IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

An IoT Based Gesture Recognition System for Patients

[1]Sooryakrishna M K,[2]Abhinav kumar K K,[3]Udayakrishnan K, [4]Bivin A V, [5]Shilja A S

[1]Student,[2]Student,[3]Student, [4]Student, [5]Professor

[1]Department of Electronics And Communication Engineering,

[1]MCET, Desamangalam-679532, Kerala, India

Abstract:This project presents a smart glove designed for real-time hand gesture recognition and emergency response. The glove incorporates five flex sensors to capture finger movements, an accelerometer to detect hand orientation, and an ESP32 microcontroller for processing sensor data. A display provides visual feedback, while an APR33A3 chip enables audio playback. Additionally, the glove integrates with a mobile application via Bluetooth connection, allowing for emergency notification

blinking and remote control of appliances like lights and fans.This smart glove offers a novel solution for hands-free emergency response. By recognizing specific hand gestures, the glove can trigger pre-recorded emergency audio messages, send notifications to a connected mobile app, and even remotely control smart home devices, promoting increased safety and accessibility for users in need of assistance.

***Index Terms*–Gesture Recognition, Flex sensors.**

I. Introduction

In today's world, quick and efficient emergency response can be the difference between life and death. However, traditional methods of communication in emergency situations often rely on bystanders or the ability to speak and operate a device. This can be a challenge for individuals in situations where they are injured, unconscious, or in environments where voice communication is impractical due to smoke or loud noises. This project introduces a groundbreaking solution: a smart glove designed for intuitive and hands-free emergency response. This innovative wearable leverages the power of gesture recognition technology to empower users to trigger crucial actions in critical moments.

The glove utilizes a combination of cutting-edge sensors:

Five Flex Sensors: These sensors strategically placed on the fingers detect the subtle nuances of hand movement, allowing the glove to recognize specific pre-programmed gestures.

Accelerometer: This sensor tracks the orientation and movement of the hand in space, providing additional data for gesture recognition and potential fall detection applications.

ESP32 Microcontroller: This powerful processing unit forms the brain of the glove, interpreting sensor data and translating gestures into pre-defined actions.

With the collected data, the glove can perform a variety of life-saving functions:

Emergency Audio Playback: By recognizing a designated gesture, the glove can trigger pre-recorded audio messages, such as calls for help or specific emergency instructions, without the need for the user to speak.

Mobile App Notification: The glove seamlessly integrates with a dedicated mobile application via Bluetooth. Upon recognizing an emergency gesture, the glove can send a notification to the app, potentially displaying a blinking or pulsating alert to catch the attention of a nearby caregiver or bystander.

Smart Home Control: The glove can be programmed to interact with smart home devices paired with the mobile application. Imagine a scenario where a user experiencing a medical emergency can activate a pre-programmed gesture to turn on lights for better visibility or activate a fan for improved air circulation.

This smart glove transcends the limitations of traditional emergency response methods. It offers a hands-free, intuitive solution for individuals who may be unable to speak or operate a device in critical situations.

By leveraging the power of gesture recognition technology, this project has the potential to revolutionize emergency response, promoting increased safety and accessibility for all

II. Block Diagram

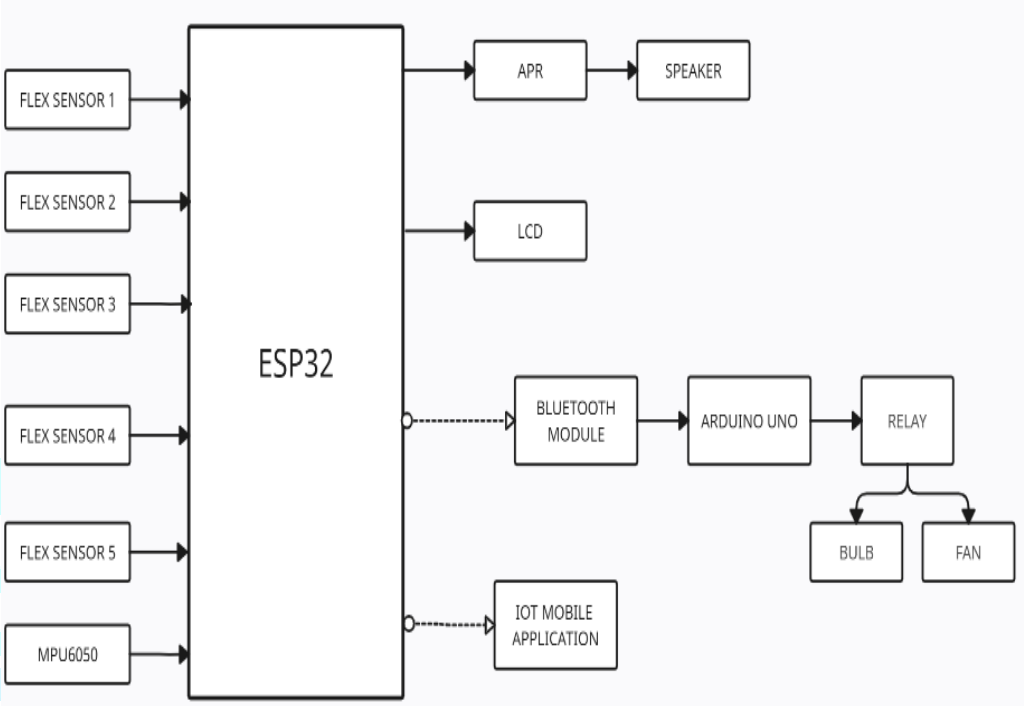

Fig 1. Block Diagram

The block diagram show a system with several sensors, a Bluetooth module, an ESP32 microcontroller, an Arduino Uno microcontroller, and multiple output devices including a speaker, LCD, relay, bulb, and fan.In this intricate system, several sensors act as the eyes and ears, constantly taking in information from the surrounding environment. These sensors include five flex sensors, adept at detecting how much an object is bent, and an MPU6050 sensor, capable of measuring a device's orientation and acceleration. This collected data is then meticulously transmitted to the ESP32 microcontroller, the brain of the operation. The ESP32, a powerful microprocessor, takes the reins and analyzes the sensor readings. To further expand its capabilities, the ESP32 utilizes a Bluetooth module to establish a wireless connection with another microcontroller, the Arduino Uno. The exact nature of the data exchanged during this Bluetooth communication depends on the specific programming designed for the system. Once the data reaches the Arduino Uno, it takes center stage in commanding a brigade of output devices. These devices include a speaker, ready to project sound, an LCD screen, prepared to visually display information, a relay, adept at electronically switching circuits on or off, a bulb, able to illuminate the surroundings, and a fan, capable of generating cooling airflow. By meticulously controlling these output devices based on the processed sensor data, the Arduino Uno brings the system to life, enabling it to react and adapt to its environment in unique ways. Ultimately, the precise functionality of this system hinges on the intricate programming uploaded onto the microcontrollers, transforming this collection of components into an intelligent entity.

III. Flow Chart

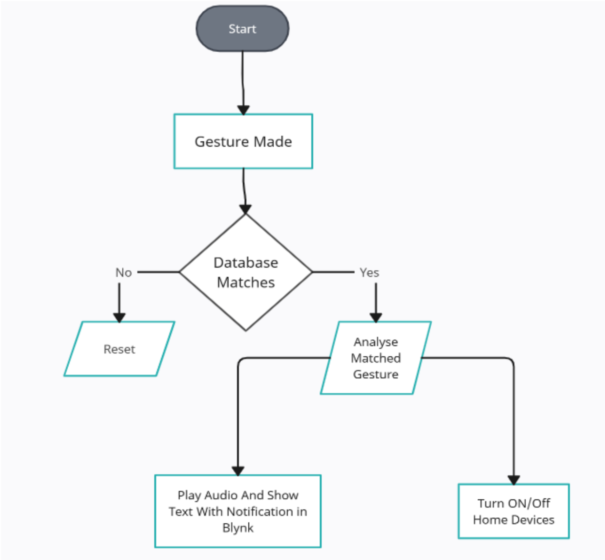

Fig 2. Flow Chart

- The system starts and waits for a gesture to be made.
- The system then checks if a gesture was made.
- If no gesture was made, the system resets and waits again for a gesture.
- If a gesture was made, the system analyzes the gesture to determine what it is.
- The system then checks the database to see if there is a match for the gesture.
- If there is a match, the system performs the action associated with the gesture. This could include playing audio, showing text with a notification in Blynk, or turning on or off home devices.
- If there is no match, the system resets and waits again for a gesture.

IV. Circuit Diagram

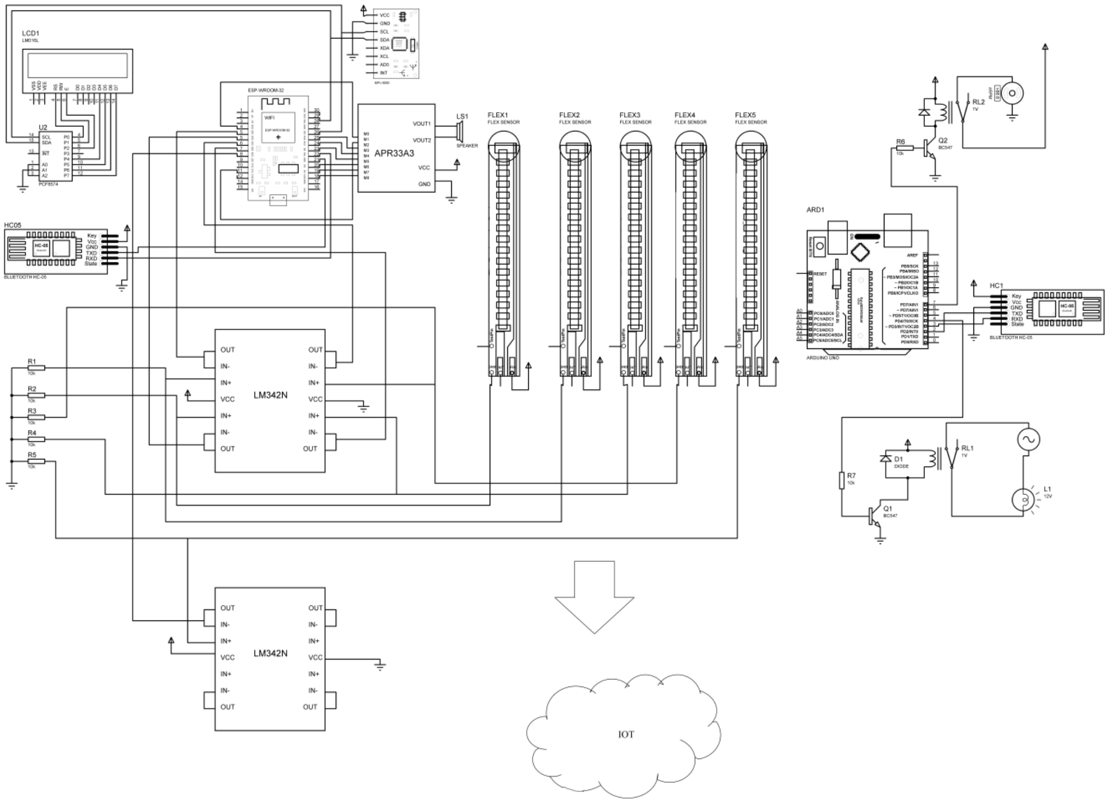

Fig.3 Circuit Diagram

- ESP32: This is a microcontroller unit (MCU) that integrates Wi-Fi and Bluetooth connectivity.
- Sensors: The system includes various sensors, including flex sensors and an inertial measurement unit (IMU).
- LCD: This is a liquid crystal display that shows information.
- Bluetooth module: This enables wireless communication between the ESP32 and other devices.
- Other components: The system also includes an Arduino Uno, relays, and other electrical components.

4.1 Hardwares

4.1.01ESP 32

ESP32 is a series of low-cost low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun , power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espress if Systems a Chinese company based in Shanghai, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.

Fig 4.01. ESP 32

4.1.02 Arduino Uno

The ArduinoUno is one kind of microcontroller board based on ATmega328, and Uno is an Italian term which means one. Arduino Uno is named for marking the upcoming release of microcontroller board namely Arduino Uno Board 1.0. This board includes digital I/O pins-14, a power jack, analog i/ps-6, ceramic resonator-A16 MHz, a USB connection, an RST button, and an ICSP header. All these can support themicrocontroller for further operation by connecting this board to the computer. The power supply of this board can be done with the help of an AC to DC adapter, a USB cable, otherwise a battery. This article discusses what is an Arduino Uno Microcontroller, pin configuration, ArduinoUnospecificationsorfeatures, and applications.

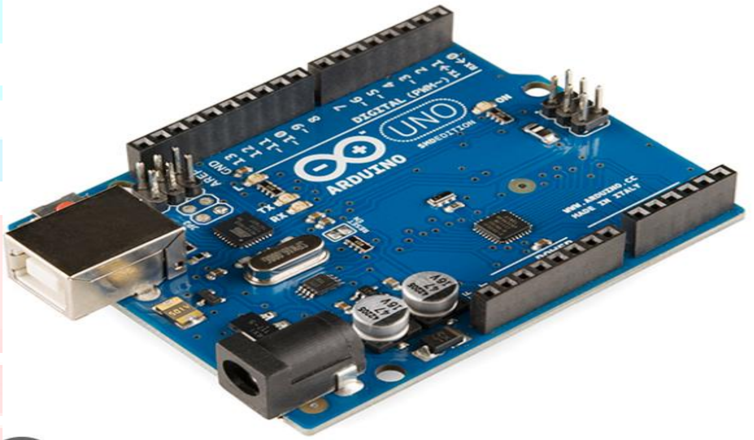

Fig 4.02. Arduino Uno

4.1.03 APR 33A3

The APR33A series is a powerful audio processor along with high-performance audio analog-to-digital converters (ADCs) and digital-to-analog converters (DACs). The IC is a fully integrated solution offering high performance and unparalleled integration with analog input, digital processing, and analog output functionality.It is a single chip voice recorder and playback device with 8 channels. Each channel can store up to 1.3 minutes speech message and total 11 minutes speech can be recorded and stored in all the channels (Fig-6). It takes the input from Arduino mega2560 and gives the voice as output.

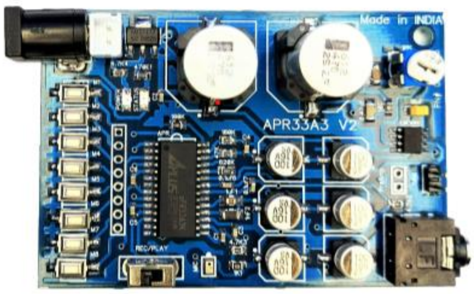

Fig 4.03 APR 33A3

4.1.04 Flex Sensor

Flex sensors, the enigmatic little devices that change their resistance when bent, hold within them a vast potential for innovation and creativity. Their compact size and ease of use belie their versatility, making them valuable tools for makers, engineers, and artists alike. Flex sensors come in various forms, each with its own unique characteristics. Resistive flex sensors, the most common type, change their resistance directly with bending, offering a simple and reliable solution. Capacitive flex sensors detect changes in capacitance, providing high sensitivity for applications requiring precise measurements. And piezoelectric flex sensors convert bending into a voltage, ideal for applications where energy harvesting is desired.

Fig 4.04 Flex Sensor

4.1.05 MPU6050 (IMU)

The MPU6050 is a compact and versatile inertial measurement unit (IMU) that combines a 3-axis gyroscope and a 3-axis accelerometer on a single chip. This powerful combination enables it to measure both orientation and movement, making it a valuable tool for a wide range of applications. the MPU6050 IMU is a powerful and versatile sensor that offers a compelling solution for measuring orientation and movement across diverse applications. Its compact size, low power consumption, and ease of use make it a popular choice for makers, engineers, and researchers alike. As technology continues to evolve, the MPU6050 will undoubtedly remain a key component in driving innovation and pushing the boundaries of what's possible.

Fig 4.05 MPU6050 (IMU)

4.1.06 HC-06 6-PIN BLUETOOTH MODULE

The HM-06 Bluetooth module is intended for short-range wireless data communication between two microcontrollers or systems. This is the cheapest and most flexible method for wireless data transmission, and it can even transmit files at speeds of up to 2.1 Mb/s. The UART interface is used to communicate with the HC-06 module. The working current is matched to 30 mA, matching the communication for 8 mA.

Fig 4.06 HC-06 6-Pin Bluetooth Module

4.1.07 LCD Display

Liquid Crystal Display (Fig-5) screen is an electronic display module. A 16x2 LCD displays 16 characters per line and there are 2 such lines. This LCD consists of Command registers andData registers. The command registers store the command instructions given to the LCD. The data registers stores the data to be displayed on the LCD. It is used for user interface.

Fig 4.07 LCD Display

4.1.08 5V Relay Module 2- Channel

‘This relay module is designed to control small electrical objects such as motor, pump, lamp, and other devices that require high voltage and high current to operate. The logic level of this module is negative, which means you need to feed a LOW (0V) signal to the input pin to activate the particular relay switch. Feed a HIGH (5V) signal to the input pins to deactivate the particular relay switch. 5V

Fig 4.08 5V Relay Module 2- Channel

4.1.09 AUDIO SPEAKER

A 5v audio speaker is a small loudspeaker designed to operate on a 5 volt power supply. These speakers are often used in battery-powered devices or alongside low-power microcontrollers like the Arduino Uno or ESP32 for creating simple audio projects. They typically offer decent sound quality for basic applications but may not be powerful enough for high-fidelity audio experiences.

Fig 4.09 Audio Speaker

4.1.10 Exhaust fan

It is a 12V DC fan with 0.15A. It has two wires (positive and negative) with connector to connect with the source. It is used for cooling operations in computer devices.

Fig 4.10 Exhaust Fan

V. IMPLEMENTATION AND SCOPE

5.1 Increased Number of Gestures: This allows for more complex interactions and customization. For patients, it could mean controlling multiple devices or settings with a single gesture. In gaming, it could enable intricate character controls or spellcasting.

5.2 Multi-hand Gestures: Using both hands can create more intuitive and expressive interactions. Imagine patients using two hands to adjust a virtual physical therapy exercise or gamers performing combo moves in a fighting game.

5.3 Biometric Monitoring: Integrating biometric sensors can enhance the system's understanding of the user's state. This could be used for:

- **Patient care:** Monitor vital signs (heart rate, etc.) and adjust automation based on the data.
- **Gaming:** Adapt game difficulty based on player stress levels.

5.4 Fall Detection and Prevention: This can be a life-saving feature for patients at risk of falling. The system could detect falls through gestures or sudden changes in motion and trigger alerts for caregivers.

5.5 Medical Applications: Gesture recognition can be used for:

- **Physical therapy:** Guide patients through exercises with visual cues triggered by gestures.
- **Surgical procedures:** Allow surgeons to control medical equipment with minimal contact, reducing infection risk.

5.6 Gaming and Entertainment: Gesture recognition can revolutionize gaming experiences with more immersive and intuitive controls. It can also be applied in VR applications for natural interactions within virtual worlds.

5.7 User Data Storing: While privacy concerns need to be addressed, storing user data can be beneficial for:

- **Personalization:** The system can learn user preferences and tailor gesture recognition or automation accordingly.
- **Medical applications:** Store patient data on gesture patterns to identify potential health issues or track recovery progress.

VI. RELAVANCE OF THE PROJECT

6.1 Social Needs

- **Valuable and Versatile Communication:** For people with speech or motor limitations, the glove offers a new way to communicate and control their environment. This can be particularly beneficial for individuals with conditions like ALS, stroke, or spinal cord injuries.
- **Enhanced Comfort and Well-being:** The ability to control lights, fans, and send alerts without relying on others fosters independence and improves quality of life for patients or individuals with disabilities.
- **Reduced Anxiety for Patients and Families:** Faster emergency response through gesture recognition can reduce anxiety for patients in need of assistance. Knowing help can be summoned discreetly can also ease anxiety for families.
- **Overcoming Communication Barriers:** For those who cannot speak clearly or have difficulty using traditional communication methods, the glove empowers them to express needs and interact with their environment.
- **Promoting Independence:** The ability to control lights, fans, or send alerts fosters a sense of control and reduces reliance on caregivers. This can significantly improve a patient's morale and well-being.

- **Reduced Reliance on Caregivers:** The glove can ease the burden on caregivers by allowing patients to manage some basic needs independently.

6.2 Industry Needs

- **Healthcare:** The glove has the potential to revolutionize patient care by improving communication and providing a hands-free way for patients to control their environment. It can also be used for fall detection and remote monitoring of vital signs (if additional sensors are integrated).
- **Assistive Technology:** The glove can be a valuable assistive technology tool for people with disabilities, allowing them to control smart home devices, communicate, and access entertainment.
- **Eldercare:** The glove can be beneficial in eldercare facilities, enabling seniors to maintain independence and call for assistance more easily.
- **Improved Patient Care Efficiency:** Faster emergency response and remote monitoring capabilities can improve healthcare efficiency and patient outcomes.
- **Reduced Hospital Readmissions:** The glove might help prevent falls and enable patients to manage their environment more effectively, potentially reducing hospital readmissions.
- **Enhanced Safety and Independence in Eldercare:** The glove can contribute to a safer living environment for seniors and promote their independence within assisted living facilities.

VII. ADVANTAGES AND DISADVANTAGES

7.1ADVANTAGES

- Improved communication between deaf and Normal people.
- Increased access to information and education.
- Improved employment opportunities.
- Increased social participation.
- Portability.
- Cost Efficient.

7.2 DISADVANTAGES

- Accuracy.
- Availability.
- Social acceptance.
- Speed.

VIII. FUTURE SCOPE

The Gesture-to-Voice Conversion System (GVCS) represents a significant leap forward in communication accessibility for individuals with hearing and speech impairments. However, its potential extends far beyond its current capabilities. Let's explore some exciting avenues for future development:

8.1 Expanding the Gesture Lexicon:

The current library of recognized gestures forms the foundation of the system. Expanding this library to include a wider range of gestures, including cultural and individual variations, would enhance its versatility and inclusivity. This could be achieved through user-driven input, machine learning algorithms trained on diverse datasets, and integration with existing sign language dictionaries.

8.2 Contextual Awareness:

Understanding the context in which a gesture is made can dramatically improve its interpretation. By incorporating factors like facial expressions, surrounding environment, and previous communication history, the GVCS can achieve a more nuanced understanding of user intent, leading to more natural and accurate communication. This could involve integrating additional sensors like facial recognition cameras and microphones, as well as developing sophisticated machine learning algorithms that analyze contextual cues.

8.3 Real-time Translation and Feedback:

Currently, the GVCS translates gestures into pre-recorded audio clips. Implementing real-time text-to-speech synthesis would offer greater flexibility and allow for dynamic communication. Additionally, incorporating haptic feedback into the wearable sensors could provide users with real-time feedback on their gestures, facilitating their learning and accuracy.

8.4 Integration with Assistive Devices:

The GVCS can be further enhanced by integrating with existing assistive devices such as cochlear implants and hearing aids. This would allow for a more personalized and comprehensive communication experience, tailored to the specific needs of each user.

8.5 Open-Source Development:

Encouraging open-source development of the GVCS platform would accelerate its advancement and foster collaboration among researchers, developers, and users. This could lead to faster innovation, wider accessibility, and cost-effective solutions for individuals with hearing and speech impairments.

8.6 Multi-Modal Communication:

The future of communication lies in multi-modality. Integrating the GVCS with other communication modalities such as text input, eye-tracking, and brain-computer interfaces could create a truly seamless and intuitive communication experience. This would empower individuals with a wider range of disabilities and communication preferences.

By exploring these future avenues, the GVCS has the potential to revolutionize communication accessibility and create a world where everyone can participate fully and express themselves freely. This journey towards a more inclusive future requires continued innovation, collaboration, and dedication to empowering individuals with hearing and speech impairments.

IX. NOVELITY OF IDEA

9.1 Customizable Gestures: Training the system to recognize patient-specific gestures is a significant innovation. This personalization empowers patients with speech limitations and caters to their specific needs.

9.2 Focus on Specific Patient Needs: This focus ensures the system provides targeted functionalities. Imagine gestures for patients recovering from stroke to control pain medication or adjust room temperature.

9.3 Enhanced Independence: Empowering patients with control over daily activities through gestures fosters a sense of independence and improves their quality of life.

9.4 Identification of Health Issues: Gesture recognition can become a valuable tool for identifying potential health issues. For instance, changes in gesture patterns or inability to perform specific gestures could indicate pain, fatigue, or tremors.

9.5 Caretaker Notifications: Integrating gestures for caretaker notifications adds another layer of value. Patients can discreetly request help or indicate emergencies using customized gestures.

XI Simulation And Result

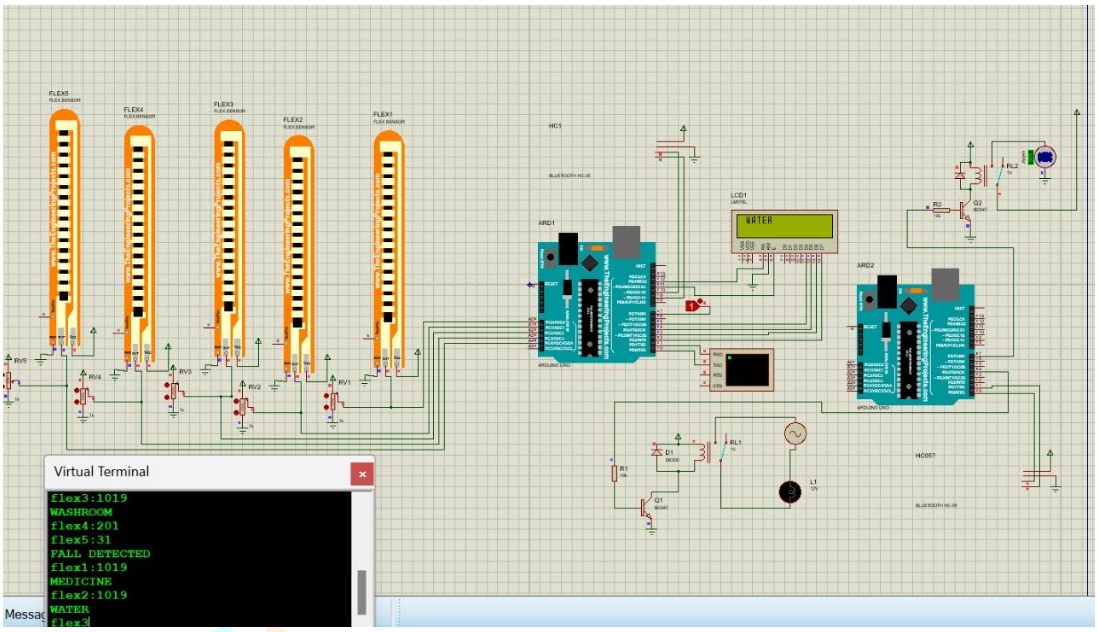

Fig 5.1 Simulation

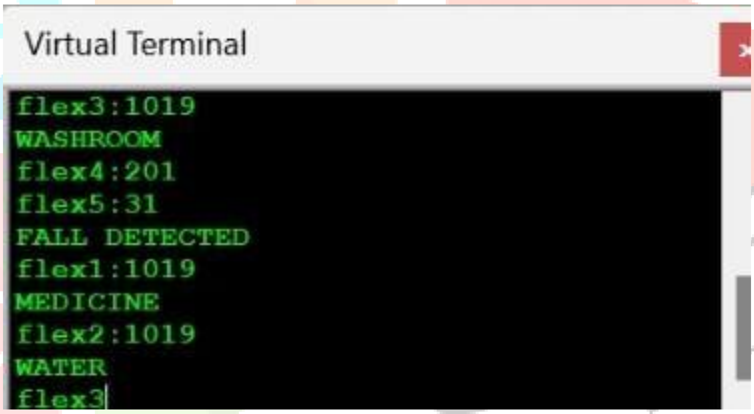

Fig 5.2 Simulation Result

XI. COST

COMPONENT	PRICE
FLEX SENSOR X5	1500
ELECTRONIC COMPONENTS	500
ARDUINO Uno	500
APR33A3 + SPEAKER	720
LIQUID CRYSTAL DISPLAY	250
LIPO BATTERY + CHARGER	750
MPU6050 (IMU)	420
BLUETOOTH MODULE	200
GLOVE	150
TOTAL	4490 INR

Fig 6 Cost

XI. CONCLUSION

In conclusion, this project culminates in a highly promising smart glove poised to disrupt the landscape of emergency response. By ingeniously combining an array of sensors – flex sensors for nuanced finger movements, an accelerometer for spatial awareness, and an ESP32 microcontroller as the processing powerhouse – the glove translates hand gestures into critical actions. The visual feedback provided by the display and the audio playback facilitated by the APR33A3 chip further enhance user experience. The seamless Bluetooth integration with a dedicated mobile app unlocks a new level of versatility. Imagine an emergency situation where a simple gesture not only triggers an alert on the app (potentially with a pulsating notification to grab attention) but also activates pre-programmed smart home features. Lights could illuminate the environment for better visibility, while a fan kicks in to improve air circulation. This ripple effect, extending beyond the user to caregivers and bystanders, underscores the true potential of this technology.
However, the path to widespread adoption necessitates meticulous attention to detail. Refining gesture design to ensure intuitive use under duress and minimizing the risk of accidental activation are crucial. Optimizing battery life to guarantee functionality during emergencies and exploring features like water resistance for specific user groups will be essential. Through rigorous development and testing, this groundbreaking technology has the potential to transcend the realm of a prototype and become a ubiquitous life-saving tool. The smart glove is more than just a sophisticated piece of wearable tech; it's a beacon of hope, empowering the vulnerable and transforming the way we approach emergency response. Its

widespread adoption has the potential to create a paradigm shift, fostering a safer and more inclusive world where help is truly at our fingertips, or rather, at the flick of a wrist.

REFERENCES

[1] Umalusi. Sign of the Times The Quality Assurance of the Teaching and Assessment of South African Sign Language. Pretoria, SA. Umalusi, Council for Quality Assurance in General and Further Education and training. 2018

[2] H. Liu and L. Wang, “Gesture recognition for human-robot collaboration: A review,” International Journal of Industrial Ergonomics, vol. 68, pp. 355–367, Nov. 2018, doi: 10.1016/j.ergon.2017.02.004.

[3] S. Ahmed, R. Islam, M. S. R. Zishan, M. R. Hasan and M. N. Islam, "Electronic speaking system for speech impaired people: Speak up," 2015 International Conference on Electrical Engineering and Information Communication Technology (ICEEICT), 2015, pp. 1-4, doi: 10.1109/ICEEICT.2015.7307401.

[4] E. Holmer, M. Heimann, and M. Rudner, “Evidence of an association between sign language phonological awareness and word reading in deaf and hard-of-hearing children,” Research in Developmental Disabilities, vol. 48, pp. 145–159, Jan. 2016, doi: 10.1016/j.ridd.2015.10.008.

[5] A. Dexter. “How Many Words are in the English Language?” wordcounter.io. https://wordcounter.io/blog/how-many-words-are-inthe-english-language (accessed Jan. 02, 2023).

[6] M. A. Ahmed, B. B. Zaidan, A. A. Zaidan, M. M. Salih, and M. M. bin Lakulu, “A Review on Systems-Based Sensory Gloves for Sign Language Recognition State of the Art between 2007 and 2017,” Sensors, vol. 18, no. 7, p. 2208, Jul. 2018, doi: 10.3390/s18072208.