

Motion Based Message Conveyor for Paralytic/Disabled People

¹Omkar Borlepwar, ²Syed Umar, ³Shaikh Aarifeen, ⁴Prof. Syed Shoeb

^{1,2,3}B. Tech. ECT (Final Year) Students, ⁴Professor

Dept. of ECT, MGM College of Engineering, Nanded

s22_omkar_borlepwar@mgmccen.ac.in, s22_syed_umar@mgmccen.ac.in,

s22_shaikh_aarifeen@mgmccen.ac.in, sayed_shoaib@mgmccen.ac.in

Abstract—*This is an innovative application that can help the disabled/paralytic patients to convey messages or call nurse by using simple gesture movements since paralytic or disabled patients cannot press a button or ring to call a nurse when they need. Even if they can move a particular body part like moving their hand up to a limit or moving their leg up to a limit, this system can be mounted on mobile body part and just by a simple movement or a gesture, and they can pass on various messages and call the attendant. Objective of this project is implementing a relatively less expensive system that helps in establishment of communication between disabled or paralytic patients and nurse/caretaker.*

Index Terms—*ESP32 microcontroller, MPU6050.*

1. INTRODUCTION

Among the enormous number of advancements done in the medical sector, very few actually focus on helping patients with disabilities to communicate. Here we propose a simple and effective way to solve the problem of physically handicapped or disabled patients. The main purpose is to replace the conventional approach of patient-nurse communication with modern technologies which is much faster and reliable way to do so. In the current scenario, the patient has to be dependent on a family member/nurse who have to attend to the patient constantly. Objective of this method is to make such patients independent to communicate with the nurse just by tilting a device located on his any other mobile body part like leg, hand. Movement of the mobile body part in a particular direction will send a message to the phone which will then display and speak out the message specified in direction. The user needs to have a transmitting device which consists of a sensor, i.e., 3-axis accelerometer.

2. PROPOSED METHODOLOGY

Literature Review

P. S. Patil, R. S. Patole, and R. R. Pawar, "Motion Based Message Conveyor for Paralytic/Disabled," Proceedings of the 8th National Conference on Emerging Trends in Engineering and Technology (NCETET), 2018.

The proposed system by Patil et al. (2018) is designed to assist paralyzed or physically disabled individuals in communicating through motion detection. The methodology involves using motion sensors, such as an accelerometer, to detect specific movements of the patient's body parts—typically hand or head gestures. These sensor signals are processed by a microcontroller, which interprets the motion and converts it into predefined messages. Each gesture corresponds to a particular message (for example, “I need water” or “Call the doctor”). The microcontroller then transmits these messages to a display unit like an LCD or to a wireless communication module that conveys the message to a caretaker. The system operates in real time, ensuring quick and reliable message delivery without requiring speech or manual typing. This methodology effectively overcomes communication barriers faced by paralyzed patients by integrating low-cost sensors and simple embedded programming techniques for gesture recognition and message display.

Drawbacks

Although the proposed system by Patil et al. (2018) successfully enables communication for paralyzed or disabled individuals, it has several limitations. The system relies heavily on the accuracy of the motion sensor, which can cause errors in message detection if the sensor is not properly calibrated or if unintended movements occur. It also depends on the physical ability of the patient to perform consistent gestures, making it unsuitable for individuals with severe paralysis or tremors. The design offers only a limited set of predefined messages, reducing flexibility in communication. Moreover, the wired connections and basic microcontroller used in the model restrict portability and scalability. Finally, the absence of advanced features like wireless data transmission, voice alerts, or mobile connectivity limits its practical usability in modern healthcare environments.

Key Points

1. The system uses motion sensors (like accelerometers) to detect body gestures of paralyzed patients for communication.
2. A microcontroller processes the motion data and converts it into predefined text messages displayed on an LCD.
3. The project provides a cost-effective and simple communication method for disabled individuals without requiring speech or touch.
4. The design focuses on real-time message delivery but has limited flexibility and fewer message options.

M. K. Verma and R. Kumar, “IoT-based Patient Assistance System Using ESP32 and Accelerometer Sensor,” International Journal of Innovative Research in Computer and Communication Engineering, vol. 9, no. 6, pp. 2105–2110, 2021.

The IoT-based patient assistance system proposed by Verma and Kumar (2021) uses an ESP32 microcontroller integrated with an accelerometer sensor to monitor motion and assist physically disabled or paralyzed patients. The accelerometer detects the user's specific movements or tilts, which are interpreted by the ESP32 to generate corresponding signals. These signals are then processed and

transmitted via Wi-Fi to a cloud platform or a connected device, such as a smartphone or monitoring system. Each predefined motion corresponds to a particular message (for example, requesting help or medical attention), which is displayed on an LCD or sent as a notification to the caretaker. The system ensures real-time communication using IoT connectivity and provides an efficient, low-cost, and wireless alternative to conventional patient assistance devices. This methodology enhances communication reliability, portability, and patient comfort through seamless integration of sensor and IoT technologies.

Drawbacks

Although the IoT-based patient assistance system developed by Verma and Kumar (2021) offers real-time monitoring and wireless communication, it still presents several limitations. The system's accuracy highly depends on stable Wi-Fi connectivity, which can affect performance in areas with weak network signals. The accelerometer sensor may generate false triggers due to sudden vibrations or accidental movements, leading to incorrect message transmission. Power consumption is also a concern, as the ESP32 and continuous Wi-Fi transmission drain the battery quickly, reducing portability for long-term use. The system requires proper calibration for each individual user, which can be time-consuming and limits ease of deployment. Additionally, the design lacks data security measures and does not include advanced features such as voice feedback or automatic emergency alerts, which are essential in critical healthcare applications.

Key Points

1. The system integrates an ESP32 microcontroller with an accelerometer sensor for motion detection and IoT-based communication.
2. Detected gestures are transmitted wirelessly via Wi-Fi to caregivers or cloud platforms in real time.
3. The model provides better portability and efficiency through IoT technology compared to traditional wired systems.
4. The system demonstrates a low-cost, wireless, and user-friendly solution for assisting physically disabled or paralyzed patients.

D. Vishnu Vardhan and P. Panchala Prasad, "Hand Gesture Recognition Application for Physically Disabled People," International Journal of Science and Research (IJSR), vol. 3, no. 8, Aug. 2014.

The methodology proposed by Vishnu Vardhan and Panchala Prasad (2014) focuses on developing a hand gesture recognition system to assist physically disabled individuals in communication and device control. The system captures hand movements using sensors or a camera module, which detect gesture patterns based on motion or positional data. These signals are processed using a microcontroller or computer vision algorithm that interprets each gesture into corresponding commands or messages. For example, specific hand orientations can represent basic needs such as "help," "food," or "water." The recognized gestures are then displayed on an LCD screen or sent to a connected device to alert caretakers. This methodology provides a simple and natural interface for users who cannot speak or type, helping them convey essential messages efficiently and independently.

Drawbacks

Despite its usefulness, the methodology by Vishnu Vardhan and Panchala Prasad (2014) has some notable limitations. The system's accuracy depends heavily on lighting conditions and background clarity when using camera-based gesture recognition. It may also struggle with variations in hand size, skin color, or gesture speed, leading to recognition errors. The processing time can increase with complex gestures, reducing real-time responsiveness. Additionally, the system is not suitable for users with limited or no hand mobility, restricting its application to a specific group of disabled individuals. The design also lacks IoT connectivity and portability features found in more modern systems, limiting its scope in advanced healthcare applications.

Key Points

1. The system focuses on recognizing hand gestures using sensors or image processing techniques to help physically disabled individuals communicate effectively.
2. Different hand movements are mapped to specific commands or messages, enabling hands-free control of devices or message transmission.
3. The proposed application enhances user independence and offers an intuitive, non-verbal way to interact with electronic systems.
4. The model demonstrates the potential of gesture recognition technology in rehabilitation and assistive communication for disabled users.

Paper Review, Methodology, and Key Points

The proposed system in the current project is designed by integrating the advantages of earlier research works while addressing their limitations. The system uses an ESP32 microcontroller along with an accelerometer sensor to detect motion or hand gestures made by a paralyzed or disabled person. Each specific motion is programmed to correspond with a predefined message such as "Need Water," "Call Doctor," or "Emergency." The sensor data is processed by the ESP32 and displayed on an LCD screen for quick visual communication. Furthermore, the system uses Wi-Fi-based IoT connectivity to send these messages wirelessly to a caretaker's mobile device or monitoring station. This methodology ensures real-time, reliable, and wireless message transfer, making it more practical, efficient, and user-friendly than previous designs.

How We Overcome

This project integrates Wi-Fi-enabled ESP32 for wireless message transfer and improves portability by using a compact power-efficient design. It also supports multiple motion gestures with flexible message customization, making communication faster and more adaptable for different users.

The design includes low-power modes for ESP32 to extend battery life and uses offline message storage in case of network failure. Additionally, buzzer or voice alert integration is added for emergencies and secure message transfer protocols are used to enhance system reliability and safety.

Instead of camera-based detection, this project uses an accelerometer sensor that works effectively in any lighting condition. It supports simple body motions like tilts or small hand movements, making it

accessible even for patients with limited mobility. Moreover, the system's IoT integration allows real-time message delivery without visual constraints.

Key Points

1. Added offline message storage for Wi-Fi issues.
2. Low-power modes to extend battery life.
3. Integrated buzzer/voice alerts for emergencies.
4. Secure and reliable transmission for critical messages.
5. Supports small body movements, suitable for limited mobility users.
6. IoT-based wireless transmission allows real-time delivery.
7. Faster processing with microcontroller-based signal handling.

Overall Review

Assistive technology for physically disabled and paralyzed individuals has been a significant area of research in recent years. The ability to communicate independently is a critical need for patients with limited motor functions, and traditional methods such as speech or manual typing are often not feasible. Early research, such as Vishnu Vardhan & Panchala Prasad (2014), focused on hand gesture recognition systems, highlighting the potential for non-verbal communication. These systems successfully mapped gestures to commands or messages, improving user independence and providing a natural interface. However, the reliance on cameras and image processing made them sensitive to lighting conditions, background noise, and variations in user hand movement, limiting accuracy and real-world usability. Moreover, they lacked wireless communication, restricting mobility and immediate response.

The 2018 study by Patil et al. advanced this field by introducing motion-based message conveyors using accelerometer sensors and microcontroller processing. This approach simplified gesture recognition, reduced dependency on environmental conditions, and allowed real-time message display on an LCD. It provided a cost-effective and accessible solution for paralyzed users. Nonetheless, the system's wired design, limited gesture options, and absence of wireless communication reduced portability and adaptability, making it less suitable for modern healthcare settings.

Building on these limitations, Verma & Kumar (2021) integrated ESP32 microcontrollers and IoT connectivity, enabling wireless transmission of messages and enhancing portability. This system allowed real-time communication between patients and caregivers and automated gesture-to-message conversion, providing a modernized, connected solution. However, its high power consumption, dependence on stable Wi-Fi connectivity, lack of emergency alerts, and limited security features revealed remaining gaps in practical applicability.

The proposed project addresses these gaps by combining the best features from all previous research while introducing several improvements. Using ESP32 with accelerometer sensors, the system captures subtle hand or body motions and converts them into predefined messages. Unlike earlier camera-based methods, it works effectively in any lighting or environmental condition. Messages are displayed on an LCD and simultaneously transmitted to a caregiver's device via IoT, ensuring real-time and wireless

communication. The system incorporates low-power operation, offline message storage, and emergency buzzer/voice alerts, making it reliable even in power outages or network failures. The flexibility of multiple gestures and customizable messages ensures that patients of varying abilities can use the system comfortably.

Compared to previous studies, this project provides a comprehensive, practical, and user-friendly solution:

1. Enhanced accessibility and inclusivity – works for patients with limited mobility, including subtle movements.
2. Wireless and real-time communication – allows caretakers to receive messages instantly without physical proximity.
3. Flexible and customizable system – supports multiple gestures and tailored messages for individual patient needs.
4. Low-power and efficient operation – ensures long-term use with minimal maintenance.
5. Safety and emergency features – buzzer/voice alerts provide immediate attention in critical situations.
6. Robustness and environmental independence – sensor-based detection ensures accuracy irrespective of lighting or background.
7. Integration of IoT technology – enables remote monitoring, data logging, and connectivity with smart devices, advancing modern healthcare practices.

Overall, this project represents a significant advancement in assistive communication technology. It successfully bridges the gaps left by previous research, offering a solution that is reliable, portable, flexible, and user-centric. Its integration of gesture recognition, microcontroller-based processing, IoT connectivity, and emergency alert systems ensures a holistic communication aid for physically disabled and paralyzed patients. By providing real-time, accurate, and customizable message delivery, this system has the potential to greatly enhance the quality of life, independence, and safety of its users. Furthermore, the approach demonstrates a scalable model for future research, allowing additional features like cloud-based monitoring, mobile app integration, or AI-driven gesture recognition to be incorporated, ensuring that the system remains relevant in the evolving landscape of assistive technologies.

3. HARDWARE USED

3.1 ESP32 Microcontroller

The ESP32 is a low-cost, low-power microcontroller developed by Espressif Systems. It comes with built-in Wi-Fi and Bluetooth connectivity, making it ideal for IoT-based applications. The ESP32 features a dual-core 32-bit Tensilica LX6 processor, operating at up to 240 MHz, and offers 520 KB SRAM with additional external flash memory support.

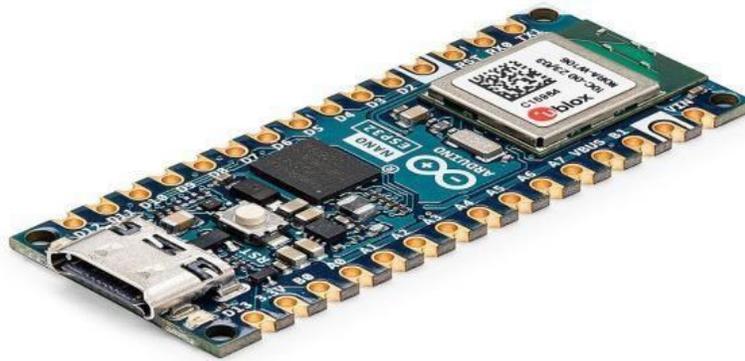


Fig. 1 *ESP32 Microcontroller*

3.2 LCD Screen

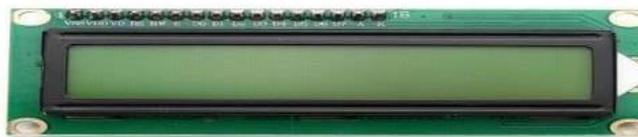


Fig. 2 *LCD Screen Module*

The LCD module operates on a 5V DC supply and is based on the Hitachi HD44780 controller, which simplifies interfacing with most microcontrollers. It can function in either 4-bit or 8-bit mode, allowing flexible data transfer depending on the application. The module contains 16 pins, which include pins for power, contrast adjustment, control (RS, RW, EN), and data lines (D0–D7). A potentiometer is connected to the contrast pin (V0) to adjust the brightness and visibility of the characters. There are many android applications that are already available which makes this process a lot easier.

3.3 Accelerometer (MPU6050)

The MPU6050 is a 6-axis MEMS motion tracking device that combines a 3-axis accelerometer and a 3-axis gyroscope in a single package. It measures both acceleration (tilt/movement) and angular velocity (rotation) of the body to which it is attached.

The accelerometer module is a motion-sensing device used to measure acceleration, tilt, and vibration in three directions—X, Y, and Z axes. It detects both dynamic forces caused by movement and static forces such as gravity. In a project using the ESP32 and MPU6050 accelerometer, the sensor plays a vital role in detecting changes in orientation, movement, or vibration of the system. The collected acceleration data is sent to the ESP32 microcontroller, which processes the information to perform specific actions such as displaying readings on an LCD or triggering alerts. This makes the accelerometer an essential component for applications involving motion detection, gesture control, tilt measurement, and stability monitoring.

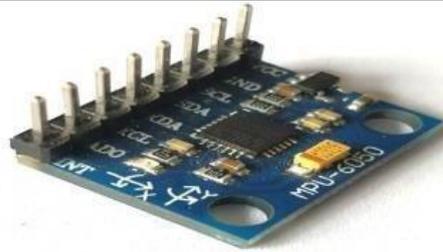


Fig. 3 MPU6050 Accelerometer Module

3.4 Flow Chart

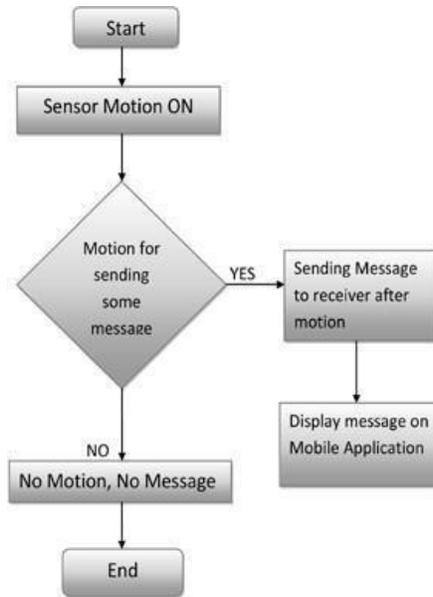


Fig. 4 System Flow Chart

The flowchart explains the working of the motion detection system. It starts with activating the motion sensor to detect any movement. When motion is detected, the system sends a message to the receiver through the ESP32 module. The received message is then displayed on the mobile application to alert the user. If no motion is detected, no message is sent, and the system remains idle. This process ensures continuous monitoring and instant notification whenever movement occurs.

4. CONCLUSION

In conclusion, the project using ESP32 and the MPU6050 accelerometer successfully detects motion and sends alerts through a mobile application. The system efficiently monitors movement and provides real-time updates to the user. It demonstrates the practical use of sensors and IoT technology for smart monitoring applications. The project enhances safety and communication by instantly notifying users of any detected motion. It is reliable, cost-effective, and easy to implement. The design can be further improved by adding additional sensors for better accuracy. Overall, this project showcases the potential of embedded systems in automation and assistive technology.

5. FUTURE SCOPE

To enhance the feature of this system, one of the features that can be added is the network part in which the messages can be sent via Wi-Fi. Another additional feature can be added in the domain of communication, that is, making a phone call instead of messages [6]. Sometimes, due to any sort of hardware failure or loss of power supply, if the message has been failed to be sent, then a phone call may be initiated conveying the message that the patient is waiting for the respective nurse/doctor/caretaker. This entire system may further be developed by introducing communication via any Android app which creates an interface for the patient-nurse communication.

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