Removing Conversational Barriers for the Communication-Impaired Individuals

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ABSTRACT
Communication disorders can be problems with talking, hearing, or understanding. They affect how we use language and symbols to communicate. These problems can include trouble with speaking clearly, understanding language, or hearing. Communication disorders can range from mild to severe, depending on how complex the issue is. One common way people communicate is through gestures or sign language. Gestures or sign language are actions we make with our hands, face, or body to send messages. They can be used instead of or along with speech. Unlike other body movements that don't convey specific messages, gestures let us express various feelings and thoughts. Processing gestures happens in parts of the brain used for speech and sign language. Some think that language might have started from manual gestures, a theory called Gestural Theory.

Keywords
Application, Blind, Communication-Impaired Individuals, Conversational Barriers, Communication, Deaf, Mute, Open-Source Electronic Platform, Sign Language.

1. INTRODUCTION
Individuals with communication difficulties experienced impairments in voice, hearing, and sight. Some were born with these challenges, while others developed them over time due to accidents or aging. People with this condition were deemed to have two of the most debilitating disabilities. Although there were several methods to facilitate communication and enable them to lead relatively normal lives, they encountered significant daily challenges. It was crucial to address these communication impairments, as failing to do so could lead to isolation, depression, and loss of independence. The proponents presented a more adaptable project than the existing features. The project enabled communication-impaired individuals to communicate with one another and with everyone else without troubles.

[1] The project provided a solution for these people to communicate with everybody else without any problem. It was an IoT-based project that converted hand gestures into synthesized textual format. The apparatus included a glove equipped with flex sensors across all the fingers to discern hand orientation. As the hands and fingers moved, the device detected words and numbers based on the gestures. A Bluetooth speaker was connected to a Raspberry Pi, which translated the detected text into speech. To standardize gestures, the device required testing on multiple subjects. In this study, gesture-to-speech conversion was conducted using only one hand. The proponents presented a more adaptable project than the existing features. The project enabled communication-impaired individuals to communicate with one another and with everyone else without troubles. Given that sign language was not something that everyone was familiar with, they could select which mode they preferred, which user they were, and what input and output they needed.

2. RELATED LITERATURE
This passage discusses communication as the transfer of information, often through vocal means. It highlights the challenges faced by deaf and mute individuals in expressing their thoughts verbally, leading to difficulties in communication with sighted people. For deaf-blind individuals, issues with mobility and communication pose significant challenges, contributing to feelings of loneliness and isolation. The text emphasizes how being deaf or mute can create substantial barriers in a person's life, leading to intense despair [2]. The impact of muteness and deaf- blindness varied widely among individuals, influenced by factors such as the specific nature of their hearing, vision, and speech impairments, the causes of these conditions, other medical issues they faced, as well as their attitudes, personalities, and life experiences. For some, the effects were minimal, especially if they had good self-support systems in place. A few simple adjustments or the use of technology sufficed for them. Others required more assistance from support workers or communication guides to navigate daily tasks. Importantly, even small changes in the behavior and communication of friends and family members could make a significant difference in the lives of those affected by muteness and deaf-blindness. With the help of technology, people with disabilities and normal people could communicate more efficiently. Normal people improved in using sign language to interact with people with disabilities who were mute, deaf, and blind people every day [3].

A person with disabilities such as deafness and muteness communicated using sign language to express their thoughts. Both the person with the disability and those without communicated through sign language, text, and modern technology. Mute individuals utilized sign language and other forms of communication to convey their thoughts and words to the person they were communicating [4]. Blind individuals faced significant challenges due to their inability to see real-life objects and read text. To assist them, recognized text characters were converted into audio format, aiding in their identification by blind users. The primary difficulty for the blind was their inability to read and see, making interactions challenging. Our project adopted a similar approach to the Tesseract OCR technique, converting text characters into audio. However, we took it a step further by inputting text into our database and processing it into audio output [5]. Several existing technological solutions aimed to mitigate challenges for deaf and mute individuals. The proponents developed a tool enabling communication between mute-deaf individuals and others. This system, designed as a learning tool, observed user behavior to enhance reliability.

Additionally, a device was created to facilitate communication among deaf, mute, and blind individuals, aiding them in communicating effectively with both disabled and non-disabled individuals [6]. Communication with hearing-impaired individuals, such as the deaf and mute, presented a significant challenge in society at that time. Their primary means of communication, such as Sign Language or hand gestures, often required an interpreter for every interaction. The conversion of images to text and speech could greatly benefit both hearing and hearing- impaired individuals, especially the deaf and mute, facilitating daily interactions involving images. The research aimed to convert American Sign Language (ASL) images into text and speech, providing an unsupervised learning feature for signed hand gestures. The goal was to develop a system that could return corresponding text and speech output from ASL images [7]. This method utilized a webcam displayed the results of what the mute person wanted to communicate, enhancing communication accessibility [8]. The primary aim of the technology was to promote independence and confidence among individuals with disabilities by providing them with the ability to see, hear, and speak through the device. The study introduced a Google API and Raspberry Pi-based aid for the blind, deaf, and mute. Visually impaired individuals could utilize the device to read by capturing an image, which underwent image-to- text conversion and voice synthesis. For those with hearing impairments, the device utilized a microphone to convert input voice into text, displayed as a pop-up window on the device's screen [9].

3. METHODOLOGY

The proponents conducted interviews for the proposed project, entitled Removing Conversational Barriers for the Communication-Impaired Individuals with respondents, ensuring permission was granted before gathering insights in face-to-face sessions during their free time. These interviews provided valuable ideas and insights for the project's development. Proponents prepared questions in advance and followed up with additional inquiries to gather comprehensive data as needed.

The proponents conducted in-person observations to gather insights from communication-impaired individuals, focusing on their methods of communication, daily activities, and needs. They observed how mute-deaf individuals interacted with family members, whether they used sign language or text, and identified their daily requirements.

The proponents developed a comprehensive project design encompassing database, network, and web application components using wireframe and schematic diagrams. They meticulously gathered resources via web browsing to understand project objectives and required components. Utilizing software applications and IDEs facilitated visualizing the placement of components, including the single board controller. Additionally, they designed a user- friendly web application allowing users to select preferred modes and input/output requirements, enhancing project functionality and user experience.

The first formula [1] is a survey form for communication-impaired individuals and family members regarding the system. The second formula [2] is utilized to consolidate all stakeholder assessments on the system's efficiency. connected to the system to capture images. The input image underwent preprocessing to remove noise and smooth the image using a threshold. Users could view the classification results, and the system also converted the recognized gestures into speech using the Windows Text to Speech API. The training dataset consisted of 5 gestures, each with 50 variations under different lighting conditions. Through this system, individuals could potentially express themselves using sign language, enabling them to have meaningful conversations using a webcam. Additionally, the system

4. PRESENTATION OF ANALYSIS OF DATA

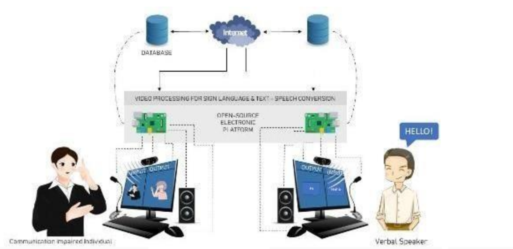

Figure 1. Operational Framework for the Proposed Project

To develop the proposed project, Removing Conversational Barriers Tool for the Communication-Impaired Individuals, based on the Operational Framework for the Proposed Project (see Figure 1) The open-source electronic platform served as the single board controller, where all the components were connected. The webcam captured sign language for deaf or mute people, while the microphone captured audio for blind and normal people, and the keyboard served as text input for normal and mute people. After the webcam, microphone, and keyboard inputs collected data, it went through either video processing, audio, and text processing to produce output appropriate for the receiver of the message. The open-source electronic platform was in charge of the processing or conversion. The project required an internet connection to access web applications for users. The databases were used for data repository that was needed for the display. The proposed project's functionalities follow:

- It can convert speech input into sign language output.
- It can convert speech input into speech output.
- It can convert speech input into text output.
- It can convert sign language input into sign language output.

- It can convert sign language input into speech output.
- It can convert sign language input into text output.
- It can convert text input into sign language output.
- It can convert text input into text output.
- It can convert text input into speech output.

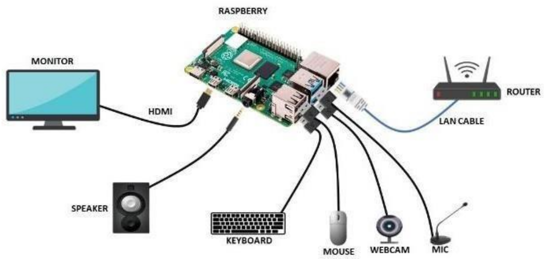

Figure 2. Schematic Diagram of Removing Conversational Barriers for the Communication- Impaired Individuals

The schematic diagram in (see Figure 2) shows the connections of all the components at once. Raspberry Pi served as the single board controller in this wireframe, which included

a webcam, speaker, microphone, mouse, keyboard, and monitor. This project was used by communication-impaired individuals to communicate with each other or even with other people. The web-based application is connected to the internet, allowing users to communicate even when they were far from each other.

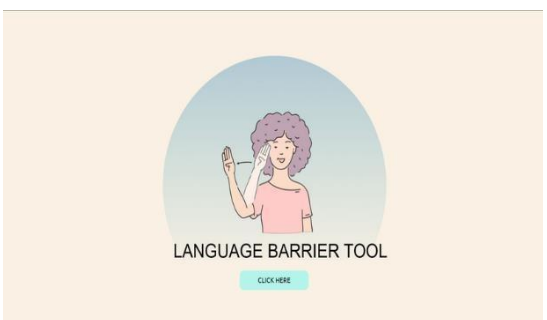

Figure 3. Web Application

The proponents designed the main screen or the first display of the web application (see Figure 3). The first screen contains the logo and a button. When the button is clicked, the main screen will transition to the second screen, which features a dashboard. The dashboard screen provided the user interface (UI) options to select their preferred input method, including Speech, Text, and Sign Language, providing users with three distinct ways to engage with the website. It also features a back button that allows you to return to the second screen. Clicking on the Dashboard will also take you back to the second screen.

Figure 4. Connection of all modules in Raspberry Pi based on Schematic Diagrams

The proponents began the integration of components for the prototype, coding the system in a step-by-step process to fulfill all the required features of the project. A suited algorithm is used as well as the language supported by the open-source electronic platform. During this phase, the proponents set a timeframe to complete the step-by-step process and must apply a variety of project management methods to track and monitor the project's development. Following the development of the units, the proponents conducted unit testing to ensure that all of the program's smaller units' function properly and to assess whether the system is ready for the next phase of the project. This stage is repeated until the system satisfies the requirements established by the users. After connecting the components to the microcontroller. The prototype was created by integrating it with sign language recognition, voice input, and text input where other components were also installed (see Figure 4).

Figure 5. Proponents Testing the Sign language, Voice Input, and Text Input

The Thonny IDE was used to upload code and programs to the microcontroller for the components to function properly as shown in (see Figure 5). This software is used to write code, compile code, and upload code to the Raspberry Pi. The supporters chose this software because it is both appropriate for the project and widely used. The code for sign language, voice, and text inputs/outputs on the Raspberry Pi was uploaded so that supporters could determine whether or not the microcontroller was working. After testing the microcontroller, the project's supporters were able to code it by connecting the all the components to the Raspberry Pi. By including the sign language, text and voice inputs/outputs, you must also include the library required for this to function. When activated, the sign language, voice, and text modules were detected. The proponents also tested the camera module.

The proponents created web app to create the actual interface and to display the inputs and outputs for the clients. We utilize Firebase to store input data, facilitating its transfer to other users for displaying the outputs. All components are tested by the proponents as well as the I.T. expert. A project must be tested on both hardware and software. Before deployment, the project's proponents did a thorough system test, so they should be aware of the defects and errors that must be rectified for the system to function properly as shown in. During the trial, the project's proponents encountered several problems, but they were able to correct them to ensure that the project's objectives were met. Hardware faults included poor cabling for devices, as well as mistakes in software. The project's proponents rapidly addressed these difficulties, and additional testing was carried out at this point to guarantee that the prototype was built with few faults and matched the project's criteria. Regular testing and monitoring would be beneficial in determining what defects and errors may develop in this project, so that they may be addressed following the project's requirements.

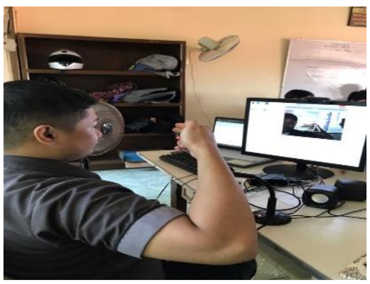

Figure 6. Thonny IDE Output Serial Monitor for Sign Language Detection

Hardware and software testing are essential to ensure that a project is usable for user. The project's proponents tested the entire system because identifying faults and problems before project deployment is critical to ensuring system stability. Proponents run the programs to detect bugs and also to see how accurate it is when executing the software (see Figure 6). The deployment phase started with a briefing of the project prototype to the stakeholders. During this part, proponents explained to the clients the functionalities of the project. After the briefing, the proponents started to test the prototype to the client. The proponents initialized the software and started the testing.

Figure 7. Mute Person testing the Project

The proponents discussed the project with Mr. Lorenzo Bautista, the guardian of a mute person, explaining the website's features. They demonstrated the user interface and key functionalities, such as communication tools and accessibility options. Mr. Jerry Bautista tried Sign Language input, while the guardian tested Text-to-Sign features. The project aimed to ease communication challenges (see Figure 7).

Figure 8. Proponents presenting the Web Application to Family Member

During the testing of the sign language conversion, the sign language recognition activates simultaneously with other conversions based on the family members' chosen preferences. The user can input sign language letters using the camera, which are then transmitted to Firebase and displayed to the family member (user 2). The family member can view the inputted sign language from the mute individual on the web app. Additionally, the proponents demonstrated other functionalities of the web app, such as the ability to change preferred conversions (see Figure 8).

5. RESULT, CONCLUSIONS, AND RECOMMENDATIONS

Table 1. Mute person, Deaf person, Blind person and Family members

Family Member	100 %
Mute Person	100 %
Deaf Person	100 %
Blind Person	100 %
Total	**100%**

The overall effectiveness rate of the project, as evaluated by both communication-impaired individuals and their family members, was 100% (see Table 1). This indicates high satisfaction with the project's usability, functionality, and ability to facilitate effective communication.

Project Removing Conversational Barriers for the Communication Impaired Individuals aimed to facilitate communication for individuals with various impairments, including mute, deaf, and blind individuals. Through surveys administered to both the communication-impaired individuals and their guardians, valuable insights were gathered to evaluate the effectiveness and efficiency of the developed system.

The surveys involved clarifying questionnaire contents, ensuring comprehension, and gathering feedback on the system's usability and functionality. Positive feedback was received across all categories, indicating satisfaction with the project's performance.

The communication tool seamlessly translates sign language and text into verbal speech, promoting inclusivity for individuals with diverse communication preferences. Despite challenges in predicting sign language accurately, the tool achieves a 95% accuracy rate overall. Stakeholder evaluations resulted in a 100% satisfaction rating, confirming the tool's efficiency in facilitating communication for communication-impaired individuals and their relatives.

It is recommended that the letter-by-letter sign language conversations are time-consuming and recommended converting entire words instead. Minor improvements suggested include organizing the wiring, ensuring a strong internet connection, and enhancing text clarity and size for adult users.

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