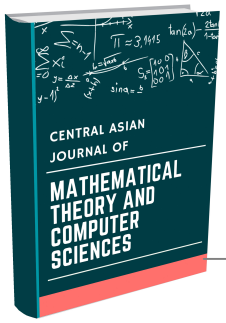

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Speak the Sign: A Real-Time Sign Language to Text Converter Application for Basic Filipino Words and Phrases

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Abstract:

This study was conducted with the aim to develop a web-based real-time application which recognizes Filipino Sign Language (FSL) and converts it into text. Purposive sampling was used to determine a total of 30 respondents: 9 Special Education Students, 7 Special Education Teachers, and 14 Non-Disabled People. The study focused on the following variables: the independent variable, the level of acceptability in terms of content, design, and functionality; and the dependent variable, SPEAK THE SIGN: A Real-Time Sign Language to Text Converter Application for Basic Filipino Words and Phrases. A researcher-made questionnaire was used to gather data on both variables. The statistical tools used in the study were frequency count, sum, percentage, and mean. The results show that according to the three sets of respondents, the level of acceptability of the web-based real-time converter application in terms of content, design, and functionality falls under the ―Very Highly Acceptable bracket. The very highly acceptability of the application among the three sets of respondents suggest that the application was a user-friendly and beneficial for the respondents in closing the communication gap. This can also be an excellent way for non-disabled people to fully understand and appreciate the importance of learning primary Filipino Sign Language(FSL).

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Introduction

Communication plays an important role for human beings. More so, such is so vital especially to these challenged individuals. Good communication contributes to greater comprehension, and it benefits everyone in the society, including the deaf and speech impaired people. In the Philippines, 1.23% of the entire population is deaf, mute or hearing impaired (Session et al., 2014). With the sign language as the mother language of the deaf and speech impaired people, the combination of hand movements, arms or body gesture, as well as facial expressions are their means of communication (Harkude et al., 2020). However, most of the people blessed with the ability to hear and speak are not well versed with sign language,

thus leading to communication gap. This application seeks to close the communication gap and assist the deaf and speech impaired in using technology to conduct everyday transactions by using a quick and easy-to-implement approach.

In terms of programming the application, Python is a programming language which can be used to create Application Programming Interfaces (API) for applications. This programming language allows app developers to design programs that can operate on a variety of operating systems (Hill, 2020). Moreover, Browser technology, Web Internet infrastructure, protocol standards, software engineering approaches, and application trends will all play a role in future Web application development (Jazayeri, 2007). However, because online applications contain a huge amount of data that may contain errors, the testing method for web apps is more thorough than for other types of software. Security, performance, load, stress, accessibility, usability, and quality assurance testing are examples of web application development tests. (TechTarget, 2010).

Furthermore, Python can be used in a wide array of application areas. This application is designed and built in such a way that the gestures are detected from the obtained input images and are converted to its standard format (i.e. the converted hand gestures are represented in Filipino language) (Kulkarni & Badhe, 2015). Python OpenCV library can be used to capture sign gestures from computer's internal camera. The dataset for various signs is collected. To predict gestures with high accuracy, around 3000 images are collected for each sign. This is why Python is an ideal programming language and favored by a lot of developers for utilizing deep learning programs or most commonly known as machine learning.

Machine learning allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Specifically, supervised machine learning is a type of machine learning where data scientists train the algorithm with both labeled inputs and desired outputs (Burns, 2021). Moreover, Long Short-Term Memory (LSTM) networks are a type of recurrent neural network that could learn order dependence in sequence prediction problems. This is a necessary behavior in complex problem domains such as machine translation, speech recognition, and others. (Brownlee, 2020). This technological tool can be used in different applications such as real-time sign language recognition which have shown remarkable success and momentous development (Elakkiya, 2021).

In connection to this, the main purpose of this research capstone was to develop a real-time sign language to text converter application for basic Filipino words and phrases for deaf and non-disabled people. With the increasing use of mobile phones and applications, this application can provide potential benefits for deaf and speech impaired people, non-disabled people, and other sign language interpreters. This will be able to contribute in the field of linguistics, and it can help deaf and speech impaired raise their confidence and give them the opportunity to be accepted in the community as a regular person.

Statement of the Problem

The research capstone entitled "SPEAK THE SIGN: A Real-Time Sign Language to Text Converter Application for Basic Filipino Words and Phrases" was conducted with the aim to develop a web-based real-time application which recognizes Filipino Sign Language (FSL) and converts it into text for Special Education Students, Special Education Teachers, and Non-Disabled People. This is in order to have a good communication that leads to better understanding and encompasses all the members of the community, including the deaf and speech-impaired people.

Specifically, this project sought to answer the following questions:

1. What is the level of acceptability of — SPEAK THE SIGN: A Real-Time Sign Language to Text Converter Application for Basic Filipino Words and Phrases among Special Education Students in terms of:

a. Content

b. Design

c. Functionality

2. What is the level of acceptability of — SPEAK THE SIGN: A Real-Time Sign Language to Text Converter Application for Basic Filipino Words and Phrases among Special Education Teachers in terms of:

a. Content

b. Design

c. Functionality

3. What is the level of acceptability of ― SPEAK THE SIGN: A Real-Time Sign Language to Text Converter Application for Basic Filipino Words and Phrases among Non-Disabled People in terms of:

a. Content

b. Design

c. Functionality

Methodology

Research Design

Research and Development (R&D) was the research design used in this study.

Participants

The participants of this study were 7 Special Education Students and 4 Special Education Teachers from Kalibo Integrated Special Education Center, 2 Special Education Students and 3 Special Education Teachers from Kalibo Pilot Elementary School, and 14 non-disabled people for a total of 30 respondents. Furthermore, purposive sampling, also known as judgement sampling which entails the researcher using their expertise to pick a sample that is most beneficial to the research's goals (McCombes, 2019), was used in selecting the participants of the study.

Data-Gathering Instrument

Researchers-made rating scale questionnaire, entitled ― SPEAK THE SIGN Application Rating Checklist was used as the main data collecting tool of the research capstone project. The purpose of this questionnaire was to determine the level of acceptability of SPEAK THE SIGN: A Real-Time Sign Language to Text Converter Application for Basic Filipino Words and Phrases in terms of content, design, and functionality. This data collecting tool was appropriate for the study because rating scale questionnaires measure the opinions of a group of people.

The questionnaires contained favorable statements, which were in accordance with the criteria on the level of acceptability of the mobile application namely content, design, and functionality. There were five statements in each criterion, having a total of 15 statements. A comments and suggestions portion were added for recommendations for the application.

Results and Discussions

Level of Acceptability of SPEAK THE SIGN in terms of Content, Design, and Functionality to Special Education Students

The results found in Table 2 showed that according to the standards of Special Education Students, SPEAK THE SIGN is a very highly acceptable web-based real-time sign language to text converter application for basic Filipino words and phrases, with an overall mean score of 4.49. Specifically, the responses of the respondents indicate that the web-based real-time sign language to text converter application is very highly acceptable in all of its three criteria: content, design, and functionality.

The design of the web-based real-time sign language to text converter application caught the interest of Special Education students more than the content and functionality. This implies that deaf students are more likely to be interested in web design, animation, and application design.

Based on the assessment of Special Education Students, design has the highest mean score as compared to the other criteria, mainly because they are more likely interested in areas related to visual aids. The application has a user-friendly design and layout that can put the Special Education Students at ease and create a clear understanding. Moreover, they are attracted more on the color scheme and typeface chosen which is why they think that it suits the content, mood, and purpose of the application.

On the other hand, content had the second highest mean score with a descriptor of ―Very Highly Acceptable because the respondents were aware that Filipino Sign Language is largely unrecognized by government in the language domains of schools, courtrooms, the workplace, hospitals and mass media. In the community, both deaf and hearing Filipinos may still disregard FSL as an authentic linguistic entity (Martinez and Cabalfin, 2008). This is one of the reasons why Special Education Students think that the application contains sufficient basic FSL gestures that can be translated into words and phrases. The purpose of the study was also conferred by the respondents because, in this way, the communication barriers between hearing people and the hearing-impaired will hopefully be greatly diminished.

Furthermore, the Special Education Students rated the functionality lower compared to other criteria. Functionality could also be improved because the video on how to use the real-time sign language to text converter application was not fully shown to the respondents. The researchers made a video for the respondents to see how to use the app. However, the application can only function on a trained computer device, which is the reason why the researchers had difficulty with the presentation of the application to the Special Education Students.

Overall, respondents gave the web-based real-time sign language to text converter application a very high rating due to its sufficient basic Filipino words and phrases for translations in the content, user-friendly design, and functions appropriately. According to the respondents, SPEAK THE SIGN would be a huge help in closing the communication gap between them and the hearing people. This supports the study of Garcia et al. (2016), in which they stated that sign language is a system of communication using visual gestures and signs, as used by deaf people. In line with this, the researchers' application, as well as other sign language converter applications, will help to promote the Philippines' indigenous sign language, thereby supporting a section of House Bill No. 6079 on education.

Table 1

Means of the Level of Acceptability of SPEAK THE SIGN to Special Education Students in terms of Contents, Design, and Functionality.

Variable	Mean	Description
Content	4.49	Very Highly Acceptable
Design	4.52	Very Highly Acceptable
Functionality	4.45	Very Highly Acceptable
Over-all	4.49	Very Highly Acceptable

Scaling	Descriptors
4.21 – 5.00	Very Highly Acceptable
3.41 – 4.20	Highly Acceptable
2.61 – 3.40	Acceptable
1.81 – 2.60	Less Acceptable
1.00 – 1.80	Least Acceptable

Level of Acceptability of SPEAK THE SIGN in terms of Content, Design, and Functionality to Special Education Teachers

Overall, the results show that Special Education Teachers considers SPEAK THE SIGN, with an overall mean score of 4.41, as a very highly acceptable web-based real-time converter application. Specifically, the responses of the respondents indicate that the web-based real-time converter application is very highly acceptable in all of its three criteria: content, design, and functionality.

Interestingly, Special Education Teachers rated the criterion content lower compared to the other two groups. This could be attributed to their comprehensiveness in assessing the web-based real-time converter application in terms of its content. This implies that the respondents were interested in validating the accuracy of the application based on their extensive knowledge and expertise in teaching Special Education Students.

Moreover, the web-based real-time converter application was rated very highly acceptable in terms of functionality by the Special Education Teachers. The respondents operated and manipulated the application and acknowledged its ease of use. This implies that the respondents encountered no difficulties or errors while using the application.

Out of the three criteria, functionality was rated the highest by the Special Education Teachers. One of the reasons for this is the utilization of the basic elements of design in the converter application. The respondents strongly agreed that the application is cohesive in terms of the typeface, color, font size, and images chosen which made the application appealing and straightforward.

However, the researchers acknowledge that design could be more improved. Since the application is still on its early phase, the design could still be improved in terms of its layout. Fortunately, the web-based real-time converter application had seen positive remarks in terms of the typeface, color, font size, and images incorporated and minimal negative feedbacks were pointed in this criterion.

In general, Special Education Teachers responded that SPEAK THE SIGN was very highly acceptable to use. Although they rated lower compared to the other two groups, their insights are valuable and

trustworthy due to their vast knowledge and experience in teaching Special Education Students. As Special Education Teachers, this application could be utilized in pedagogical opportunities not just for special education students but for non-disabled students as well. This conforms to the study Hadjerrouit (2017) where technological opportunities such as mathematical software, and in this study, sign language converter application, could provide a foundation for pedagogical or teaching opportunities by aiming to minimize the students' cognitive load and improving the accessibility of learning.

Table 2

Means of Level of Acceptability of SPEAK THE SIGN to Special Education Teachers in terms of Content, Design, and Functionality

Variable	Mean	Description
Content	4.40	Very Highly Acceptable
Design	4.43	Very Highly Acceptable
Functionality	4.41	Very Highly Acceptable
Over-all	4.41	Very Highly Acceptable

Scaling	Descriptors
4.21 – 5.00	Very Highly Acceptable
3.41 – 4.20	Highly Acceptable
2.61 – 3.40	Acceptable
1.81 – 2.60	Less Acceptable

Level of Acceptability of SPEAK THE SIGN in terms of Content, Design, and Functionality to Non-Disabled People

The results, as seen on the table 3 below, show that according to the standards of non-disabled people, SPEAK THE SIGN is a very highly acceptable web-based real-time converter application, with an overall mean score of 4.59. Specifically, the responses of the respondents indicate that the web-based real-time converter application is very highly acceptable in all of its three criteria: content, design, and functionality.

Among the groups of respondents, non-disabled people have the highest overall score for the level of acceptability of SPEAK THE SIGN as a web-based real-time converter application. This implies that the respondents were interested in learning the sign language more conveniently with the use of technology. Furthermore, the respondents found the application helpful especially to those who are willing to learn basic sign language of the Filipino words and phrases.

In addition, the web-based real-time converter application was rated very highly acceptable in terms of content having the highest score mainly because the knowledge of the respondents on sign language is very limited. They don't even know few basic sign languages thus it helps them better understand through the web-based real-time converter application. Furthermore, it was suggested for the web-based real-time converter application to add more words and phrases and making an English version of the web-based converter application.

Similar to content, design also had the description of "Very Highly Acceptable" because the respondents prefer the simple visual elements integrated in the application. The respondents found the color scheme of the application cohesive and consistent; the design is straightforward, with no overly reactive information; and the typeface chosen suits the content, mood, and purpose of the web-based real-time converter application. Furthermore, it was suggested for the web-based real-time converter application to have different design aesthetics so that the users can choose a layout that best suit their style.

On the other hand, functionality could be more improved. One reason for this is the detected results are not consistent and it disappears from time to time. However, the web-based converter application is easy to navigate and sign language conversion feature of the application functions smoothly.

Overall, according to non-disabled people, SPEAK THE SIGN was "Very Highly Acceptable" to use as a web-based real-time application that can give conversions of basic Filipino words and phrases. This is very beneficial for non-disabled people as it can close the communication gap between deaf and speech-impaired people. This supports the study of Bowman-Smart (2019) where learning sign language will benefit individual, as it will improve individual's overall communication skills and provides cognitive advantages that come from being bimodally bilingual.

Variable	Mean	Description
Content	4.71	Very Highly Acceptable
Design	4.59	Very Highly Acceptable
Functionality	4.47	Very Highly Acceptable
Over-all	4.59	Very Highly Acceptable

Table 3

Means of Level of Acceptability of SPEAK THE SIGN to Non-Disabled People in terms of Content, Design, and Functionality

Scaling	Descriptors
4.21 - 5.00	Very Highly Acceptable
3.41 - 4.20	Highly Acceptable
2.61 - 3.40	Acceptable
1.81 - 2.60	Less Acceptable
1.00 - 1.81	Least Acceptable

Conclusions

Based on the findings of the study stated above, the following conclusions were made:

1. The results showed that "SPEAK THE SIGN: A Web-Based Sign Language Converter Application among Special Education Students" is very highly acceptable to Special Education Students in terms of content, design, and functionality. Because it is easy to navigate and functions smoothly, the web-based sign language to text converter application received a very high acceptability rate from Special Education Students. Despite some inaccuracies in detecting words, particularly basic phrases, respondents find our application to be user-friendly and useful as an alternative for effectively communicating with people who do not understand sign language. As a result, hearing-impaired people will be able to communicate with those who can hear and speak more easily and effectively. Additionally, the application may be used to teach basic Filipino sign language to non-hearing impaired people. Non-disabled persons may no longer have an excuse to ignore hearing-impaired people because they will be understood by a wider number of people.

2. The findings revealed that in terms of content, design, and functionality, "SPEAK THE SIGN: A Web-Based Sign Language Converter Application among Special Education Students" is very highly acceptable to Special Education Teachers. Because the application obtained such a very high acceptability rating from Special Education Teachers, it shows that they find our software valuable in teaching Filipino sign language to their special education students and their parents. Furthermore, because the app contains enough Filipino sign language movements translated into words and sentences, functions well according to its features, and includes user-friendly design and layout, Special Education Teachers have awarded it a very high rating. Therefore, special education teachers strongly believe that our application will help their work especially their students. Additionally, because the application converts hand motions into text smoothly, miscommunication between the teacher and the student can be prevented. This will also be an excellent approach for parents to learn Filipino sign language more effectively and efficiently.

3. The results showed that "SPEAK THE SIGN: A Web-Based Sign Language Converter Application among Special Education Students" is very highly acceptable to non-disabled people in terms of content, design, and functionality. A very high acceptability rating from non-disabled people means that our application is beneficial not just for deaf and hard of hearing people but also for non-deaf ones. Furthermore, non-deaf individuals found our application to be a helpful tool for communicating with people who are deaf. Although our program has certain mistakes and lacks some of the terms necessary for basic conversation, the respondents gave it a very high acceptability rating. Thus, the application can also be an excellent way for non-disabled people to fully understand and appreciate the importance of learning primary Filipino sign language.

Recommendations

Based on the findings and conclusion presented, the following recommendations are suggested:

1. Since some of the deaf and speech-impaired people were not familiar in using Filipino Sign Language, it was recommended to use this web-based application for them to learn basic Filipino Sign Language and gain more confidence in interacting with other hearing people. Using FSL in today's generation is largely unrecognized,

however, we can use this step to further acknowledge the use of FSL in the Philippines.

2. Special Education Students are recommended to use this web-based application to improve their knowledge about Filipino Sign Language. Moreover, they may also encourage others like their families and friends to try this application because it will help them close the communication gap between them.

3. Special education teachers are recommended to continually use the SPEAK THE SIGN as effective tool for teaching Filipino sign language to their special education students and their parents. SPEAK THE SIGN could be a useful web-based real-time converter application not just for special education students but for non-disabled students as well. Furthermore, studying sign language promotes better awareness for deaf and speech-impaired community.

4. For non-disabled people, it is recommended to learn the basic Filipino sign language through SPEAK THE SIGN. In that way, they can fully understand and communicate to the deaf and speech-impaired people. Moreover, they would develop a strong appreciation for deaf culture, and they can promote understanding and acceptance of the language among others.

5. To the future researchers, it is recommended to improve the content, design, and functionality of the web-based real-time sign language converter application in order to know more about its features and limitations. Likewise, it is advised to upgrade the application by increasing the amount of reference photos for each word to increase the accuracy of each conversion so it could also detect dynamic gestures and convert it into words and phrases. This would solve the drastic fluctuations as observed by one of the respondents.

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