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# IoT Based Paralysis Patient Health Monitoring System using Raspberry Pi

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**Abstract:** *This project is focused on creating a health monitoring system using IoT technology to improve the care of paralysis patients. The system continuously tracks essential health metrics like heart rate, body temperature, and movement. It's designed to detect any unusual changes, such as abnormal vital signs or falls, and immediately sends alerts to caregivers, ensuring a quick response when needed. By monitoring these conditions in real time, the system enhances patient safety and helps caregivers provide better, more timely care, even from a distance.*

**Keywords:** IoT Health Monitoring, Paralysis Patient Care, Real Time Vital Sign Tracking, Remote Patient Monitoring, Emergency Alert Systems, Assistive healthcare Technology

## I. INTRODUCTION

**P**aralysis is a serious medical condition that results in the loss of muscle function in one or more parts of the body, often due to neurological injuries, spinal trauma, or strokes. Patients with paralysis frequently experience restricted mobility and limited communication capabilities, which makes routine health monitoring and emergency alerting systems especially important. The inability to express physical distress or call for assistance in a timely manner can pose life-threatening risks. Traditional healthcare solutions, especially those used in home-care settings, often lack the ability to provide continuous monitoring or instant response mechanisms. To overcome these limitations, the incorporation of Internet of Things (IoT) technology into healthcare systems has emerged as a powerful solution. IoT allows for real-time monitoring, remote access to patient data, and automated alert systems, significantly improving the quality of care. This paper introduces an IoT-based health monitoring system specifically developed for paralysis patients, designed to track vital physiological parameters, detect emergencies, and communicate critical information instantly to caregivers or medical professionals.

The system is built around the Raspberry Pi 4 B+ Model, which functions as the main microcontroller and processing unit, efficiently handling data acquisition, analysis, and communication tasks. A set of biomedical sensors are interfaced with the Raspberry Pi to monitor various health parameters in real time. The LM35 temperature sensor records the patient's body temperature to detect potential infections or other anomalies. The MAX30100 sensor is used for continuous monitoring of heart rate and blood oxygen saturation levels (SpO2), offering insights into cardiovascular health. The ADXL335 accelerometer sensor detects motion and orientation, helping to identify falls or prolonged immobility that may require immediate attention. To monitor psychological and emotional stress, a Galvanic Skin Response (GSR) sensor measures changes in skin conductivity. A flex sensor is also included to track muscle movements or joint activity, which is particularly useful in assessing any recovery of motor function or limb movement in paralyzed patients.

To ensure immediate communication during emergencies, the system incorporates a SIM900A GSM GPRS Module with RS232 interface and an external SMA antenna. This module allows the system to send automated SMS alerts to predefined contacts, such as caregivers or healthcare providers, when sensor readings indicate abnormal conditions. The RS232 interface ensures reliable data transmission between the Raspberry Pi and the GSM module, while the SMA antenna enhances signal strength and stability, making the system effective even in areas with weak cellular connectivity. Additionally, a voice module is embedded to provide real-time audible alerts for nearby caregivers,

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enhancing response speed. An OLED display is also integrated into the setup, offering a compact visual output of the patient's real-time vitals such as heart rate, temperature, and movement status. This user-friendly interface allows both the patient and the caregiver to easily monitor the current health state without the need for external monitoring devices.
In conclusion, the proposed IoT-based health monitoring system delivers a robust, affordable, and scalable solution for ensuring the safety and well-being of paralysis patients. By combining multiple sensors, a powerful microcontroller, a visual interface, and real-time wireless communication using the SIM900A GSM module, the system ensures continuous health tracking and instant alert delivery. It reduces caregiver burden, improves emergency response times, and enhances patient care through smart automation. This work contributes to the growing field of intelligent healthcare technologies and demonstrates how IoT can be effectively leveraged to support patients with severe mobility impairments.

## II. SCOPE

In the future, this IoT-based health monitoring system can be enhanced by integrating additional vital sensors like BP, ECG, and temperature to provide more comprehensive care. Features such as mobile app support, cloud data storage, real-time alerts, and AI-based health prediction can make it smarter and more reliable. With portability, GPS tracking, and multilingual voice support, the system can become highly user-friendly, especially for remote or elderly patients, making healthcare more accessible and efficient.

**Integration with More Health Parameters:**
Extend the system to monitor additional vitals like:
- Body temperature
- Blood pressure (BP)
- ECG (Electrocardiogram)
- Glucose

  This would make the system more comprehensive for overall health tracking.

**Mobile Application Development:**
Create a dedicated Android/iOS app that displays real-time data, alerts, and historical health trends. This will help family members and doctors track the patient's condition remotely.

**Emergency Alert System:**
Enhance the system to send instant alerts via SMS, WhatsApp, or email to caregivers or doctors when a patient's vitals cross critical limits.

**Cloud-Based Data Storage:**
Store patient data on the cloud for:
- Long-term health tracking
- Remote access by healthcare providers
- Analysis using machine learning for predicting health issues

**Telemedicine Integration:**
Connect the system with online consultation platforms so doctors can access real-time data and provide remote diagnosis and prescriptions.

**AI-Powered Health Analysis:**
Use AI/ML algorithms to:
- Detect abnormal patterns


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- Predict possible health emergencies
- Suggest lifestyle improvements or alerts based on historical trends

**Battery Backup and Portability:**
Improve the system with a battery backup or solar power option to make it portable and usable in areas with unstable electricity.

**Multilingual Voice Assistance:**
Add voice-based interaction and alerts in regional languages to assist non-tech-savvy users or elderly patients.

**GPS Integration:**
For emergency cases, integrate location tracking so ambulances or caregivers can quickly reach the patient if needed.

**Modular Hardware Design:**
Design the system as a plug-and-play module so additional sensors can be added or removed as per the patient's needs without reprogramming the system.

## III. METHODOLOGY

The proposed system employs a modular design centered around the Raspberry Pi 4 B+ Model, which serves as the main processing and control unit. Various biomedical sensors are interfaced with the Raspberry Pi to collect real-time data on key health parameters relevant to paralysis patients, such as body temperature, heart rate, blood oxygen levels, body movement, emotional stress, and limb activity. This data is then processed to identify abnormalities using threshold-based logic. In case of an emergency, alerts are issued via a voice module for nearby awareness and an SMS alert using the SIM900A GSM GPRS module for remote caregiver notification. Simultaneously, all sensor data and system status are displayed on an OLED screen for immediate visualization. The system continuously loops through these processes to ensure non-stop monitoring, making it a responsive and accessible solution for home or clinical use.

Table 1- Hardware Components

| Component | Description |
|---|---|
| Raspberry Pi 4 B+ Model | Central microcontroller handling data processing and sensor interfacing |
| LM35 Temperature Sensor | Measures the patient's body temperature |
| MAX30100 Sensor | Monitors heart rate and blood oxygen saturation ($SpO_2$) |
| ADXL335 Accelerometer | Detects posture changes, movement, and falls |
| GSR Sensor | Tracks emotional stress via skin conductivity |
| Flex Sensor | Detects muscle movement or limb activity |
| SIM900A GSM GPRS Module | Sends SMS alerts via RS232 interface and SMA antenna |
| OLED Display | Displays real-time sensor data and alerts |
| Voice Module | Provides local voice alerts during emergencies |
| Power Supply | Powers the Raspberry Pi and peripheral sensors/modules |

## IV. LITERATURE REVIEW

The use of IoT in healthcare has expanded dramatically in recent years, transforming the way patient health is monitored and cared for. particularly for patients with less mobility—such as paralysis patients—IoT-based systems hold great promise over round-the-clock physical oversight, enabling safer, more tailored, and more anticipatory care. This literature review presents the seminal research contributions to the fields of IoT-based healthcare monitoring, systems designed for paralysis patients, challenges involved, and recent technology advancements.

Several researchers have contributed significantly to the development of health monitoring technologies using IoT and wearable sensors. Patel et al. highlighted the effectiveness of wearable sensors in rehabilitation, especially for remote patient monitoring through compact and real-time data acquisition devices ([1]). Pantelopoulos and Bourbakis emphasized how these systems support early disease detection and continuous care through sensor integration and data analysis ([2]). In the context of elderly care, Sharma and Raj introduced an IoT-based system that offers constant monitoring and emergency alerting through mobile connectivity ([3]). Similarly, Alemdar and Ersoy surveyed wireless sensor networks in healthcare, explaining their role in enabling consistent data transfer across wearable devices ([4]). Islam et al. presented a comprehensive survey of IoT in healthcare, supporting the integration of smart devices like Raspberry Pi for centralized control and health data processing ([5]). Alzahrani and Jalab's work during the COVID-19 pandemic showed how IoT-based wearables like smart helmets could track vital signs and identify symptoms in real time ([6]). Malarvizhi and Anuradha discussed the importance of IoT solutions in monitoring elderly patients' health and ensuring timely alerts in emergencies ([7]), while Priya and Usha shared a practical implementation model for IoT-based systems using standard sensors and microcontrollers ([8]). Prasanth and Prasad reinforced the need for real-time monitoring systems that use sensors for continuous tracking of vital signs ([9]). Razzaque et al. reviewed IoT middleware platforms, emphasizing how crucial they are for connecting sensor networks to applications that process, analyze, and act on health data ([10]). These studies collectively validate the scope and effectiveness of our IoT-based paralysis patient health monitoring system, which uses a variety of biomedical sensors to provide real-time updates and enhance patient safety and caregiver response.

## V. WORKING

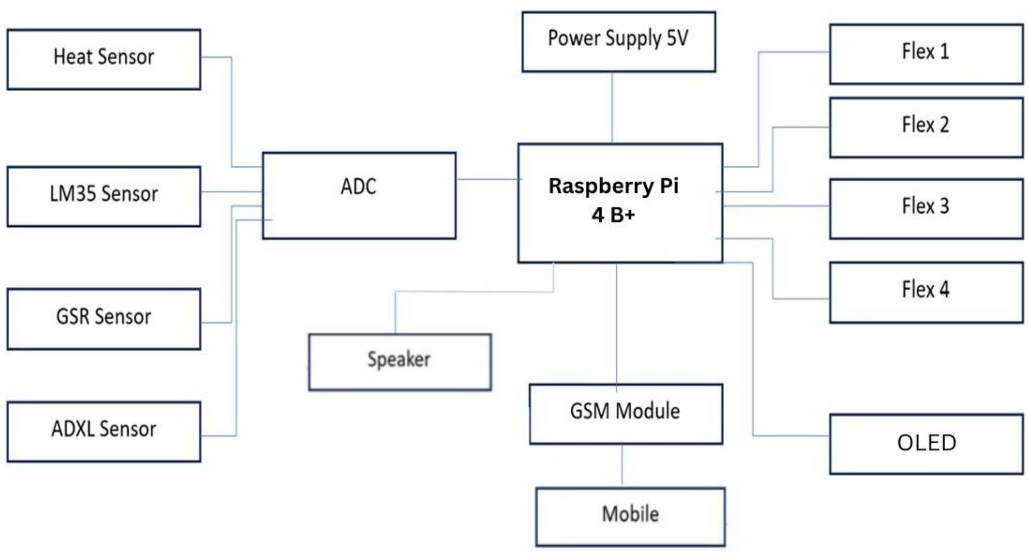


Fig 3.1 Block Diagram of IoT based Paralysis Patient Health Monitoring System

The health monitoring system for paralysis patients integrates multiple biomedical sensors with a central controller, the Raspberry Pi. Although the block diagram shows a Raspberry Pi 3, the actual implementation uses the more advanced Raspberry Pi 4 B+, offering better speed and connectivity. Acting as the system's brain, it collects and processes real-time data from all connected sensors. To gather vital health information, the system uses multiple sensors. A temperature sensor (LM35) and an additional heat sensor monitor the patient's body temperature. A GSR sensor is included to assess emotional stress by measuring skin resistance, while an accelerometer (ADXL335) tracks body orientation and detects any falls. These analog sensors send their signals to an Analog-to-Digital Converter (ADC), which makes the data readable by the Raspberry Pi. In parallel, four flex sensors are directly connected to the

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Raspberry Pi to detect limb or finger movement, which is especially helpful in monitoring any voluntary or involuntary motor response in paralyzed patients.

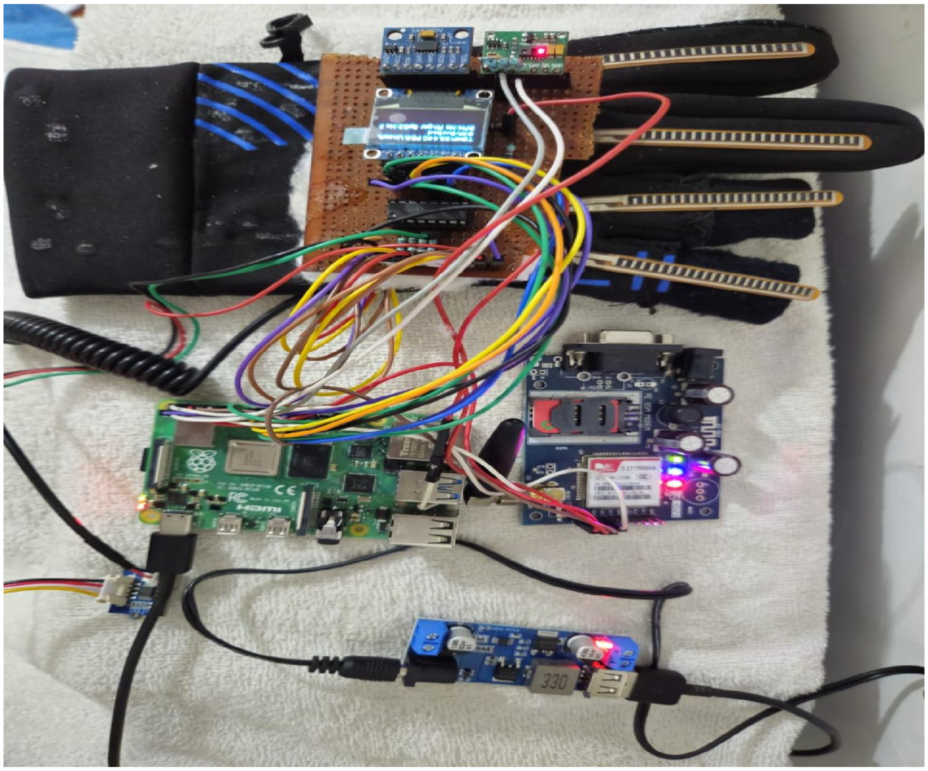

Fig. 1- Fig shows the working model

Once the sensor readings are received, the Raspberry Pi compares the values with set thresholds to determine whether the patient's condition is stable or needs urgent attention. When everything is normal, the readings are shown on a 16x2 LCD display for easy observation. But if a critical reading is detected—such as a sudden temperature spike, abnormal stress level, or fall—the system instantly sends a text message alert using the GSM module (SIM900A) to a registered caregiver's mobile phone. Alongside, a voice module is activated to generate an audible alert through a connected speaker, making sure that nearby individuals are also notified.

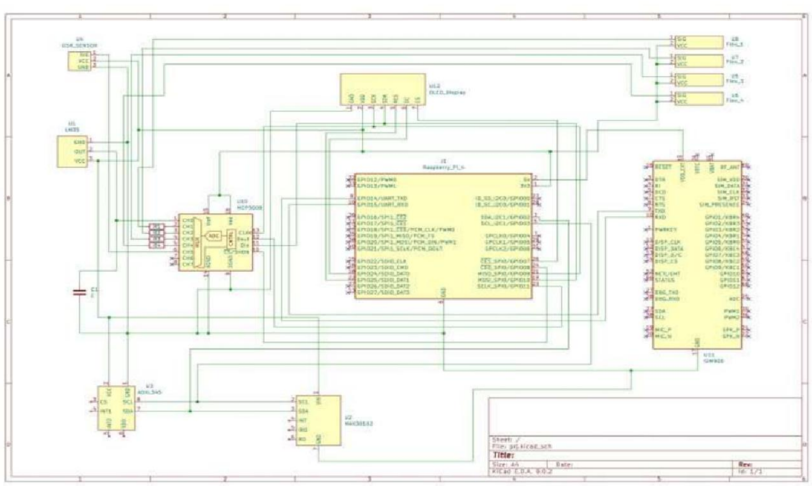

Fig. 1- fig shows the circuit diagram

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The whole system is powered by a 5V power source, supplying energy to all connected devices and modules. The flow of operation is continuous and cyclic, meaning the system keeps monitoring, analysing, and responding in real time without any pause. This ensures that any irregularities in the patient's condition are caught immediately, allowing for quick responses that could be life-saving. This design offers a smart, low-maintenance solution for patient care—especially in homes or clinics where round-the-clock human monitoring might not always be possible.

## VI. RESULT

We gathered sensor data from 50 people in order to assess the efficacy of our health monitoring system. Our device was used to record each person's vital parameters, including heart rate, body temperature, SpO2 levels, movement patterns, and stress indicators. After that, the data was examined to find patterns, anomalies, and the general accuracy of the system. Graphs are used to visually represent these results, giving clear insights into the system's performance across various user conditions and health parameters.

**Body Temperature Result:**

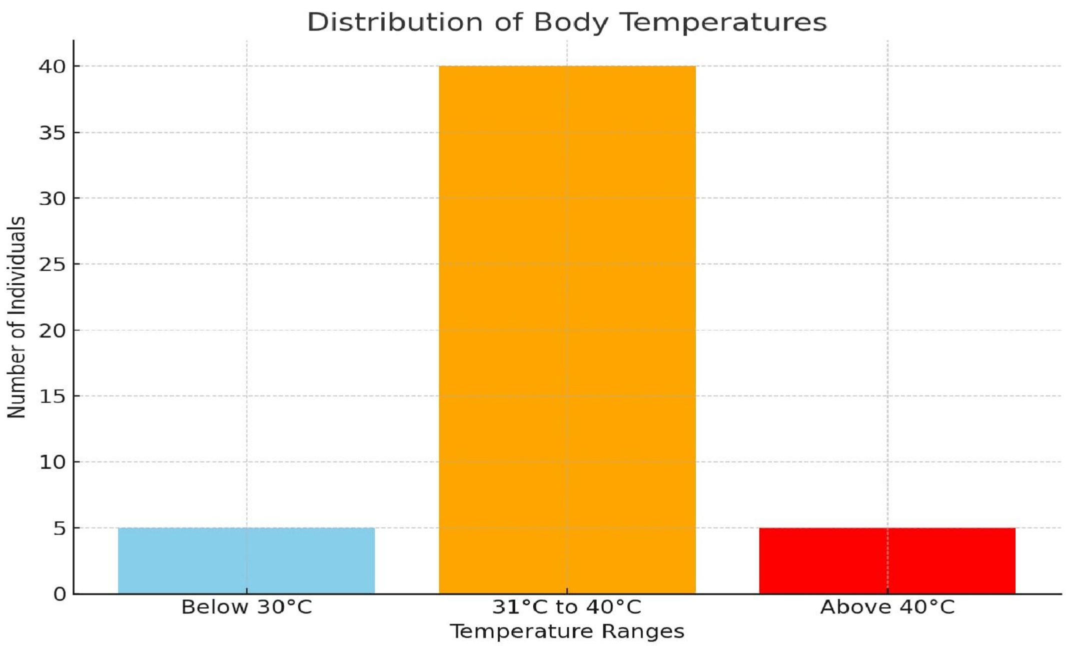


Fig. 11.1 Graph of Distribution of Body Temperature

The "Distribution of Body Temperatures" bar graph displays the temperature readings of fifty people divided into three ranges. 40 people, or the majority, had body temperatures in the normal range of 31°C to 40°C. Potential hypothermia or fever conditions were indicated by five people who recorded temperatures below 30°C and five more who recorded temperatures above 40°C. This information confirms that the system can reliably identify and categorize temperature changes, which is essential for early health warnings.


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GSR Result:

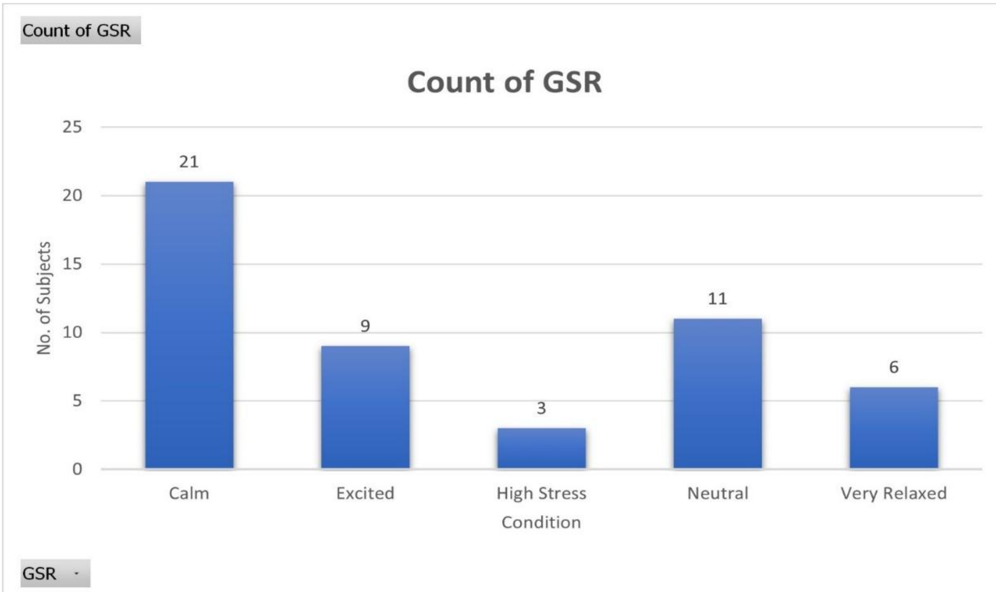


Fig. 11.2 Graph of GSR count

The GSR (Galvanic Skin Response) data graph shows the emotional and stress levels detected in the 50 participants. The majority of individuals—21 subjects—were found to be in a calm state, followed by 11 showing a neutral response. A smaller group experienced excitement (9), while 6 were recorded as very relaxed, and only 3 exhibited signs of high stress. This indicates that the system effectively captures a wide range of emotional states, helping monitor psychological well-being in real time.

**SpO2 levels distribution Result:**

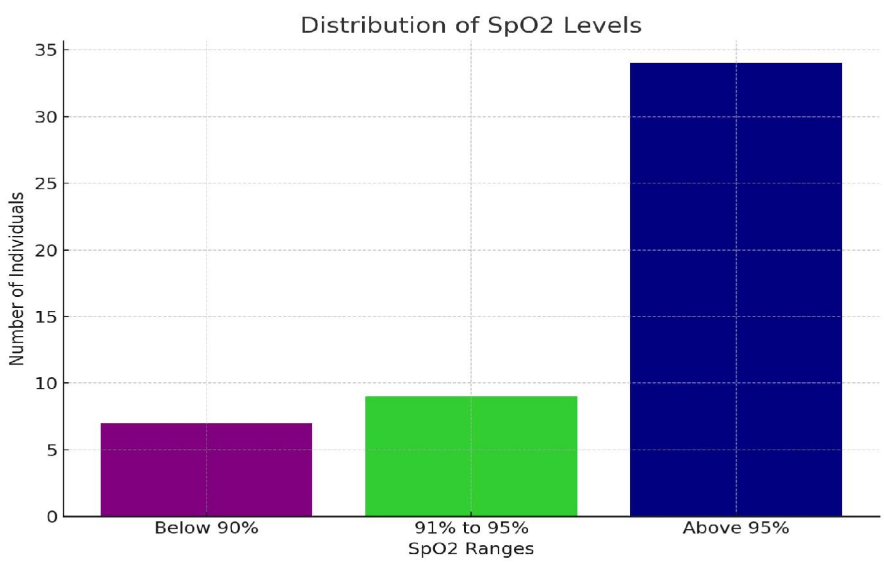


Fig 11.3 Graph of SpO2 levels

The SpO2 (oxygen saturation) level chart illustrates the oxygen health status of individuals. A majority of subjects—34 individuals—had SpO2 levels above 95%, indicating normal and healthy oxygenation. 9 individuals fell within the 91% to 95% range, suggesting a slightly lower but still acceptable level. However, 7 individuals had SpO2 levels below 90%, a potentially critical range that may indicate hypoxemia and require immediate attention. This distribution highlights that while most individuals maintained healthy oxygen levels, a small percentage may need medical monitoring or intervention.

**BPM distribution Result:**

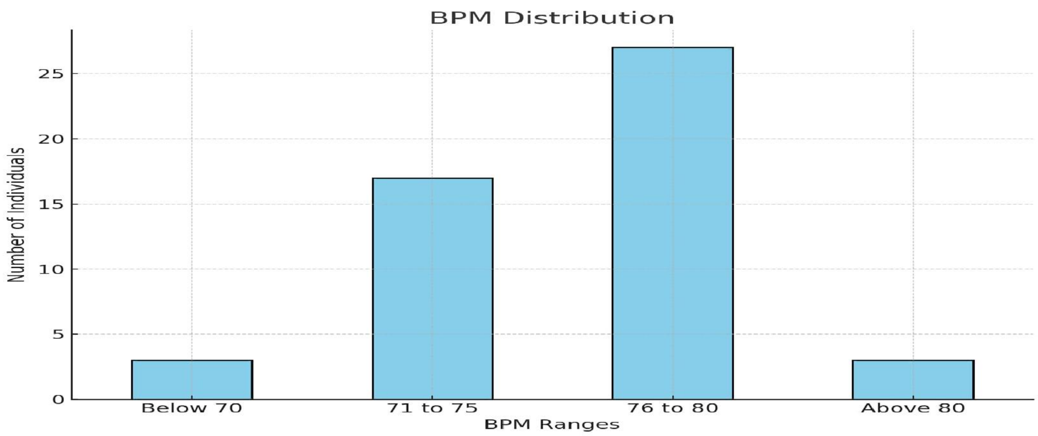


Fig 11.4 Graph of BPM

The BPM (Beats Per Minute) Distribution chart provides insight into the heart rate range of individuals. The majority—27 individuals—have a BPM between 76 and 80, which lies within the normal resting heart rate range for adults. 17 individuals fall in the 71 to 75 range, also considered healthy. Only 3 individuals each fall into the Below 70 and Above 80 categories. While BPM below 70 may be normal for well-trained individuals (e.g., athletes), BPM above 80 could indicate stress or a possible cardiovascular concern. Overall, most individuals exhibit a stable and healthy heart rate.

The overall health indicators suggest that most individuals are in a stable and healthy condition. However, a small group exhibits signs that warrant further medical evaluation, particularly those with low $SpO_2$ (<90%) or high BPM (>80). Continuous monitoring and timely intervention are recommended for at-risk individuals.

## VII. CONCLUSION

In conclusion, paralysis patients face daily challenges due to their limited mobility and inability to communicate discomfort or emergencies effectively. This makes regular health monitoring not just important, but essential. Traditional systems often fall short in providing the real-time attention these patients need. By integrating IoT technology, we can bridge this gap—making it possible to track vital signs continuously, detect emergencies quickly, and instantly notify caregivers or doctors. This IoT-based health monitoring system is a step toward safer, smarter, and more responsive care for those who need it most.

## VIII. ACKNOWLEDGEMENT

We would like to express our heartfelt gratitude to everyone who supported and guided us throughout the development of this project. First and foremost, we thank our project guide for their continuous encouragement, valuable suggestions, and expert insights that helped shape this work. We're also grateful to our faculty members and college for providing us with the necessary resources and environment to explore and grow. A special thanks to our families and friends for their unwavering support and motivation. This project has been a journey of learning and collaboration, and we truly appreciate the contribution of everyone who played a role in making it successful.

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