins
const int S0 = 2;
const int S1 = 3;
const int S2 = 4;
const int zInput = A0;

struct MyData {
    byte X;
    byte Y;
    byte Z;
    byte gX;
    byte gY;
    byte gZ;
};

MyData data;
```

```
void setup() {
  Serial.begin(9600);
  BT.begin(9600);
  lcd.init();
  lcd.setCursor(3, 0);
  lcd.print("WELCOME TO FSL");
  delay(2000);
  BT.println("WELCOME TO FILIPINO SIGN LANGUAGE");

  // Setup the multiplexer pins
  pinMode(S0, OUTPUT);
  pinMode(S1, OUTPUT);
  pinMode(S2, OUTPUT);
  pinMode(zInput, INPUT);

  Wire.begin();
  mpu.initialize();

}

int readFSR(int channel) {
  // Set the multiplexer to the desired channel
  digitalWrite(S0, channel & 0x01);
  digitalWrite(S1, (channel >> 1) & 0x01);
  digitalWrite(S2, (channel >> 2) & 0x01);

  // Read the FSR value from the selected channel
  int value = analogRead(zInput); // Read from the multiplexer output pin
  return value;
}
    data.Z = map(az, -17000, 17000, 0, 255);  // Y axis data
    data.gX = map(gx, -17000, 17000, 0, 255); // Gyroscope X axis data
    data.gY = map(gy, -17000, 17000, 0, 255); // Gyroscope Y axis data
    data.gZ = map(gz, -17000, 17000, 0, 255); // Gyroscope Z axis data

    // Print motion data
    Serial.print("Axis X: ");
    Serial.print(data.X);
    Serial.print(" | Axis Y: ");
    Serial.print(data.Y);
    Serial.print(" | Axis Z: ");
    Serial.println(data.Z);

    Serial.print("Gyro X: ");
    Serial.print(data.gX);
    Serial.print(" | Gyro Y: ");
    Serial.print(data.gY);
    Serial.print(" | Gyro Z: ");
    Serial.println(data.gZ);

    int thumbValue = readFSR(0);
    int indexValue = readFSR(1);
    int middleValue = readFSR(2);
    int ringValue = readFSR(3);
    int pinkyValue = readFSR(4);
```

```
Serial.print("Thumb: ");
Serial.print(thumbValue);
Serial.print(" | Index: ");
Serial.print(indexValue);
Serial.print(" | Middle: ");
Serial.print(middleValue);
Serial.print(" | Ring: ");
Serial.print(ringValue);
Serial.print(" | Pinky: ");
Serial.println(pinkyValue);

lcd.setCursor(5, 2);
lcd.print("                ");
lcd.noBacklight();

  // Check if data is available from Bluetooth module - SpeechRecognition
if (BT.available() > 0) {
  String text = BT.readString();
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.backlight();
  lcd.print(text);
  delay(5000);

}
```

```
    //Text to Speech using Android phone
  if (thumbValue <= 50 &&
indexValue <= 50 &&
middleValue >= 300 &&
middleValue <= 600 &&
ringValue >= 20 &&
ringValue <= 500 &&
pinkyValue >= 50 &&
pinkyValue <= 150 &&
data.X >= 200 &&
data.X <= 250 &&
data.Y >= 30 &&
data.Y <= 80 &&
data.Z >= 80 &&
data.Z <= 150) {
    BT.println("I LOVE YOU");
    Serial.println("I LOVE YOU");

  } else if (data.X >= 210 &&
data.X <= 250 &&
data.Y >= 150 &&
data.Y <= 200 &&
data.Z >= 50 &&
data.Z <= 100 &&
data.gX >= 120 &&
data.gX <= 140 &&
data.gY >= 110 &&
data.gY <= 130 &&
data.gZ >= 120 &&
data.gZ <= 130) {
    BT.println("THANK YOU");
    Serial.println("THANK YOU");

  } else {
    // If none of the specific gestures are detected, send a default message
    Serial.println("Gesture not recognized");
}

  delay(1000); // Reduce delay for more responsive speech
}
```

## Appendix D

## CURRICULUM VITAE

### CONTACT

jgcbaluyot777@gmail.com

09214038354

N1B1 Coastal Plaza Condominium, Brgy. Daniel Fajardo, Las Piñas City

### SKILLS

- Computer Networking
- Fundamental Computer Literacy
- Critical Thinking
- Computer Hardware Troubleshooting

### REFERENCE

**Mr. Dennis Quinto, MBA**
BSIT Program Chair, Olivarez College
09958467404

**Ms. Robelyn B. Pilotos**
Olivarian Echo Publication Adviser
AB Communication Program Chair, Olivarez College
0976 077 9411

**Ms. Joanah Marie O. Santos, MAEd, LPT**
Olivarian Peer Facilitator - Adviser
College Guidance Counselor
09634726343

# JERICHO GERALD C. BALUYOT

I.T STUDENT

Multitasking achiever 4th year student of Bachelor of Science in Information Technology, searching for an on-job training opportunity that will step up my game, not just in the field, but as a person. Critical thinker, problem solver, collaborator and knowledgeable in computer networking and hardware.

### TRAINING AND SEMINARS ATTENDED

- RI5E - Technology Seminar Day 5(FEU)
- Anti - Hazing Act(RA 8049)
- Data Privacy Act of 2012
- SDG5 - Gender Equality
- DOST - Understanding GAD Concept
- TESDA - Practicing COVID-19 Preventive Measures in the Workplace
- Understanding Anxiety: Raise Awareness and Break the Stigma

### EDUCATIONAL HISTORY

**Olivarez College - Paranaque**
Bachelor of Science in Information Technology
2021 - Present

- Olivarian Echo Publication Head Writer || 2023-2024
- Secretary || 2023
- Campus Ministry Volunteer || 2022 - Present
- Olivarian Echo Publication Writer || 2022-2023
- Olivarian Peer Facilitator - Representative || 2022-
- Dean's Lister || 2021 - Present

### PORTFOLIO

**THESIS/CAPSTONE**
WLVocGenARG: Development of a Wireless Voice-Generating Arduino Gloves for the Deaf Used for Virtual Communication

- A wireless voice-generating gloves with speech transcription feature through Bluetooth, which enables young deaf people, as well as whole population to have two way communication

# ERICKA MAE RODILLO

## PROFILE

Detail-oriented and motivated individual with a solid understanding of computer fundamentals, including proficiency in MS Word, Excel, and other office applications. Seeking an entry-level position where I can apply my computer skills to contribute to the efficiency and productivity of the team. Eager to learn and grow in a supportive work environment.

## CONTACT ME

+63 9612272705

erickarodillo@gmail.com

Pembo, Makati City

## HIGHEST EDUCATIONAL ATTAINMENT

**OLIVAREZ COLLEGE**

*Bachelor of Science in Information Technology*

2022-2023

## COMPUTER SKILLS

Data Entry and Database Management

Typing Proficiency

Email Management

Document Management

## CONTRACT EXPERIENCE

**COMELEC DISTRICT 2 | 2022**

Organizing and maintaining of voter registration documents and related files for easy access and retrieval.

# JOHN SYTE L. TIOPES

IN ORDER TO IMPROVE MYSELF AS A PERSON, I WANT TO IMPART ALL OF MY KNOWLEDGE AND ABILITIES TO EVERYONE.

## Contact

**Phone**
+63 9154555633

**Email**
tjsyte@gmail.com

**Address**
John St., Multi. Village Brgy. Moonwalk Parañaque City

## Character References

**Name / Position**
***Dennis Quinto***
*Head, College of Computer Studies Olivarez College 826-07-50 Local (114)*

## Personal Information

Age: 21
Birthdate: July 27, 2002
Height: 5'5
Nationality: Filipino
Place of Birth: Parañaque City

## Education

**Primary**
School: Col. E. De Leon Elementary School
Date: 2009 - 2015

**Secondary**
Junior High School: Parañaque National High School - Main
Date: 2015 - 2019
Senior High School: Parañaque National High School - Main
Date: 2019 - 2021

**Tersiary**
School: Olivarez College
Date: 2021 - Currently Attending

## Seminars Attended

TESDA - Computer System Servicing NC II - Immersion Program