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SMART GLOVE TRANSLATES SIGN LANGUAGE IN REAL TIME

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Abstract

India's population is disproportionately made up of dumb and deaf people. To translate ASL into speech, the system is therefore creating a glove-based device. Only via speech can we convey our thoughts or propagate a message, yet a person with a disability finds it challenging to engage in typical social interactions. To overcome this communication barrier, we are developing a glove that transforms sign language into text and then voice. The basic system is divided into 2 parts recognition of sign language and conversion to text, followed by voice. To carry out this whole procedure, we have trained and tested the dataset for that. The fundamental operation of hand gloves that make up the sign language glove have IR sensors that can detect how the fingers flex and an accelerometer that can detect how the hand moves. The Node MCU receives data from the sensors, converts it to binary signals, compares them to the recorded value for sign detection, and displays the results as text on the mobile display. Deaf or hard-of-hearing people connect with society through sign languages that are challenging for non-deaf or hard-of-hearing people to understand. Communication between deaf-mutes and non-mutes has therefore always been difficult. There are challenging tasks all throughout the world. Those who are deaf or dumb should be able to express themselves better. Since then, they have improved their ability to blend in with their environment.

KEYWORDS: IR Sensors , NodeMCU ,Gesture Recognition, Sign Languages, Accelerometer.

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1. INTRODUCTION

Around the globe, there are about 70 million deaf-mute people, according to statistics from the World Federation of the Deaf and the WHO. Around 32 million. youngsters that are deaf out of a total of 360 million people. The majority of those with speech and hearing impairments are unable to read or write in standard languages. To communicate with others, deaf and mute people utilise sign language (SL), which is their native tongue. In SL, gestures—which incorporate the use of finger gestures, hand motions, and facial expressions—are used primarily to convey message rather than voice. Real-time communication between those who have hearing and speech impairments is the major goal of this initiative. The only means of conveying thoughts is through communication, although some individuals are not as fortunate as us. This shouldn't limit them in any way. Therefore, it is crucial to create a model that is effective and satisfies the needs of those who are deaf or have trouble speaking or hearing so that they may communicate effectively. We therefore mostly communicate via hand gestures, which are connected to a mobile application that outputs text and speech commands. Speech-impaired people's verbal communication is constrained, whereas hearing-impaired people's inability to understand what others are saying is a constraint. We have created a model that accepts gestures as input and outputs voice and display in order to better communication between them. The person with hearing loss is able to see but not hear. whereas a person with speech impairments can communicate using hand gestures and speak while still understanding through hearing. We combine hardware and software to create the technologies we use. The hardware will process user gesture input in the microcontroller and output speech and display as a result.

2. PROPOSED SYSTEM

A glove that instantaneously translates American sign language into voice and text has been a project of ours.. The fingertips of the glove are equipped with small IR sensors. Through accelerometer and IR sensor, these sensors can detect finger location and motions. Our project is completely wireless and includes hand sign symbols and voice tips for user convenient.

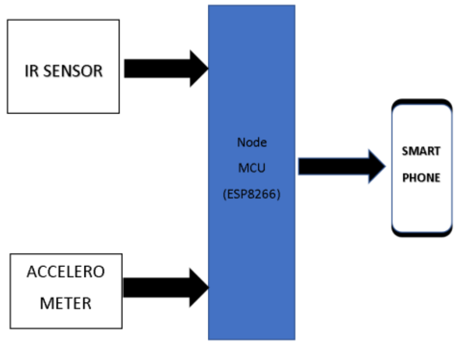

Fig 2.1: block diagram

Popular microcontroller board called the Node MCU is based on the ESP8266 Wi-Fi module. It is a great option for IoT applications because it has built-in Wi-Fi capability and utilises the Arduino IDE to be programmed.. The accelerometer is used to measure the acceleration and tilt of the glove, while the IR sensor can be utilised to detect hand movements. You would need to create a database of sign language motions and their accompanying meanings before you could put the system into use. The glove would then require calibration to make sure the accelerometer and IR sensor are correctly detecting hand movements. The Node MCU can then be configured to read the sensor data and compare it to.

3. Existing Method

These gloves often contain sensors that can track the movements of the wearer's hands and fingers, which may then be translated into spoken or written language using software and machine learning techniques. The "SignAloud" glove, created by two University of Washington undergraduate students, is an illustration of such a smart glove. The wearer's hand movements are detected by sensors in the glove, which wirelessly sends the information to a computer where machine learning techniques are used to convert the hand movements into spoken words. Another illustration is the "GestureTek" glove, which recognises and understands sign language using a mix of sensors, motion tracking, and machine learning. The glove can instantly Text or spoken language that is signed.. can be used to communicate between hearing and deaf people. In general, real-time sign language translation capabilities in smart gloves represent an exciting advancement in the field of assistive technology and have the potential to significantly enhance accessibility and communication for the deaf and hard-of-hearing communities.

4. RELATED WORK

4.1 LITERATURE SURVEY

Numerous studies and investigations have been conducted in the area of smart communication for those who are deaf or hard of hearing. According to which, sign language is the most efficient medium, other from writing and sketching, for a smooth communication between normal people and these specifically challenged persons. In this field, numerous patent applications have been made with diverse approaches to solve this problem. In his development of a sign language/text system for the hearing and speech impaired, **DalalAbdullah** [1] took a certain approach. In which he put up the concept of creating a two-part electric gadget, one of which would serve as a transmitter and the other as a receiver. The Arabic sign language can now be translated into speech or text thanks to this method. The concept was straightforward: attach flex sensors to each finger and connect them to an Arduino. This microcontroller gathers data from flexible sensors and transmits it using an RF transmitter. In contrast, the Arduino Mega receives the output from the transmitter and delivers it to the RF receiver, which then processes it to produce the output for the LCD and speakers. To connect the data to the gestures made, they used the Arduino IDE.Arduino IDE's space and speed restrictions are a downside. Their system is confined to a small number of gestures. Flex sensors have another drawback since they alter in resistance value with heavy use. Because of this, the likelihood Reduces by a certain proportion of getting the right output.

AbhinandanDas [2] used flex sensors and gyro sensors for finger and hand movement, respectively, in his study as a different strategy. He did this by using a gyro sensor for hand movement and a flex sensor on each finger. As a result, the dataset of gestures rose along with the number of gesture combinations. Xbee transceivers are used for data transmission to ensure smooth data flow. They classified the activities and hand motions into the sign .To categorise quickly many types of gestures, it was necessary to use this robust processor. According to the method they designed, a user's movements could be an alphabet or a number, for which suitable classification is required. The data is handled quickly thanks to this strong Intel processor. A microprocessor processed the data when it was received, and the output was displayed in accordance with the text mapping to the sign language. The Grove LCD displays the text that was generated. The Grove-buzzer sensor further converts it to voice. The main flaw with this entire setup is that it can only produce 200 words. The use of alphabets and numbers, which significantly slows down communication, is another drawback of this method.

Adarsh Ghimire's [3] technology, which is based on a desktop programmer and uses a machine learning algorithm, produced yet another remarkable result. Data collection from the embedded flex sensors in each finger, coupled with the accelerometer and gyroscope from each hand, is the first step of the procedure .The data is fed into a machine learning system to forecast how the user's gesture would be received by a speaker or an output screen, respectively. The machine learning model's accuracy ranges from 75 to 80%, and it can store 350 datasets for each alphabet. This system's accuracy and precision are much higher than those of the other suggested systems. However, a disadvantage of the correlation plot was that it often left the results unclear because the algorithm had trouble understanding some alphabets because of how similarly the fingers were bent.

5. METHODOLOGY

Collect your materials: We'll need an accelerometer, IR sensor, NodeMCU (or a similar microcontroller board) and a mobile app with the required code to construct this system. Put the components together: Connect the accelerometer and IR sensor to the NodeMCU device. To make sure the connection is correct, we must adhere to the directions for our particular sensors.

Write the code: We created the code to decipher the data coming from the accelerometer and IR sensor. This code should be able to identify the particular hand signals we're looking for to detect and convert them into digital signals that can be electronically transmitted to the mobile app. Additionally, we made sure the code could be compiled, published, and work with the NodeMCU. The code was tested after it was created to make sure it functions as intended. To do this, the IR sensor and accelerometer will be put through its paces to make sure they are accurately sensing the hand signals and transmitting them to the NodeMCU board. Additionally, we examined the wireless link between the NodeMCU and the mobile software.

Integrate with the mobile app: We combined the two systems, assuming that the mobile app already possesses the required code for deciphering the signals sent by the NodeMCU board. This will require making sure the mobile app can receive the signals sent by the NodeMCU board and convert them into the proper text and voice commands.

Test the integrated system: After the NodeMCU board and mobile software were connected, we tested the system to make sure everything operated as it should. To test the system's ability to identify and interpret different hand signs, this will be necessary. Once the system is functioning as anticipated, we want to further refine and optimise it. This might entail enhancing the hand sign recognition algorithm's precision, lowering energy usage, or increasing the system's usability. Overall, setting up a hand sign recognition system can be a challenging process that includes hardware assembly, software development, and testing. Yet, by adhering to a clear methodology and spending the time to test and improve the system, we may create a dependable and efficient tool for communicating using hand gestures.

6. COMPONENTS

These are the Components are

- NodeMCU
- IR sensor
- 7805 voltage regulator
- 9v battery
- MPU6050

6.1 NodeMCU

FIGURE :6.1 [NodeMCU ESP8266]

Wi-Fi connection is incorporated into NodeMCU, making it simple to connect to the internet and communicate with other devices. General Purpose Input/Output (GPIO) Pins: The NodeMCU contains a number of GPIO (General Purpose Input/Output) pins that can be used to connect to sensors, switches, LEDs, and other devices. NodeMCU also features analogue input pins that can be used to measure analogue signals like temperature, light intensity, and sound. PWM Output: NodeMCU offers PWM (Pulse Width Modulation) output, which can be used to regulate a variety of devices, including the brightness of LEDs and the speed of motors. NodeMCU enables over-the-air (OTA) updates, allowing you to upgrade the firmware of the device without physically connecting to it. These are only a few of the NodeMCU features that may be applied to applications. You could also be able to leverage other platform capabilities and functions depending on the needs of your project. I2C (Inter-Integrated Circuit) communication, a widely used protocol for interacting with sensors and other devices, is supported by NodeMCU. SPI Communication: Another widely used protocol for interacting with sensors and other devices is SPI (Serial Peripheral Interface), which NodeMCU also supports. NodeMCU can be used to build a web server that enables remote device control and data viewing from any location with an internet connection. MQTT: NodeMCU is compatible with the MQTT (Message Queuing Telemetry Transport) protocol, which enables device communication via the internet in Internet of Things projects.

6.2 IR SENSOR

The two primary tasks that IR sensors are capable of are object detection and temperature sensing. In order to identify the existence of an object, infrared sensors gather up the infrared radiation that the object emits or reflects. IR sensors are advantageous for applications including proximity sensing, motion detection, and obstacle detection because of this capabilities. IR sensors, on the other hand, are valuable in a variety of applications, including medical diagnostics, thermal imaging, and temperature monitoring in industrial operations. They may measure an object's temperature by detecting the infrared light that it emits. Remote control: IR sensors can be used to receive signals from a remote control device and translate them into instructions for an electronic device, such as a television or DVD player. IR sensors can measure the infrared radiation emitted by light sources like LEDs and incandescent bulbs to detect the presence of light. In applications including remote sensing, wireless communication, and data transmission between devices, IR sensors can be utilised to send and receive data.

FIGURE: 6.2 [IR Sensor]

6.3 7805 VOLTAGE REGULATOR

A consistent output voltage of 5 volts is produced by the 7805 by regulating an input voltage that can range from 7 to 35 volts. This makes sure that electrical equipment get a consistent power supply and helps shield them from voltage swings.

Current limiting: The 7805 contains an inbuilt circuit that limits the amount of current it can give without damaging the device. By preventing overloading, this helps safeguard the regulator and the electronic devices it is attached to.

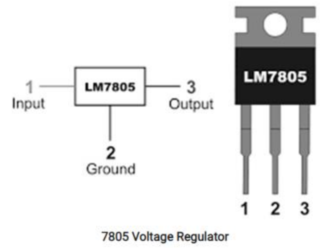

FIGURE: 6.3 [7805 Voltage Regulator]

The 7805 may produce a lot of heat, especially when operating at high currents. The regulator is intended to dissipate heat through a heat sink or other cooling mechanism to prevent overheating.Reverse polarity protection: The 7805 features built-in reverse polarity protection that guards against harm to the regulator and attached devices in the event that the input voltage is applied in reverse.

6.4 9V BATTERY

Little electronic equipment: Portable radios, smoke detectors, and remote controls are just a few examples of the compact electronics that are frequently powered by 9-volt batteries. Microcontrollers are also powered by a 9-volt battery, which can be used with many microcontroller boards including the Arduino and Raspberry Pi. In applications that call for mobility, this makes them transportable and simple to utilise. Lighting up a few LEDs only needs a small amount of power, and a 9-volt battery is more than capable of supplying it. LEDs (Light Emitting Diodes) require relatively little voltage and current to operate.cells in succession are used to create primary lithium kinds.

FIGURE: 6.4 [9V BATTERY]

6.5 MPU6050 x 1

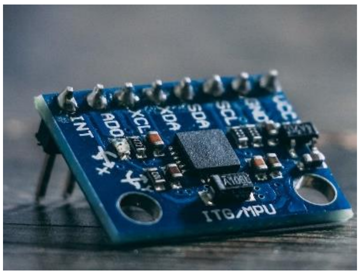

FIGURE: 6.5 [MPU6050 x 1]

The microelectromechanical system (MEMS) sensor structure, which is housed on a tiny silicon chip, is how the MPU6050 detects changes in capacitance. A proof mass suspended by beams from a silicon substrate makes up the MEMS structure. The proof mass suffers an acceleration or angular velocity force when the sensor is moved or rotated, which causes it to deflect and alter the capacitance between the proof mass and the electrodes. An analog-to-digital converter amplifies and transforms the capacitance change into a voltage signal, which is then translated into a digital signal (ADC).The MPU6050 also features a digital motion processor (DMP), which can carry out intricate computations on the unprocessed sensor data to produce outputs that are more useful, such quaternion values, for example. This can be used to figure out how the sensor is oriented in space. Moreover, the DMP is capable of complex motion processing tasks and gesture recognition. The I2C (Inter-Integrated Circuit) protocol, which enables two- wire serial communication between the microcontroller and the sensor, can be used to interface with the MPU6050. The MPU6050 library, for example, can be used to quickly receive the raw sensor data from the device and carry out the necessary computations to provide useful data.

7. PROJECT IMAGES

TOP VIEW

FIGURE : 7.1

HAND SIGN OF A

FIGURE : 7.2

A will be exposed in audio format Also the user

SIDE VIEW

FIGURE : 7.3

HAND SIGN OF C

FIGURE : 7.4

C will be exposed in audio format Also the user

8. CONCLUSION

Those who are blind, deaf, or dumb can converse with one another using this method. Those who are dumb communicate in a language that is difficult for blind and illiterate people to grasp. To aid the deaf, the sign language is also translated into written form. These words are displayed on a computer screen. Those who are deaf must be healed. We'll utilizing it to watch how the blind and deaf move their hands. The system translates hand motions into text, which is subsequently translated into voice. A provision has been included to the text system so that people can still read and comprehend what the other person is attempting to say even if they are unable to hear the sound emitted owing to those limitations.

9. Future Scope

Enhanced accuracy: The accuracy rate of the most recent state-of-the-art technology for translating sign language using smart gloves is about 98%. Nonetheless, there is always potential for improvement, and upcoming developments in artificial intelligence and machine learning may contribute to enhancing the precision of sign language identification Miniaturization: At the moment, smart gloves are very large and can be difficult to wear for extended periods of time. Upcoming developments in wearable technology and material science may result in the creation of smaller, lighter smart gloves that are more comfortable to wear. Increased language support: Although American Sign Language (ASL) can be translated using current technology, there are numerous additional sign languages in use throughout the world. Future technological developments might result in the creation of smart gloves that can understand and translate a variety of sign languages. Connectivity with other devices: Smart gloves that can translate sign language could be connected to other gadgets like tablets or smartphones for easier accessibility and communication. Real-time feedback: Future smart gloves could translate sign language as well as give the user immediate feedback on how accurately they are signing. This could help the user become more fluent in the language.

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