Sign Language to Text Converter using Arduino

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***Abstract*—** In India itself nearly 63 million people are deaf and 5 million suffer from muteness. The way of communication for these people is Sign Language. But very often these people find it very difficult to communicate with normal people. Since most of the people don't know basic sign language. The aim is to a bridge communication gap between deaf-mute and those who don't understand sign language for this purpose, a sign-to-text converting glove is proposed in this paper. This glove will convert sign language to text and will display it on 16X2 LCD. The system consists of flex sensors, Arduino and LCD as main components. This system at the basic level will recognize the alphabets and numbers based on sign language and will further display it on LCD.

***Keywords*—**Sign language, Arduino, LCD, Sign-to Text.

INTRODUCTION:

Sign Language is used by millions of deaf-mute to express since it is a simple way of communication for them . Sign Language is recognized by hand gestures representing certain activities or alphabets. But not everyone is knowing the sign language.This makes communicatng hard for deaf-mute people. Due to this many times deaf, mute individuals find it difficult to communicate with other people. Sign language serves as a vital communication method for these deaf, hard-of-hearing as well as mute individuals who can not speak. This work demonstrate the development of a sign language to text converter using Arduino uno, aiming to bridge the communication gap between the deaf, mute communities so that they can communicate. So the purpose behind this system is to make communication easy for deaf-mute people. The gloves translates the hand gestures to text and then dispays it so that everyone can read the gesture, which will make the communication more efficient. The gloves convert the specific gestures to text using Arduino. The flex sensors are attached on the glove which will note the resistance due to gesture and will convert it into text using Arduino uno. Flex sensors are flexible. The output of the sensors is processed on Arduino uno to get text as an output displayed on LCD. There are many sign languages that are being practiced by people but ASL (American Sign Language) is used most commonly. Since most of the signs in ASL are single handed, complexity is less. Here this system is able to recognize the various alphabets of American Sign Language.

This system can-
Facilitate communication between deaf and hearing individuals. Users without sign language proficiency can understand the message conveyed through the text output. Support deaf education and learning. Text output can be used for real-time captioning in classrooms or educational settings.

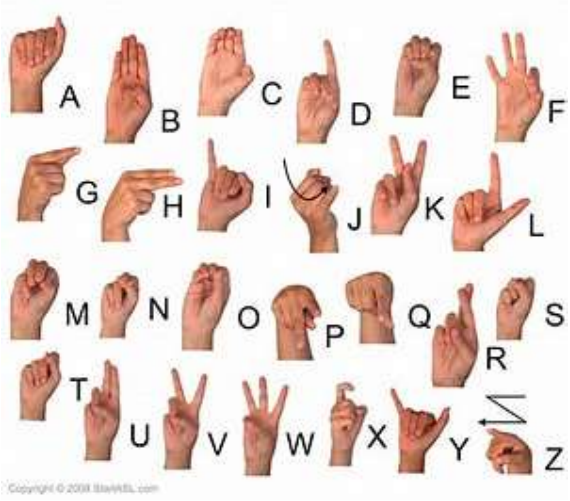


Fig 1: American Sign Language

LITERATURE REVIEW:

[1]Thomas Pryor.et.al undergraduate students at the University of Washington created a glove called Signaloud. The glove can translate sign language gestures in texts and speech.

[2]Ryan Patterson designed the first Hand Talk glove back in 2001. However, his version needed a computer or laptop to work, making it less portable.

[3]Going back to 1620, Juan Pablo Bonet wrote a book about teaching deaf people to speak, which included methods for sign language. This book is considered one of the first modern works on sign language.

[4]Kuldeep Singh Rajput.et.al developed an interactive glove for hearing-impaired individuals. Their goal was to make communication easier between hearing-impaired and hearing people.

[5]Swapnil D. Badgujar.et.al created a system that lets users control a computer using hand gestures captured by a video camera.

[6]Thalmic Labs (now North Inc.) developed the Myo armband, which can track hand and arm movements. While it's not specifically for sign language, developers have used it for that purpose.

The Leap Motion device tracks hand and finger movements in 3D space and has been experimented with for sign language recognition.

DESIGN METHODOLOGY

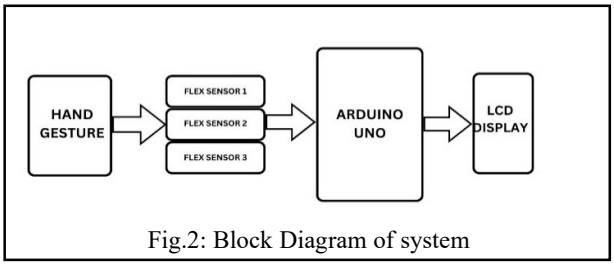


Fig.2: Block Diagram of system

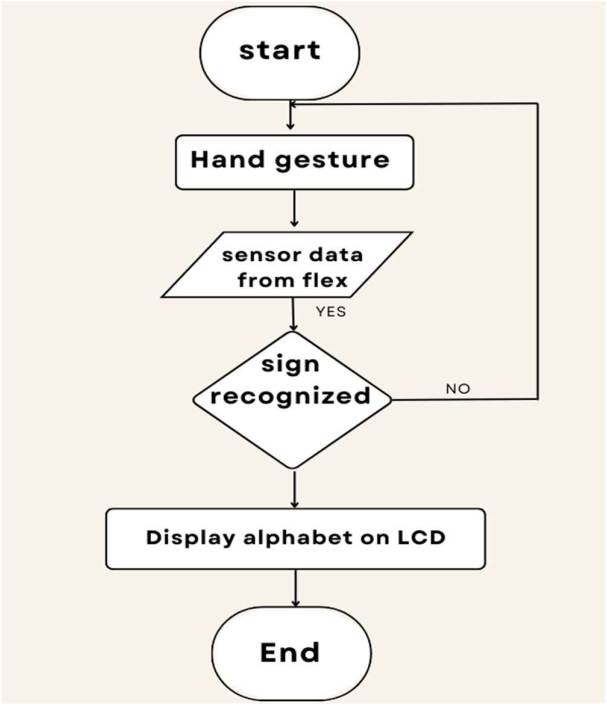
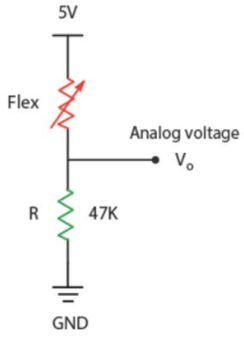


Fig 3: Flowchart of system

When the gesture is recognized by the Arduino it will give the resulting output to the LCD where the text will be displayed.

If in some case the gesture is not recognized then the system will go back to the initial stage where it will again start recognizing the signals from the flex sensors that are placed onto glove. The process will repeat every time to give the detected results on LCD.

The method commonly employed to interpret the readings of a flex sensor involves its integration with a static resistor to establish a voltage divider configuration. This arrangement facilitates the generation of a variable voltage output, which can be conveniently processed by the analog-to-digital converter of a microcontroller. It is imperative to acknowledge that the voltage measured in this setup pertains to the voltage drop across the pull-down resistor, rather than directly across the flex sensor.



The relationship governing the output voltage (Vo) in this configuration can be expressed by the equation:

$$V_O = V_{CC}\frac{R}{R + R_{Flex}}$$

In this equation: Vo is the output voltage. Vcc is the supply voltage. $Rflex$ is the resistance of the flex sensor. R is the resistance of the static resistor.

Fundamentally, as the flex sensor undergoes bending, its resistance undergoes a commensurate alteration, consequently influencing the measured output voltage. Notably, an increase in the bend radius of the flex sensor results in a proportional decrease in the output voltage. This output voltage is then given to the Analog pins of Arduino UNO board. When Arduino uno detects any gesture movement it will read the data from the Flex sensor that are used in the system. If the Arduino uno gets data from the Flex sensor, it will detect the sign based on the flex sensor data according to programming logic that is implemented in the Arduino uno. If it gets a sign that matches with programming logic then the system will display the alphabet on LCD based on given logic.

SIMULATION RESULT*:*

When Arduino uno detects any gesture movement it will read the data from the Flex sensor that are used in this system. A flex sensor, also known as a bend sensor, is a sensor that detects deflection or bending of the target (finger in this work). If the Arduino uno gets data from the Flex sensor, it will detect the sign based on the flex sensor data according to programming logic that is implemented in the Arduino uno. If it gets a sign that matches with programming logic then the system will display the alphabet on LCD based on given logic

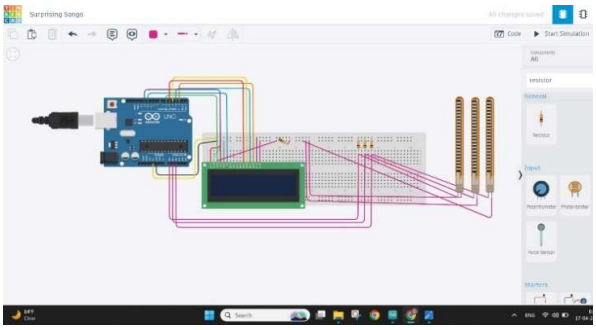


Fig 4: Circuit diagram

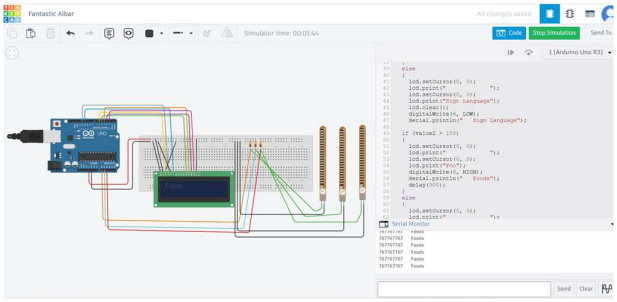
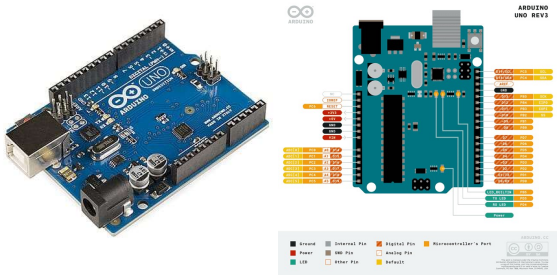


Fig 5: Simulation result

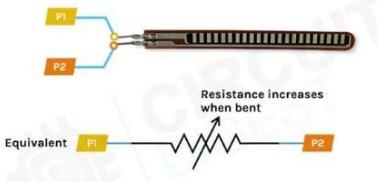
COMPONENTS USED

A. Arduino uno :



The Arduino Uno is a microcontroller board featuring the ATmega328P chip. It's widely used for electronics projects and is known for its versatility and ease of use. t has 14 digital pins that can be used for input or output. Six of these pins can also provide Pulse Width Modulation (PWM) signals for things like dimming LEDs or controlling motors. There are 6 analog input pins (A0 to A5) that can read varying voltages from sensors, making it great for projects involving environmental data. The board runs on a 16 MHz ceramic resonator, ensuring smooth and accurate operation. It includes a USB port for programming and power, a power jack for external power sources, and an ICSP header for in-circuit programming. The Arduino Uno has 32KB of flash memory to store your code, 2KB of SRAM for running your programs, and 1KB of EEPROM for storing data that needs to persist even when the board is turned off. The board operates on a 5V power supply, with a recommended input voltage range of 7 to 12 volts. It can also be powered through the USB connection, which supplies 5V directly.

*B. **Flex sensors:***

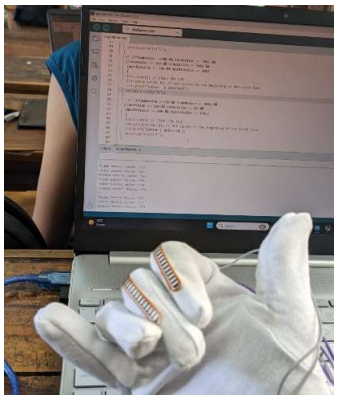


Flex sensors operate as variable analog voltage dividers. They contain a carbon resistive element embedded in a thin, flexible material. When this material bends, the resistance of the element changes, producing an output that corresponds to the degree of bending. In a gesture recognition system, typically 5 flex sensors are used, each attached to different fingers of a glove. This setup is crucial because fingers play a central role in sign language gestures, requiring individual sensors for accurate tracking. As a user forms hand gestures, the flex sensors on each finger bend accordingly, altering their resistance values. These resistance changes are then transmitted as analog signals to an Arduino Uno or similar microcontroller for interpretation and processing.

*C. **16X2 LCD display:***

A 16×2 LCD display is a type of liquid crystal display designed to show 16 characters on each of its two rows, allowing a total display of 32 characters. This display is commonly utilized to present alphanumeric information across a variety of electronic devices.

RESULTS:



In the end results we were able to get recognize the alphabet gestures performed by the user and further display it on LCD using Arduino.

CONCLUSION

In conclusion, the development of a sign language to text converter using the Arduino Uno marks a significant advancement in promoting inclusivity and accessibility for the deaf and mute communities. This glove successfully implemented a system that translates sign language gestures

into text using Arduino Uno, flex sensors, and an LCD display.

Throughout the working on this system, the goal of converting hand gestures into readable text was achieved. This allows individuals who are unable to hear or do not understand sign language to easily comprehend the communicated messages. By utilizing the Arduino Uno's capabilities, a portable and cost-effective solution was created, suitable for deployment in diverse environments such as classrooms and public spaces.

The simplicity of the hardware setup, combined with efficient programming, ensures that the converter is user-friendly and accessible to a wide audience. This initiative contributes significantly to inclusivity by facilitating effective communication for the hearing-impaired community across educational, public, and personal contexts.

In essence, this system highlights the transformative potential of technology in fostering inclusivity and overcoming communication barriers. As we move forward, it is crucial to continue leveraging innovation for societal advancement, ensuring equitable access for all members of our community.

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