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SIGN LANGUAGE TO TEXT AND SPEECH CONVERTER

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ABSTRACT—

In a world that prioritizes inclusivity, effective communication is essential for empowering the deaf and hard-of-hearing community, with sign language serving as a fundamental mode of expression. However, the general lack of proficiency in sign language highlights a pressing need for innovative solutions, such as sign language translators, to bridge this communication gap. This paper is designed to facilitate communication for individuals who rely on sign language by translating hand gestures into both written and spoken language. The system consists of a glove equipped with flex sensors connected to an Arduino UNO microcontroller, which interprets finger movements as specific gestures. These gestures are then converted into text displayed on a LCD screen and simultaneously into audio output through a voice module and speaker. By enabling real-time conversion of sign language into text and speech, this device aims to bridge communication gaps, especially in settings where interpreters may not be available. Its portability, affordability, and user-friendly design make it a practical solution for enhancing accessibility and fostering inclusivity, empowering non-verbal individuals to communicate seamlessly with those unfamiliar with sign language.

Keywords- Sign Language Recognition, Text-to-Speech Conversion, Communication Accessibility.

INTRODUCTION

Communication is an essential part of life and a fundamental skill that shapes how we interact with others. In a world where communication is key to social inclusion, individuals who rely on sign language often face barriers when interacting with those who do not understand it. Sign language is a non-verbal system that uses visual signs and gestures to convey meaning, serving as a crucial bridge for those with speaking and/or hearing disabilities. This gap in communication can lead to social isolation, limited opportunities, and a lack of independence for non-verbal individuals. Therefore, there is a growing need for an innovative solution that provides real-time, accessible, and convenient translation of sign language into a form that everyone can understand. To address this issue, our paper offers a practical solution, translating sign language gestures into text and speech to facilitate seamless communication for those unfamiliar with sign language.

This paper, the “Sign Language To Text And Speech Converter”, aims to address this challenge by offering a portable and user-friendly device that converts hand gestures into both text and audio outputs. By using a glove fitted with flex sensors that detect finger movements, an Arduino UNO microcontroller processes each gesture and converts it into corresponding text, which is displayed on a LCD screen. Additionally, the system uses a voice module and speaker to output the text as speech, allowing non-verbal individuals to communicate directly with others. Through this device, we aim to empower individuals who rely on sign language, enhancing their ability to interact, participate, and be included in diverse social, educational, and professional settings.

LITERATURE SURVEY:

[1] The investigation done by Ahmed, Syed Faiz, et al. reveals ELECTRONIC SPEAKING GLOVE, designed to facilitate easy communication through synthesized speech for the benefit of speechless patients. This project is designed to solve this problem. Gestures of fingers of a user of this glove will be converted into synthesized speech to convey an audible message to others, for example in a critical communication with doctors. The glove is internally equipped with multiple flex sensors that are made up of “bend-sensitive resistance elements”. For each specific gesture, internal flex sensors produce a proportional change in resistance of various elements.

[2] According to research Chandra, Malli Mahesh, et al. , prototype has proposed to give speech output for the Sign Language gestures to bridge the communication gap between the people with speech impairment and normal people. This prototype consists of a glove which has flex sensors, gyroscopes and accelerometers embedded on it. These sensors capture the real time gestures made by the user. An Arduino UNO microcontroller is used to collect

data from these sensors and send it to the PC via Bluetooth. The PC processes the data sent by the Arduino and runs a Machine Learning Algorithm to classify the Sign Language gestures and predicts the word associated with each gesture. Support Vector Machine (SVM) is used for classification.

[3] Murillo, Shawn Clifford M., et. al, has aims to developed 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.

[4] In a report, Yash Jhunjhunwala, et al. has introduced a basic system consisting of two parts; sign language recognition and conversion to text and further to speech. The sign language glove consists of simple hand gloves fitted with flex sensors which are being used for monitoring the amount of bend on the fingers. Flex means bend, this is the sensors that change the resistance depending on the amount of bend on the sensor. Data from the sensors is sent to the Control unit which is the Arduino UNO the analog signals from the sensors are digitally converted and compared with the stored value for the recognition of sign and then displayed as a text on the 16x2 LCD. Further the text output is wirelessly transmitted to a cellular phone or a PC which consist of a test to speech conversion software.

[5] Poornima, N., Abhijna Yaji, et. al, has aim to develope a system which can assist disabled people in converting gestures to text and/or speech. Creating a robust communication system for the deaf and speechless community will help them be more independent and confident. In this article, an extensive review is made on the various approaches available for gesture recognition.

[6] The article details the research efforts of K. Prasanna Mery, et al. has introduced a glove-based device, integrating flex sensors and an Arduino Nano control unit, facilitates the recognition of intricate sign language gestures. The system's ability to convert these gestures into text, displayed on an LCD, demonstrates a tangible bridge between sign language and written communication. The wireless transmission of information to a PC or cellular phone for subsequent text-to-speech conversion underscores the adaptability and potential widespread use of the technology. Moreover, the ongoing prototype development indicates a commitment to expanding the system's capabilities beyond basic alphabets and numeric characters.

[7] Based on study Sparsha, U., M. Priyanka, et. al, proposed to develop a system that is capable of converting sign language to speech, with an objective to assist the specially abled people communicate with the world seamlessly. Because for the masses with speech impairments, it is extremely challenging to communicate with everyone else. These people make use of sign language for communication with normal people, but the sign language is not known by many people. Whenever a speech- impaired person communicates with a normal person, a communication gap is created which happens to be hard to fill.

[8] Vijayalakshmi, P., et. al, has developed a system for recognizing sign language, which provides communication between people with speech impairment and normal people, thereby reducing the communication gap between them. In the current work flex sensor-based gesture recognition module is developed to recognize English alphabets and few words and a Text-to-Speech synthesizer based on HMM is built to convert the corresponding text.

[9] Finding from the assessment E. Karthiga, et. al, presented a sign language to speech conversion which has obtain by folding of flex sensors. In this flex sensor based gesture recognition system, according to the resistance of the flex sensor the input is provided to the Arduino which in turn responds by giving voice output. This system has faster response and efficiency for communication is improved

[10] Heera, S. Yarisha, et. al, has presented an approach that gives a technique for improving Sign Language Recognition systems. In the proposed method; they will be using sensors which are incorporated on a glove to detect the gestures and convert it to speech with the help of a Bluetooth module and an Android Smartphone. The gloves will help in producing artificial speech which provides an environment similar to daily communication.

METHODOLOGY

The proposed system aims to bridge the communication gap for individuals who rely on sign language by converting their hand gestures into spoken text. This system will use a glove equipped with three flex sensors that detect the bending of fingers to interpret different gestures. These flex sensors are connected to an Arduino UNO microcontroller, which will analyze the data and map each gesture to a specific text output. The processed text will then be displayed on a 16x2 LCD screen for visual confirmation. Simultaneously, an 8-channel voice module will convert the text into audio, which is played through a connected speaker, allowing the message to be heard by others. The glove's flexibility and lightweight design allow for ease of use, enabling sign language users to communicate seamlessly with individuals who may not understand sign language. This system is particularly useful in enhancing accessibility, promoting inclusivity, and facilitating interaction in diverse settings.

A. BLOCK DIAGRAM:

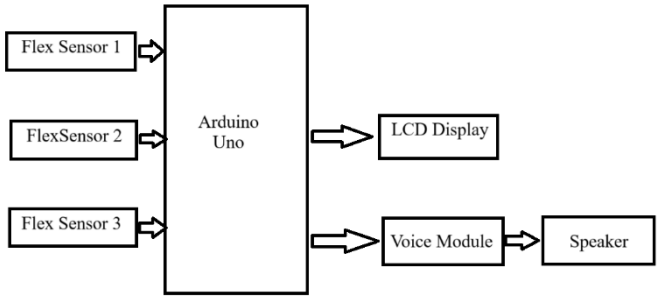


Figure 1 : Block Diagram of Sign Language To Text And Speech Converter

DESCRIPTION

In this Block diagram, we have used the Arduino UNO as a microcontroller. And three Flex Sensors and a Voice module (8 channel) and a Speaker as input devices. A 16x2 LCD Display is connected as an output device to the microcontroller.

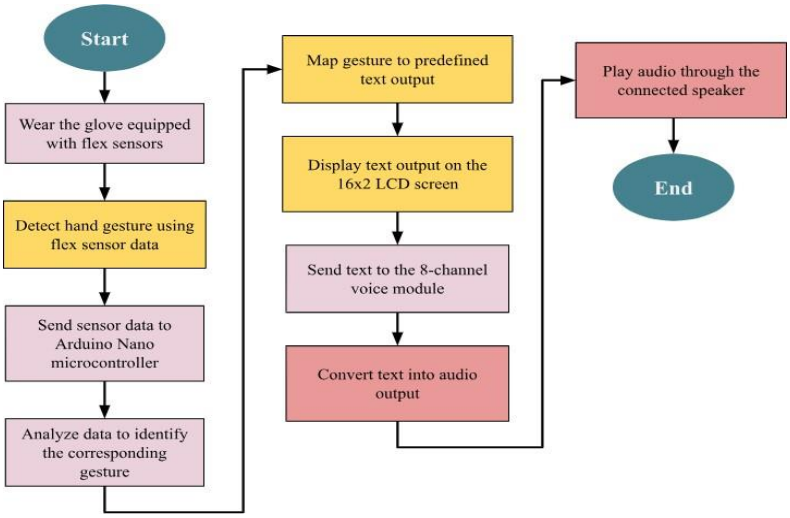
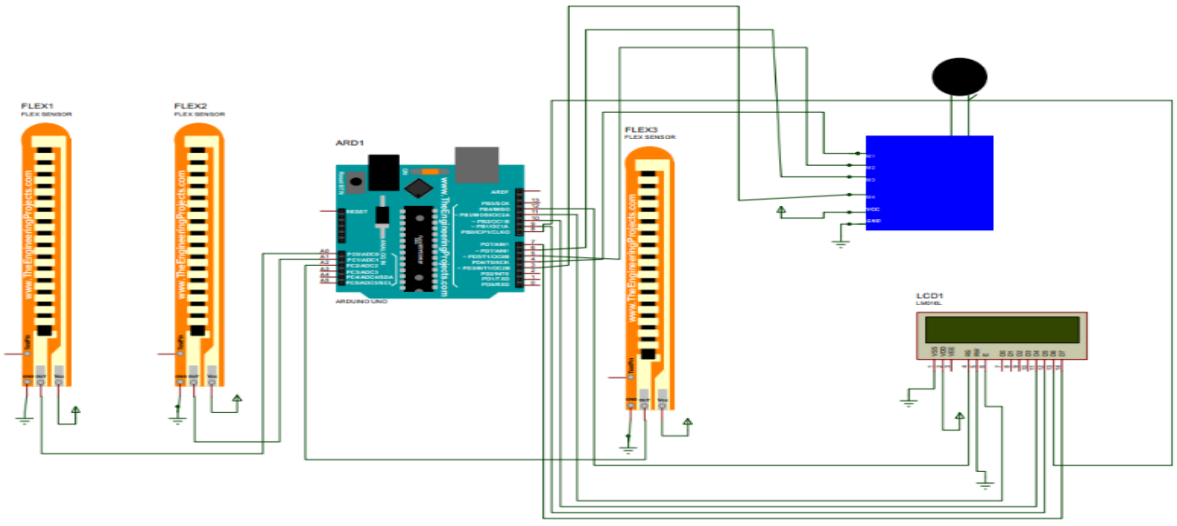


Figure 2 : Flow Chart of Sign Language To Text And Speech Converter

B. CIRCUIT DIAGRAM

Figure 3 : Circuit Diagram of Sign Language To Text And Speech Converter



WORKING

The system functions by detecting hand gestures through three flex sensors embedded in a glove, which measure the degree of finger bending. These sensor readings are transmitted to an Arduino Nano, which processes the analog input and identifies the corresponding gesture based on predefined values. Once a gesture is recognized, the Arduino sends the associated text output to a 16x2 LCD display for visual feedback. Simultaneously, the mapped text is sent to an 8-channel voice module, which plays the corresponding pre-recorded audio through a speaker, effectively converting the gesture into audible speech. This real-time operation ensures smooth and intuitive communication for sign language users.

C. SYSTEM REQUIREMENT :

HARDWARE REQUIREMENT

1. Arduino Nano
2. Flex sensor *3
3. 16x2 LCD Display
4. Voice module (8 channel)
5. Speaker
6. Gloves

SOFTWARE REQUIREMENT

1. Arduino IDE
2. Proteus

D. EXPERIMENTAL SETUP & RESULT

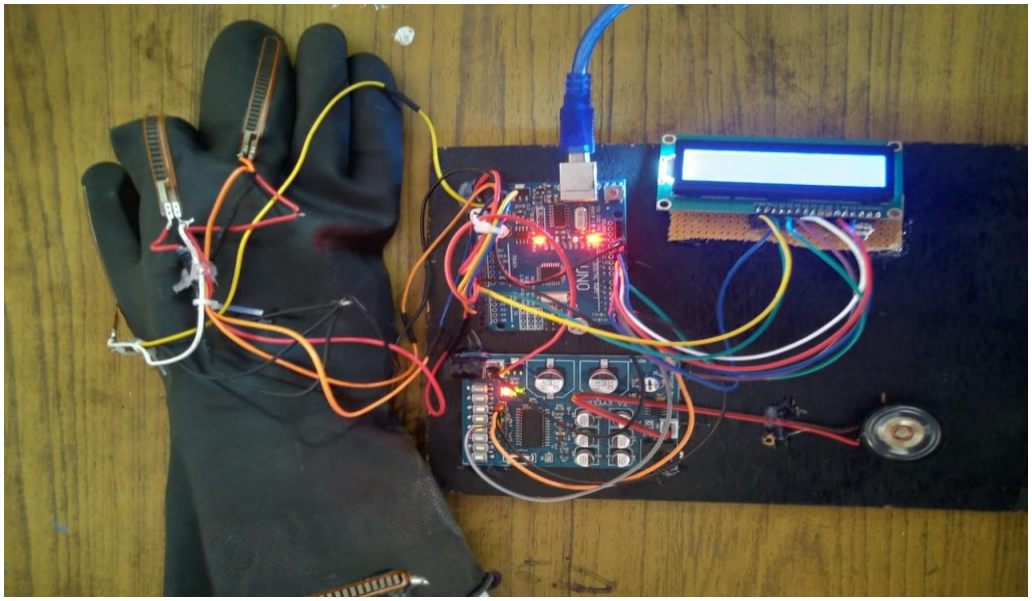


Figure 4: Experimental Setup of system

RESULT

The result of the paper demonstrates successful real-time translation of specific hand gestures into both text and speech. When different gestures are performed using the glove, the flex sensors accurately detect finger movements, and the Arduino Nano correctly maps these inputs to their corresponding text messages. The mapped text is clearly displayed on the 16x2 LCD screen, while the voice module simultaneously outputs the appropriate audio through the speaker. This confirms that the system can effectively interpret sign language gestures and convert them into understandable spoken language, showcasing its potential to improve communication for individuals with hearing or speech impairments

Figure. I. and II. shows the output of the LCD displaying the converted gesture text as "Need Food" and "Need Water" with corresponding voice output

The figures i) and ii) demonstrate the system's response to different hand gestures. The Arduino UNO processes the input from the flex sensors and displays the interpreted message on the LCD. Simultaneously, the corresponding voice output is generated using the 8-channel voice module and played through the speaker. This step validates the successful integration of gesture-to-text and text-to-speech conversion, effectively completing the sign-to-speech transformation. It highlights the system's potential in enabling non-verbal users to communicate essential needs both audibly and visually.

CONCLUSION

The "Sign Language Text And Speech Converter" paper offers an innovative and practical solution to bridge the communication gap for individuals who rely on sign language, providing a means for real-time, accessible, and inclusive interaction. By translating hand gestures into both visual and auditory outputs, this device enhances the independence of non-verbal individuals and fosters a greater sense of inclusion in various social, educational, and professional settings. The system's affordability, portability, and user-friendly design make it a viable tool for widespread use, offering significant benefits in improving communication and understanding between sign language users and non-sign language speakers. This paper underscores the potential of technology to break down barriers and promote accessibility, creating a more inclusive society for all.

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