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Smart Limb Mobility/Paralysis Movement Indicator

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Abstract: Paralysis causes the loss of muscle function, often rendering individuals unable to move or communicate their basic needs. This project addresses these challenges by developing an Arduino-based system that uses Micro-Electro-Mechanical Systems (MEMS) accelerometers to detect intentional limb, hand, or head movements, and gyroscopes for fall detection. The MEMS sensor (such as ADXL345/MPU6050) measures movement, translating specific gestures into command signals. The Arduino microcontroller processes these gestures to trigger predefined messages, which are transmitted to caregivers via a GSM module. Furthermore, a GPS module (Neo6m) is integrated to provide real-time location tracking in case of emergencies, such as a, falling from a bed or wheelchair. The system offers a low-cost, reliable, and real-time monitoring solution, promoting independence for paralyzed patients

I. INTRODUCTION

According to the Global Burden of Diseases (GBD), stroke claims the lives of around 5.8 million people each year. Stroke is the most common cause of paralysis, affecting around 33.7 percent of the population. Paralysis can also arise because of severe spinal cord injury sustained because of a serious accident. The World Health Organization recently conducted a survey. Of 5.6 million people who were predicted to be paralyzed, accounting for 1.9 percent of the population among the fifty. However, there is no ideal tracking system in place to keep track of the patient's health and daily demands. In today's fast-paced world, it's impossible to continually look after loved ones who require assistance. To address these issues, a device is presented that uses the ESP32 and the accelerometer to detect the motion of the patient's hand, allowing them to convey their most basic requirements to their caregivers. We come across hospitals and non-governmental organizations (NGOs) that serve paralytic individuals who have had their entire or partial body paralyzed by the paralysis attack. Most of the time, these persons are unable to communicate their requirements since they are unable to speak properly or communicate through sign language owing to a lack of motor control in their brain. In this case, we present a system that allows a disabled person to display a message on an LCD screen by simply moving any portion of his body with motion capabilities. This system also handles situations where no one is available to assist the patient, by sending a message via ESP32 of what he wishes to say via SMS. To send a message, the user now only needs to tilt His hand at a specific angle. Different messages are conveyed by tilting the gadget in different directions. We're going to use an accelerometer to measure motion statistics. The ESP32 analyses the data and displays the appropriate message based on the input received from various sensors. The associated message is now shown on the LCD screen. When it receives a motion signal from the accelerometer, it also sounds a buzzer and displays a message. In this approach, the Automated Paralysis Patient Care System truly automates the patient's ability to care for them, ensuring timely attention and, as a result, optimal health

II. LITERATURE SURVEY

Kinjal Raykarmakar, et al. (2022) this device was created using microcontroller-based circuitry. It makes use of a receiver and transmitter circuit as well as a hand motion recognition circuit. The accelerometer and gyroscope are utilized in the hand motion circuit to detect hand movements, which are subsequently wirelessly transmitted to the receiver system through radio frequency (RF). The receiver system is designed to accept and interpret hese commands and show them on the LCD and transfer the data online to a Gecko Server for the Internet of Things (IoT). The IoT Gecko Server subsequently presents this information online to obtain the desired result. This device was created using microcontroller-based circuitry. It makes use of a receiver and transmitter circuit as well as a hand motion recognition circuit.

The accelerometer and gyroscope are utilized in the hand motion circuit to detect hand movements, which are subsequently wirelessly transmitted to the receiver system through radio frequency (RF). The receiver system is designed to accept and interpret these commands and show them on the LCD and transfer the data online to a Gecko Server for the Internet of Things (IoT). The IoT Gecko Server subsequently presents this information online to obtain the desired result. Hira Beenish, et al (2021) The suggested and implemented system of this device is designed to facilitate communication between the paralyzed patient and the caregiver by allowing the paralyzed patient to communicate their needs by message using hand, finger, and foot movement. The gyro MPU6050 is connected to Arduino UNO, which is mounted on the gloves, to detect movement. Flex sensors are utilized to monitor finger movement, while gyro sensors are put on the patient's hand to detect any changes in the patient's hand. The system is tethered to three major tasks. These are to send messages to communicate and understand the demands of the patient through the hand, finger, and foot movements. After any of these movements, i.e. hand, finger, and foot, the system will alert the caretaker to the patient's needs. Because they are unable to voice their issues and needs correctly, paralyzed patients have difficulty communicating with caregivers to meet their needs. They have created a paralysis patient healthcare system integrating IoT and GSM to tackle this challenge faced by the paralyzed patient. In this system, the paralyzed patient sends signals to the caregiver using gyro gloves. The GSM module activates when the patient tilts their hand, fingers, or feet, sending a message to the pre-programmed caretaker's contact numbers. A.F. Kadmon et, al. (2018) Using the gesture sensor on the (APDS-9960), the patient will be able to communicate whatever they wish via the GSM module by sending a message. This sensor's function is that it allows the patient to send a message by just swiping their hand across the gesture sensor. Aside from that, the data will be shown on an LCD screen at the convey sign, making it easier for the patient to understand what they wish to communicate. Aside from that, if the patient swipes their palm to the emergency case, the buzzer will sound. The primary idea behind the project is that the hand gestures work as a transmit signal, while the gesture sensor receives the signal and sends data to the Arduino board. This concept will aid paralyzed patients in communicating their needs or instructions. Finally, the project was designed to establish a system with an ARDUINO as the primary controller. This project was built by current technologies to ensure that paralyzed patients receive the finest treatment and care while in the hospital, without the need for family members to assist them. All they have to do is give a simple movement gesture to the sensor. Mohan raj. P et, al. (2018) Heart rate, respiration rate, and temperature are among the metrics included in this module. The main purpose of this system is to monitor the paralyzed person's heart rate, breathing rate, and temperature, with the data acquired by the sensors being relayed to the msp430 Launchpad. This Launchpad will use code composer studio complier to process the sensed data using an embedded program for the appropriate parameters. At the operational level, the program is open for monitoring. A paralyzed person's normal heart rate is around 60-100 beats per minute. When the range falls below 60, it causes heart block and syncope, but when it rises above 100, it causes anxiety and tachycardia. Numerous issues paralyzed people face, including paralysis in their limbs, hand, voice tract, and other body parts. There are procedures in place for their unique comforts. However, this method will aid in the monitoring of all causes that cause paralysis and informing the caregivers so that therapy may be administered before the paralysis progress.

III. METHODOLOGY

This system detects slight body movements of a paralyzed patient using an ADXL accelerometer sensor and sends an emergency alert with location (GPS coordinates) to caregivers via GSM SMSIt is useful for: Stroke patients, Bedridden patients, patient monitoring, Emergency tracking

A. Working Principle

Power Supply the system starts with a regulated power supply that provides stable DC voltage to all electronic components such as the Arduino board, sensors, GSM module, and LCD display. This ensures the system operates reliably without voltage fluctuations. Sensor Data Collection An accelerometer sensor (ADXL) is attached to the patient's limb to detect movement and orientation. The sensor continuously measures motion along the X, Y, and Z axes and sends the movement data to the Arduino microcontroller. Data Processing using Arduino: The Arduino Uno microcontroller acts as the main processing unit of the system. It receives the data from the accelerometer sensor and analyses the values to determine whether the patient has moved their limb or if there is an abnormal condition. Movement Detection When the patient attempts to move the limb, the accelerometer detects the change in position. The Arduino compares the sensor readings with predefined threshold values to identify whether the movement is normal or if assistance is needed. Alert Generation If the system detects a significant movement or emergency signal, the Arduino activates a buzzer to produce an audible alert. This helps notify nearby caregivers immediately.

B. Hardware Components

The proposed paralysis patient monitoring system uses several hardware components to detect patient movement and send alerts to caregivers. The Arduino Uno acts as the main controller that processes data from sensors and controls the movement or tilt of the patient's limb by measuring changes in the X,Y, and Z axis. When movement is detected, the Arduino processes the data and determines the patient's condition. AGSM module (SIM800L) is used to send SMS alerts to caregivers during emergency situations. A GPS module (NEO-6M) provides the exact location of the patient and includes the coordinates in the alert message. A 16×2 LCD display is used to show system messages and patient status. Additionally, a buzzer provides an audible alert when movement or emergency conditions are detected. All the components are powered through a regulated power supply circuit, which converts AC voltage into stable DC voltage required for the system. Together, these components ensure effective monitoring and communication for paralysis patient care.

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Figure 1.1. Block Diagram

C. Data Acquisition and Preprocessing

Data acquisition is the process of collecting raw data from various sources such as sensors, databases, webes, or files. The collected data may contain errors, missing values, or irrelevant information. Therefore, preprocessing is required to clean and organize the data before analysis. In this stage, tasks such as removing duplicate data, handling missing values, normalizing data, and converting it into a suitable format are performed. Proper data acquisition and preprocessing improve the quality of the dataset and ensure that the data is accurate, consistent, and ready for further analysis or model training.

D. Self-Learning Mechanism

A self-learning mechanism enables a system to automatically improve its performance by learning from data and past experiences without constant human intervention. The system analyses input data, identifies patterns, and updates its internal models or rules based on the feedback Navigation and Decision-Making Navigation and decision-making allow a system to determine the best actions based on the available information and environment. The system analyses input data, evaluates different possible options, and selects the most suitable path or solution. In intelligent systems, algorithms are used to guide movement, avoid obstacles, and achieve specific goals efficiently. Effective navigation and decision-making improve the system's ability to operate independently and respond quickly to changes in its surroundings.

E. User Feedback Mechanism

A user feedback mechanism allows a system to collect responses, suggestions, or evaluations from users about its performance or results. This feedback helps the system understand user needs, identify errors, and improve its functionality. The feedback can be gathered through ratings, comments, surveys, or direct input from users. By analyzing this information, the system can make necessary adjustments and enhance its accuracy, usability, and overall performance over time.

F. Testing and Evaluation

Testing and evaluation are important processes used to measure the performance and effectiveness of a system. During testing, the system is checked using different inputs and scenarios to ensure it works correctly and meets the required objectives. Evaluation involves analysing the results to determine the accuracy, reliability, and efficiency of the system. This process helps identify errors, improve system performance, and ensure that the system functions as expected before final deployment.

G. Expected Outcome

The expected outcome of the system is to provide accurate, efficient, and reliable results based on the input data and implemented algorithms. The system should be able to process information, learn from data, and make effective decisions with minimal human intervention. Additionally, it should improve its performance over time through feedback and self-learning mechanisms. Overall, the system is expected to enhance efficiency, support better decision- making, and deliver consistent and meaningful results for users. The system is also expected to operate with high reliability so that users can depend on it during important situations, especially in emergency conditions. By analysing the input data, the system should be able to identify the required actions and provide appropriate responses automatically. This reduces the need for constant human supervision and allows caregivers to focus on other important tasks. Another important outcome is the improvement of user convenience and accessibility. The system aims to make communication easier for individuals who face physical limitations, particularly paralyzed patients who may find it difficult to express their needs. By providing a simple and responsive interface, the device helps patients communicate their requirements quickly and efficiently. Furthermore, the system should maintain consistent performance and accuracy even after long periods of use. It is also expected to improve gradually through feedback, updates, and learning mechanisms that enhance its functionality over time. This adaptability ensures that the system remains useful and relevant as technology advances.

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Overall, the expected outcome is to create a dependable and user-friendly solution that enhances communication, increases efficiency, supports better decision-making, and improves the quality of care provided to patients in hospitals or home-care environments.

H. RESULT

The developed system was successfully tested to monitor limb movement using the MEMS accelerometer sensor. The sensor was able to detect small movements of the patient's limb and send the data to the Arduino microcontroller for processing. When movement or an emergency condition was detected, the system activated the buzzer and sent an alert message to the caregiver through the GSM module. The GPS module successfully provided the real-time location of the patient, which was included in the alert message. The LCD display showed the system status and movement information clearly. The results show that the system works effectively in detecting limb movement and providing timely alerts, which can help caregivers respond quickly and improve the safety and monitoring of paralysis patient. The experimental results show that the system works effectively in detecting even slight limb movements. The alert system responded quickly and provided immediate notification to the caregiver. The GPS location sharing feature helped to identify the patient's exact position during emergencies. The overall performance of the device was stable and reliable during testing. This system can help caregivers monitor paralysis patients continuously and improve patient safety in hospitals and home care environments.

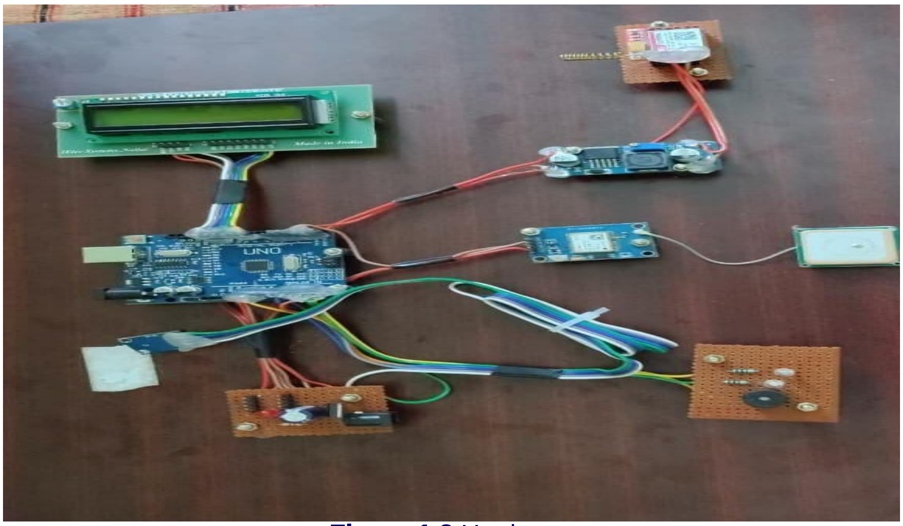

Figure 1.2 Hardware

The integration of the SpO and heart rate sensors allowed simultaneous monitoring of the infant's oxygen saturation and pulse rate. The readings were accurately displayed on the LCD and transmitted to the Blynk IoT mobile application for remote monitoring. The alarm module successfully notified caregivers whenever any parameter exceeded or fell below the preset safe limits, confirming the safety features of the system.

IV. CONCLUSION & FUTURE SCOPE

In the future, this project can be further improved by integrating advanced technologies to enhance its efficiency and usability. For example, the system can be connected with mobile applications or cloud-based platforms so that caretakers and doctors can receive instant notifications from anywhere. Additional sensors and artificial intelligence can also be incorporated to better understand patient needs and detect emergency conditions automatically. Voice assistance, Internet of Things (IoT) connectivity, and wearable devices can make the system more user-friendly and reliable. Furthermore, the device can be made more compact, wireless, and cost-effective so that it can be widely used in hospitals and home care environments, helping more paralyzed patients communicate easily and receive timely assistance. Another improvement could include voice assistance and smart communication features that allow patients to interact with the device more easily. Internet of Things (IoT) technology can also be used to connect the device with other smart healthcare systems, enabling better data sharing and remote monitoring. In addition, wearable devices can be integrated with the system to continuously collect patient health information and provide valuable insights for doctors and caregivers. Furthermore future versions of the device can be designed to be smaller, lighter, and completely wireless, making it more comfortable for patients to use for long periods. Efforts can also be made to reduce the overall cost of the device so that it becomes affordable and accessible to more people. With these improvements, the system can become a reliable solution for hospitals, rehabilitation centres and home-care environments, helping paralyzed patients communicate their needs effectively and receive timely medical assistance.

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REFRENCES

1. Kinjal Raykarmakar, Shruti Harrison, Anirban Das, "Paralyzed Patient Healthcare", Medical Internet of Things Techniques, Practices and Applications. (Publishing Company: Chapman & Hall)-2021|content no:11| https://doi.org/10.1201/9780429318078-11 Page. No: 161 to 173.
2. Hira Beenish, Ahsan Sheikh, Fakiha Nasir -Design and Implementation of a Monitoring System for Paralysis patient using IoT-KIET Journal of Computing & Information Sciences [KJCIS]-2021| Volume 4 | Issue 2| Page.no:49 to 58.
3. Aziz S. A. C, A.F. ,Kadmon , N. Rahim, W. H. W. Hassan-Development of automatic healthcare instruction system via movement gesture sensor for paralysis patient-International Journal of Electrical and Computer Engineering (IJECE)| Vol. 9, No. 3, June 2019, pp. 1676~1682| ISSN: 2088-8708, https://doi.org/10.11591/ijece.v9i3.pp1676-1682|Page.no: 1676 to 1682.
4. Deepasri.T, Kokilapriya's, Arun Kumar. G, Mohanraj. P, Mrs.M.Shenbagapriya- Automated Paralysis Patient Health Care Monitoring System- South Asian Journal of Engineering and Technology Vol.3, No.2 (2017) 85–92|Page.no: 85 to 92.
5. Ms.N.Renee, Sigrid Reddiyar, S.Remina, S.Sabrin, M.Subhashini-IOT Based paralysis patient health care monitoring system-Journal of the University of Shanghai for Science and Technology-2021| ISSN: 1007-6735| Volume23, Issue 6, June – 2021| Volume 23, Issue 6, June – 2021|Page.no: 431 to 437.
6. Vidya Sarode, Victor Thomas, Akash Dubey, Shashank Shukla5- AUTOMATED PARALYSIS PATIENT HEALTH CARE SYSTEM- International Research Journal of Engineering and Technology (IRJET)- 2021| e-ISSN: 2395-0056| p-ISSN: 2395 0072| Volume: 08 Issue: 05 | May 2021| Impact Factor value: 7.529| ISO 9001:2008 Certified Journal| Page.no: 680 to 686.
7. Diptee Gaikar, Pradnya Porlekar, Divya Shetty, Akash Shitkar, Prof.Kalindi Kalebere-AUTOMATED PARALYSIS PATIENT HEALTHCARE SYSTEM |International Journal of Creative Research Thoughts (IJCRT)-2021| Volume 9, Issue 8 August 2021 | ISSN: 2320-2882| IJCRT2108139| Page.no: b251 to b256.
8. Dr.M.Mohana, S.Priyadharshini, N.Sowmiya, G.Pavithra Devi- An IOT based automated communication system for paralyzed patients using simple hand gestures- European Journal of Molecular & Clinical Medicine-2020| ISSN 2515-8260| Volume 7, Issue 4, 2020| Page.no: 2681 to 2686.
9. Vacancy. V, Avinash Wilson, Anusha. P- Paralyzed Patient Monitoring Equipment–IoT- International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)-2020| Vol.6, Issue.10, October 2020| ISSN (ONLINE):2456-5717| Page.no: 25 to 28.
10. Rohit Malgaonkar, Saurabh Kamble, Manthan Jadhav, Satyam Parkale-Survey on Automated Paralysis Patient Healthcare Monitoring System- IJSRD - International Journal for Scientific Research & Development 2019| Vol. 7, Issue 10, 2019| ISSN (online): 2321-0613| Page.no: 517 to 519.