International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 SJIF 2023: 8.176 ISSN: 2582-3930

SPEAKING SYSTEM FOR MUTE PEOPLE USING HAND GESTURES

Dr P Shanmugapriya[1], S Dhivya [2], P Kedzi Jero Kathrin[3], I Keerthana[4], K Kirthiga[5]

[1] Electronics and Communication Engineering, Saranathan College of Engineering
[2] Electronics and Communication Engineering, Saranathan College of Engineering
[3] Electronics and Communication Engineering, Saranathan College of Engineering
[4] Electronics and Communication Engineering, Saranathan College of Engineering
[5] Electronics and Communication Engineering, Saranathan College of Engineering

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Abstract - It is quite challenging for mute people to communicate with non-mute people, because most of the people are not trained in hand sign language. So, communication becomes hard to do, especially in an emergency or when they are travelling in a new setting. To make it simple smart speaking system is proposed, which allows mute people to communicate with hearing people through hand gestures. A speaker unit, a hand motion reading device, and accelerometer sensors are used in this system and it is powered by battery-operated circuitry. An Arduino Nano is used for data processing and system management. The technology helps mute people communicate by giving them access to four to five present messages, such as "Need some help", "Can you help me?" and others. For numerous hand movement types, the system interprets user hand gestures. As a result, when the user is simply making unconscious hand motions, the system will not speak. The Arduino Nano microprocessor continuously receives sensor input values and processes them. If the sensor values match with the message, then it will be retrieved from memory and pronounced out loud through the interfaced speaker using Gesture to speech technology. Instead, we employed a mobile application in our proposed system "Speaking System for Mute People Using Hand Gesture."

Key Words*: *Arduino Nano, Mute people, Hand motion, Sensor, Regular people, Message, Help, Sign language, Speaker

I.INTRODUCTION

Being disabled shouldn't prevent someone from participating in all aspects of life. According to the 2011 census, India has 1,640,868 people who are unable to talk and 1,261,722 people who are unable to listen. More than 70% of India's deaf population works in both the public and private sectors. They are dependent on sign language for communication. Indian Sign Language is the most widely used language in India. Many other South Asian nations also employ this sign language.

Since they are not required to learn it, few people in the rest of India's population can utilize Indian Sign Language. Communication between Deaf Dumb and Normal persons is hampered as a result. As a result, hearing-impaired people are marginalized in society. To resolve this problem, a communication assistant is required to convert sign language into audible speech. To achieve the same objective, several devices have been developed in the past, but they were either expensive, impractical to implant, or not portable. The focus of earlier technologies was solely on one-way communication.

Several methods for collecting gestures have been adopted during the past ten years, including inertial sensors, data gloves, vision systems, and electromyography. The most popular of these methods is the vision-based methodology. However, these methods may be impacted by occlusions, poor lighting, and cluttered backdrops, making them unsuitable for mobile applications. With users unaffected and working conditions unrestricted, an alternative technique for recording hand movements has been made possible by the ongoing development of inertial sensor technology. Inertial sensor-based gesture identification has emerged as a very promising research field. For instance, accelerometer-based hand gesture recognition systems have been successfully used to control consumer gadgets, wheelchairs, and handwriting recognition.

It is important to note that the majority of studies on inertial sensor-based gesture detection only used accelerometer data. Acceleration signals, however, are subject to inherent measuring mistakes and are frequently mistaken for gravitational acceleration. It is challenging to get precise gesture movement trajectories with just one kind of sensor. According to the author, Anjali Jayaraj, [1] it is now commonplace to employ integrated inertial sensors that combine a 3D magnetometer, gyroscope, and accelerometer. By using a variety of efficient fusion methods, accurate and drift-free orientation estimation may be accomplished, which can be used to reconstruct more precise gesture trajectories.

II. LITERATURE SURVEY

A. Framework for Hand Gesture Recognition with Application to sign language.

Authors: M. K. Bhuyan, D. Ghoah, P. Bora

Description: For hearing-impaired people, sign language is the most expressive and natural method. This is why vision experts have been interested in automatic sign language detection for a long time. It promises greater social chances and integration while improving speech and hearing-challenged people's communication abilities. In this study, a gesture recognition system that uses a vision-based set up to recognize a variety of hand gestures is described. Results from experiments show that our suggested recognition system can be utilized to accurately identify various signs of native Indian sign language.

B. Smart Gloves for Hand Gesture Recognition Sign Language to Speech Conversion System

Authors: Abhijith Bhaskaran K, Anoop G Nair, Deepak Ram K, Krishnan Ananthanarayanan, H R Nandi Vardhan

Description: In a society where the majority of the population does not understand sign language, those with speech impairments find it challenging to communicate. The concept put out in this paper is a smart glove that can output speech in sign language. Flex sensors and an Inertial Measurement Unit (IMU) are integrated inside the glove to detect the gesture. To track the movements of the hand in three-dimensional environments, a unique State Estimation approach has been devised. The prototype was put to the test to see if it could successfully translate Indian Sign Language into vocal output. Although the glove is designed to translate sign language into voice, it has other uses in the gaming, robotics, and medical fields.

III. PROPOSED SYSTEM

The proposed method enables one-way communication between mute and non-mute individuals. Fig 3.1 shows the block diagram of the speaking system which has an accelerometer, which measures the position of the finger and converts it to a digital signal. The values are sent to the mobile app through Bluetooth, and the message is presented via the mobile speaker.

WORKING PRINCIPLE

The system receives input from the accelerometer sensor and recognizes it by comparing the values to the database stored in the Microprocessor, after which the output is transferred to the receiver module as a text message. The final result is shown on the Android application or received as a voice via the device's microphone. The accelerometer sensor detects finger movement, such as changes in direction, finger bend, and finger movement backward and forward.

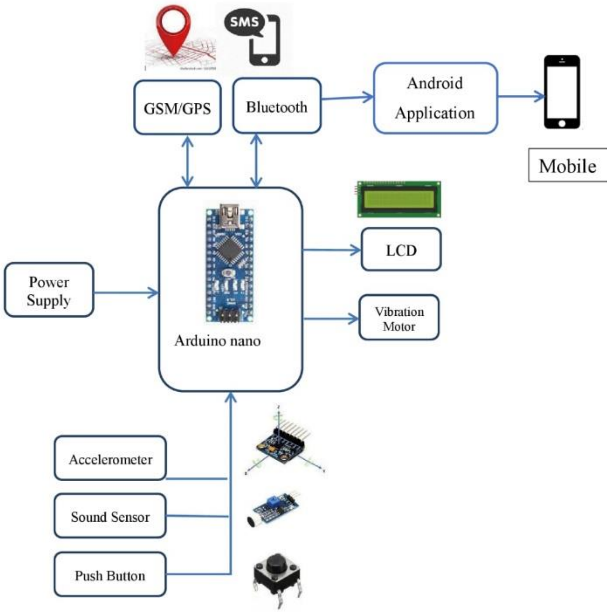


Fig 3.1 Block diagram of speaking system

The gesture is recognized by the sensor values and converted into a digital signal. It compares the gesture to the code stored on the Arduino microcontroller. If the gesture matches the code, it transmits the appropriate output; otherwise, it waits until the correct input is sensed. We built five basic messages in this project to allow mute persons to communicate.

The recognized output is then communicated to the Android application via Bluetooth module, which is connected to Arduino Nano separately, and the Bluetooth module output is received on mobile. The final result is displayed as text in the Android application and as speech in the Android mobile via the microphone. This method of sign language translation is effective for communicating with deaf-mute people. Additional aspects of our project will include a sound sensor built into the wearable device that detects high noise levels in the environment and a vibrator sensor that alerts the user via vibration to help us prevent mishaps. If the user is in an emergency, they can press the push button, and the GPS/GSM Module will broadcast the user's current location to their family members via SMS.

IV. SOFTWARE AND HARDWARE DETAILS

The following steps were taken to build and execute the app:

1. From the run configurations option in the toolbar, select your app.

2. In the target device option, choose the device on which you want to launch your app.

Follow these steps to keep track of the Build process:

1. If you don't have any devices configured, you must either build an Android virtual device or connect a physical device to use the Android Emulator.

2. Click the Run button.

If an error occurs during the build process, Gradle may provide command-line options such as stack trace or debug to assist you in resolving the problem. To use command-line options in your build process:

1. Open the Settings or Preferences dialog box:

• In Windows or Linux, select File > Settings from the menu bar.

• On macOS, navigate to Android Studio > Preferences from the menu bar.

2. Go to Build, Execution, Deployment > Compiler.

3. Enter your command-line options in the text box next to Command-line Options.

4. Select OK to save and quit.

Gradle will use these command-line options the next time you build your app.

PACKAGES

o A Java package is a collection of comparable classes, interfaces, and sub-packages. In Java, packages are divided into two types: built-in packages and user-defined packages.

O In this package, we have included five packages. They are:

- Android accelerometer
- Bluetooth activity
- Device List activity
- Function
- GPS Tracker

ANDROID ACCELEROMETER

In this package, we have provided how to print the message in the app with the specified input parameters which helps in communicating with normal people. Fig 4.1 shows some of the functionalities used in the Android accelerometer package are

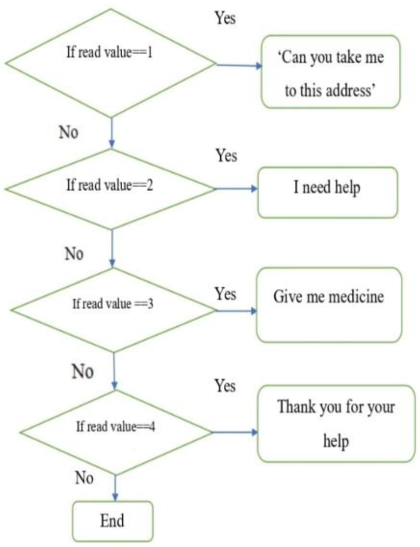


Fig 4.1 Flowchart of Android accelerometer

BLUETOOTH ACTIVITY

This package is used in the Speech recognition process which is used to identify handler messages and SPP UUID is used for working as platform independent. It gets the string for the MAC address and reads the input. It connects to a Bluetooth adapter and prints the message that is provided. Bluetooth sockets are created to store the MAC address and give I/O streams for connections.

DEVICE LIST ACTIVITY

It is the package that is used for the general process of connection of Bluetooth and gives formatting techniques in the Android studio webpage or template and also checks the connection of Bluetooth whether it is connected or not.

FUNCTIONS

This package provides basic permissions for connecting to Packet Manager. This feature enhances the security and privacy of the entire app.

GPS TRACKER

For GPS Tracking we should get the latitudes and longitudes of the user's current location. By using the Location Manager Function, we can easily get the location of the user's address in longitude and latitude. After that process, we need to update the user's location continuously to provide the correct output. When the function comes to an end we should end the process by making it null.

HARDWARE DETAILS

Power supply: It is used to provide power to the Arduino NANO (controller). The 230 volt AC supply is converted to 3.3 volt DC supply suitable for the controller.

Accelerometer: The ADXL335 is a small, thin, low- power, complete 3-axis accelerometer with signal-conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL335 is available in a small, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package (LFCSP_LQ).

Arduino Nano has similar functionalities as Arduino Duemilanove but with a different package. The Nano is inbuilt with the ATmega328P microcontroller, the same as the Arduino UNO. The main difference between them is that the UNO board is presented in PDIP (Plastic Dual-In-line Package) form with 30 pins and Nano is available in TQFP (plastic quad flat pack) with 32 pins. The extra 2 pins of Arduino Nano serve for the ADC functionalities, while UNO has 6 ADC ports but Nano has 8 ADC ports. The Nano board doesn't have a DC power jack like other Arduino boards, but instead has a mini-USB port. This port is used for both programming and serial monitoring. The fascinating feature of Nano is that it will choose the strongest power source with its potential difference, and the power source selecting jumper is invalid.

Analog to digital converter: The inbuilt ADC present in the Arduino board has a resolution of 10 bits. Any analog voltage in the range of 0-5 volts is converted to an equivalent digital value of 01023. The resolution hence obtained is between readings of: 5 volts / 1024 units or, .0049 volts (4.9 mV) per unit. The input range and resolution can be changed using analog reference (). The conversion time is about 100 microseconds (0.0001 s) - to read an analog input, hence the maximum reading rate is about 10,000 times a second.

Bluetooth uses unlicensed radio frequency (RF) bands of 868, 915, and 2400 MHz these three bands offer a total of 27 channels at RF data rates of 20, 40, and 250kbps. Bluetooth protocols are used in embedded systems when low data rates and power consumption are required. The goal of Bluetooth is to design a general-purpose, low-cost, self-organizing mesh network that may be used for industrial control, embedded sensing, medical data gathering, smoke and intrusion detection, building automation, home automation, and other applications.

GSM/GPS: GSM is an abbreviation for Global System for Mobile Communication. It is used to encrypt and transmit data. GSM technology is employed, which comprises mobile stations, base stations, and network systems. The mobile station consists of a basic mobile access point or a mobile phone that connects to the GSM network for communication.

GPS stands for Global Positioning System. GPS is a network of satellites and receiving devices used to determine the location of something on Earth. Some GPS receivers are so precise that they can pinpoint their location to one centimeter (0.4 inch). GPS receivers offer location information in the form of latitude, longitude, and altitude.

Vibration and sound sensor: A vibration sensor, also known as a vibration detector, measures vibration levels in machinery for screening and analysis. Maintenance personnel utilizes industrial vibration sensors to check the magnitude and frequency of vibration signals.

A sound sensor is one sort of module that detects sound. In general, this module is used to detect the strength of sound. This module's principal applications are switch, security, and monitoring. The precision of this sensor can be adjusted for simplicity of use.

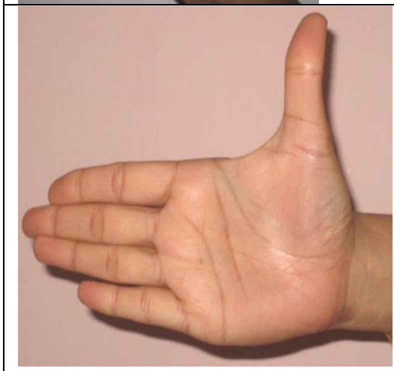
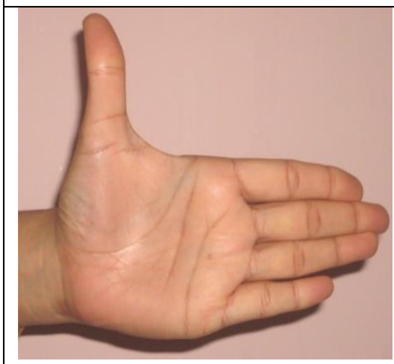
V. IMPLEMENTATION PART

First, we created a smart wearable device. We used an accelerometer sensor to design this device, and the data pin of the accelerometer sensor was connected to the analog pins of the ATmega328, which not only senses analog data but also converts analogue data to digital data. We employed a wireless connection using Bluetooth technology to send digital data to a mobile phone, and we used cross-communication between the ATmega328 and the Bluetooth module to send data.

The data will be successfully sent to the microcontroller via Bluetooth Module using C programming on the Arduino IDE. The sound can be heard through the speaker using the mobile phone application we created. The hand gestures are converted from analog to digital signals and then played back through speakers.

If the user is in an emergency situation, they can send an SOS message with their current position by pressing the push button on the wearable gadget. The GSM/GPS module will be used for additional functionality. Another add-on feature will be for deaf and dumb people who will not hear the vehicle's horn, therefore we will use a sound sensor to capture the loud noise and a vibration sensor to provide a alert to the deaf people through, preventing an accident.

Table I: Hand gestures signs with voice a message

IMAGE OF HAND GESTURE	INTEGER VALUE	VOICE MESSAGE
	1	Can you take me to this address?
	2	Need food or water
	3	Give me medicine
	4	Thank you for your help

VI. CONCULSION AND FUTURE SCOPE

A smart, inexpensive, portable, cost-effective, lightweight, and user-friendly system is intended to help a person who cannot talk in comparison to the other proposed system. We've successfully created five different gestures as well as an audio message that can help someone who has trouble speaking express their wants. By producing output in the form of speech, which bridges the gap between the dumb people and the rest of us, this approach aims to make it simpler to understand the actions of the mute people. The fact that we incorporated four motions in our prototype demonstrates that additional gestures can be employed to recognize the entirety of sign language.

The following will be the future scope of the project:

- The device could be upgraded to support different sign languages used in other nations.
- We hope to develop it into a full-fledged tool that enables persons with cognitive disabilities to interact with others normally.
- We wish to develop an aid for the blind that can translate written information from books, newspapers, and notes into an audible audio signal.
- The "Microcontroller and Sensors Based Gesture Vocalizer" wireless transceiver system is designed.
- Perfection in the "Microcontroller and Sensors Based Gesture Vocalizer's monitoring and detecting of dynamic movements.
- A touchpad (mobile screen) can be used in place of the glove's flex sensor to improve the system. A touchpad (smartphone screen) can be used to make a "n" number of motions, allowing a person who is deaf to transmit a "n" number of messages. They can transmit the message directly using the touchpad; no gestures are required.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to Dr.P Shanmugapriya who served as my project advisor, because of her constant assistance and support we finished this project. Her consistent help and guidance are the main reasons for getting our project finished.

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