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IOT based health monitoring system for paralysis patient

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ABSTRACT

The IoT-Based Health Assistance System for Paralysis Patients is a robust solution designed to monitor essential health parameters. It employs a DHT11 sensor for temperature and humidity, a vibration sensor for fall detection, an SpO_2 sensor to track blood oxygen levels, and four flex sensors to interpret patient needs. Centered around the ESP32 microcontroller, the system activates voice alerts when any parameter exceeds the set threshold or a fall is detected, promptly informing both the patient and caregivers. Additionally, it transmits the collected data to an IoT platform, enabling real-time remote monitoring. This innovative system enhances patient safety and overall well-being, equipping caregivers with vital tools for emergency response. It marks a significant step forward in healthcare technology for individuals with paralysis.

INTRODUCTION:

The Internet of Things (IoT) has transformed the healthcare sector by introducing intelligent, interconnected systems that improve patient care, streamline medical processes, and enhance emergency response mechanisms. IoT technology enables real-time health monitoring, automatic alerts, and remote access to medical data, helping caregivers and healthcare professionals provide efficient, proactive, and personalized care.The Internet of Things (IoT) is revolutionizing the healthcare industry by integrating smart devices that collect, process, and transmit health-related data in real time. Unlike traditional healthcare systems that rely heavily on manual monitoring and periodic check-ups, IoT-enabled health solutions provide continuous tracking of patient conditions, ensuring faster responses to emergencies and improved medical decision-making. IoT in healthcare is a game-changer, as it enables remote patient monitoring, automated alerts, and seamless data-sharing between patients, caregivers, and healthcare professionals. This technology is especially beneficial for individuals suffering from chronic illnesses, disabilities, and conditions requiring long-term care, such as paralysis. For patients suffering from severe medical conditions such as paralysis, IoT-based solutions are especially crucial. Paralysis patients often face challenges related to limited mobility, difficulty in communication, and dependency on caregivers for daily activities. Traditional healthcare monitoring methods are often insufficient, as they require frequent manual intervention and do not provide instant alerts in case of emergencies. IoT-based healthcare systems bridge this gap by ensuring that patients are continuously monitored, and caregivers receive immediate notifications in case of abnormal health conditions, thereby reducing the risk of unattended medical emergencies. The integration of smart healthcare technologies allows for seamless tracking of vital health parameters, automatic detection of emergencies, and gesture-based communication, empowering patients to convey their needs. By using real-time data transmission and remote monitoring capabilities, IoT-based health assistance systems not only improve patient safety but also significantly reduce caregiver burden, making healthcare more accessible and effective.

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2. LITERATURE SURVEY

Several studies have explored IoT-enabled solutions for paralysis patients, focusing on gesture-based communication, emergency alert mechanisms, and wearable health monitoring devices. Early research emphasized sensor-based tracking systems that transmitted patient health data to caregivers via IoT platforms. However, these systems often lacked real-time voice alerts, AI-driven analytics, and interactive communication interfaces, limiting patient independence and proactive healthcare intervention. More recent advancements have integrated machine learning algorithms for predictive healthcare, enhancing the system's ability to detect potential health deteriorations. Despite the growing adoption of IoT in healthcare, existing systems still have limitations, such as network dependency, absence of AI-powered decision-making, and lack of integrated home automation for enhanced patient mobility. Addressing these challenges requires a multi-functional healthcare system that incorporates gesture-based interaction, voice- assisted communication, and predictive analytics for early diagnosis and intervention. This literature survey reviews various IoT-based health monitoring systems for paralysis patients, highlighting their features, benefits, limitations, and potential improvements. The survey aims to identify gaps in existing research and propose enhancements for developing a comprehensive, AI-powered, real-time health monitoring solution tailored to the needs of paralysis patients. [1] Anil Kumar R., Shahameer Taj, et al. (2020) - IoT-Based Automated Paralysis Patient Monitoring System This study developed an IoT-based system for real-time health tracking of paralysis patients using oxygen level, temperature, and movement sensors. The collected data was transmitted through an IoT platform for remote caregiver monitoring. It included emergency alert mechanisms but lacked a voice-based alert system, limiting immediate response capabilities. Another limitation was the absence of a patient-specific communication system, restricting interactive healthcare assistance. Enhancing the system with AI-based predictions and voice assistance could improve patient interaction and emergency response. [2] Diptee Gaikar, Pradnya Porlekar, et al. (2021) - Automated Paralysis Patient Healthcare System The research introduced an automated healthcare system that integrated gesture-based communication and emergency alert mechanisms for paralysis patients. It employed flex sensors to recognize predefined hand movements and generate emergency alerts. However, the system relied on GSM-based communication, which could delay message delivery in areas with weak network coverage. The study did not include a voice-based assistance feature, limiting the effectiveness of non-verbal patient interaction. [3] Sayali A. Bhurke, Prajakta A. Jadhav, et al. (2021) - IoT-Based Healthcare Monitoring System This study proposed an IoT-based healthcare monitoring system that enabled paralysis patients to control home appliances and communicate with caregivers through hand gestures. The system used an Arduino microcontroller integrated with cloud-based remote health tracking for continuous monitoring. A major limitation was the absence of fall detection and voice- based alerts, which are crucial for immediate caregiver response. Additionally, the system lacked AI-driven analytics for predictive health monitoring. Incorporating AI and voice assistance could significantly enhance patient safety and overall system efficiency. [4] M. Priiya dharshini, et al. (2021) - Smart Glove for Gesture-Based Communication The study developed a smart glove designed to assist individuals with speech impairments by converting hand gestures into voice-based messages. While effective for communication, the system lacked real-time health monitoring features essential for paralysis patients who require continuous medical supervision. There was no mechanism for tracking vital signs or detecting emergencies, limiting its use in critical healthcare scenarios. The system also did not support remote monitoring, making it less effective for caregivers. Future improvements could involve integrating health tracking sensors and real-time emergency alerts. [5] H. P. Patel, T. K. Roy, et al. (2022) - AI-Driven IoT-Based Health Tracking for Disabled Patients This research integrated AI into IoT-based health monitoring systems, providing predictive analytics to detect potential health deterioration in paralysis patients. By using AI-driven insights, the system enabled early medical interventions, reducing the risk of severe complications. However, the study did not

incorporate direct interaction features such as voice alerts or gesture-based communication, which are crucial for non-verbal patients. Additionally, it lacked home automation support, which could improve patient independence. Future developments should focus on integrating AI-powered interactive assistance alongside predictive healthcare analytics. [6] N. Kumar, S. Sinha, et al. (2023) - IoT-Based Patient Health Monitoring System The research proposed an IoT-enabled health tracking system that continuously monitored vital signs and movement patterns of paralysis patients. AI-based analysis ensured early detection of anomalies, improving healthcare outcomes. However, the system did not support gesture- based controls, limiting non-verbal patient communication. It also lacked a speech- based interface for real-time caregiver interaction. Adding interactive communication features and expanding automation capabilities could enhance patient usability and caregiver responsiveness.

[7] H. A. Gupta, J. K. Mehta, et al. (2023) - Sensor-Based Wearable Systems for Paralysis Patients This study explored wearable IoT devices for continuous monitoring of oxygen levels, heart rate, and movement in paralysis patients. The research demonstrated significant benefits in detecting early health issues but lacked a built-in emergency communication system. Without real-time voice alerts or gesture-based interaction, the system had limited usability for non- verbalpatients. Future improvements should include real-time emergency response mechanisms and AI-powered health predictions for better patient care. [8] R. T. Das, B. M. Reddy, et al. (2023) - Wireless IoT Monitoring for Quadriplegic Patients The study introduced wireless IoT monitoring solutions that improved healthcare access for quadriplegic patients. It allowed real-time health data transmission to caregivers but lacked real-time voice alerts for emergencies. There was no provision for smart communication or AI-driven predictive analytics. Integrating automated alerts and interactive voice response systems could enhance patient safety and caregiver responsiveness. [9] A. Roy, M. Sinha, et al. (2023) - Wearable IoT-Based Health Monitoring Systems This research explored IoT-integrated wearable devices that used biosensors for continuous health tracking. The study demonstrated improved patient outcomes but did not include a speech- based communication interface. The system lacked emergency voice alerts and real-time interactive assistance, making it less effective for critical patient care. Future improvements should incorporate AI-driven alerts and gesture-based interaction features. [10] D. K. Verma, S. Sharma, et al. (2023) - IoT-Based Automated Health Monitoring for Paralysis Patients The study developed an IoT-based system integrating gesture-based assistance and automated alerts for emergency response. The system provided reliable real-time tracking but lacked AI- powered predictive analytics. Additionally, there was no voice-based communication, limiting non-verbal patient interaction. Enhancing the system with machine learning and speech- enabled features could improve usability and healthcare outcomes. [11] A. S. Khan, M. U. Javed, et al. (2024) - Implementation of an Efficient IoT Enabled Automated Paralysis Healthcare System The research developed an IoT-enabled healthcare system for paralysis patients, featuring smart sensors, remote monitoring, and emergency notifications. The system improved health tracking efficiency but lacked voice-based communication, limiting patient interaction. [12] T. K. Sharma, H. Patel, et al. (2024) - Smart Glove with Gesture-Based Communication and Monitoring of Paralyzed Patients The study introduced a smart glove that assisted paralysis patients by translating hand movements into commands for interaction. However, it lacked comprehensive health monitoring, limiting its use for critically ill patient [13] K. S. Agarwal, L. J. Patel, et al. (2024) - AI - Driven IoT Healthcare Systems for Disabled Individuals. This research integrated machine learning with IoT healthcare, providing predictive analytics for paralysis patients. However, it lacked gesture-based communication, which is essential for non- verbal patients [14] J. A. Khan, P. N. Singh, et al. (2024) - IoT-Based Smart Beds for Paralysis Patient Assistance This research introduced smart hospital beds with IoT connectivity for continuous monitoring of patient movements. The system effectively tracked posture and health trends but did not include AI-driven predictions. [15] S. L. Mehta, A. C. Sharma, et al. (2024) -

Wireless IoT-Based Patient Health Monitoring The study introduced wireless IoT-based solutions for paralysis patients, ensuring continuous monitoring and caregiver connectivity. However, it lacked fall detection capabilities. [16] M. R. Patel, A. A. Shaikh, et al. (2025) - Real-Time Health Insights: A Smart IoT- Based Approach for Monitoring Paralysis Patients This study presented a cloud-connected IoT-based system integrating AI-driven predictions for health risks. However, the absence of gesture-based communication limited direct patient interaction. [17] R. R. Bose, P. Agarwal, et al. (2025) - Health Monitoring and Observatory System for Paralyzed. The research used the Blynk IoT platform for real-time tracking and remote caregiver access. However, the lack of an emergency voice alert system reduced its effectiveness in critical conditions. [18] IOT based health monitoring system for paralysis patient P. R. Singh, V. K. Gupta, et al. (2025) - IoT-Based Patient Monitoring System using TCP/IP This study developed a health tracking system utilizing TCP/IP connectivity for stable data transmission. However, the system did not integrate predictive analytics for proactive medical care

3. PROPOSED SYSTEM

The proposed system is designed to assist paralysis patients by providing real-time health monitoring, gesture-based communication, and emergency alerts. The system utilizes an ESP32 microcontroller to process data from multiple sensors and enable IoT-based remote monitoring. Flex sensors are used to detect predefined hand gestures, allowing patients to communicate their needs effectively. The system also includes a vibration/MEMS sensor to detect accidental falls and immediately notify caregivers. The SPO2 and DHT11 sensors continuously monitor vital health parameters such as oxygen levels, temperature, and humidity, ensuring comprehensive patient tracking.

A voice alert mechanism is integrated into the system to provide immediate emergency notifications, improving caregiver response time. The LCD display is used to show real-time health updates, making it easier for caregivers to monitor patient conditions at a glance. The IoT module allows continuous remote access to patient data, ensuring that health records are updated in real time and can be accessed from anywhere.

The system operates with a reliable power supply, ensuring uninterrupted functionality. The ESP32 microcontroller manages the input from all sensors and processes the data efficiently. Whenever an abnormal health condition or emergency situation is detected, the system triggers an alert through the voice module and updates caregivers via IoT. This eliminates the need for constant physical monitoring and enhances patient safety. The system ensures real-time health tracking, seamless patient communication, and quick emergency response, making it a highly efficient healthcare solution for paralysis patients.

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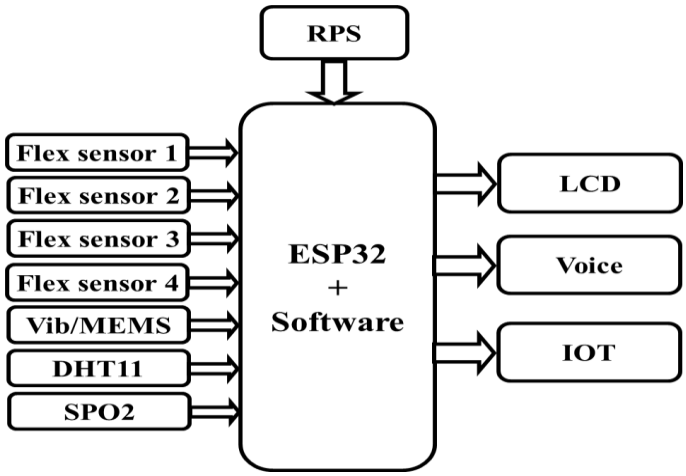

Fig 1: Flow Chart

The proposed system follows a structured workflow, integrating multiple sensors and communication modules to ensure seamless healthcare assistance for paralysis patients. As shown in the flowchart, the system begins by continuously monitoring patient vitals using SPO2 and DHT11 sensors, capturing essential health parameters such as oxygen levels, temperature, and humidity. Simultaneously, flex sensors detect predefined hand gestures, enabling the patient to communicate their needs efficiently. Once the sensor data is collected, it is processed by the ESP32 microcontroller, which acts as the central control unit. The microcontroller analyzes inputs from all connected sensors and determines if any critical conditions, such as abnormal oxygen levels or a detected fall, require an emergency response. If an emergency is identified, the system triggers a voice alert for immediate caregiver attention and transmits real-time health data to an IoT platform for remote monitoring. Additionally, an LCD display provides a continuous visual representation of patient vitals, ensuring that caregivers can access information at a glance. The IoT module enhances accessibility by allowing healthcare providers and family members to monitor the patient's condition from any location. The system's integrated approach ensures that patient safety is maintained, reducing the need for manual intervention while improving response time in emergencies. By automating real-time monitoring and communication, this system significantly enhances the quality of care for individuals with paralysis.

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Circuit Diagram:

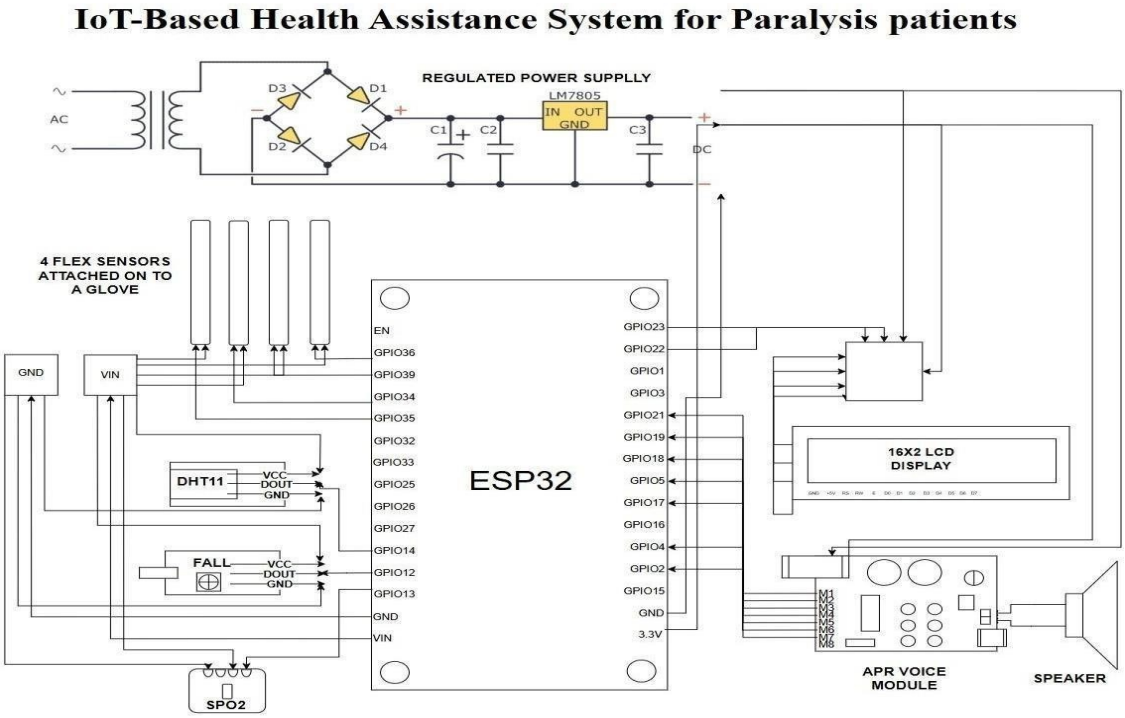

Fig 2: Circuit Diagram

The proposed system functions as described in the flowchart above. Once the system is activated, it begins real-time monitoring of the patient's health and movement. The system continuously collects input from multiple sensors, including flex sensors, SPO2 sensors, DHT11 sensors, and vibration/MEMS sensors, ensuring comprehensive tracking of vital signs and patient activity. The collected data is then processed by the ESP32 microcontroller, which determines whether any emergency conditions, such as abnormal oxygen levels or accidental falls, require an immediate response. By implementing this structured approach, the system ensures real-time health tracking, improves patient safety, and enables timely response in emergencies. The integration of IoT and automated alerts eliminates the need for continuous physical monitoring, enhancing the overa

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4. RESULTS

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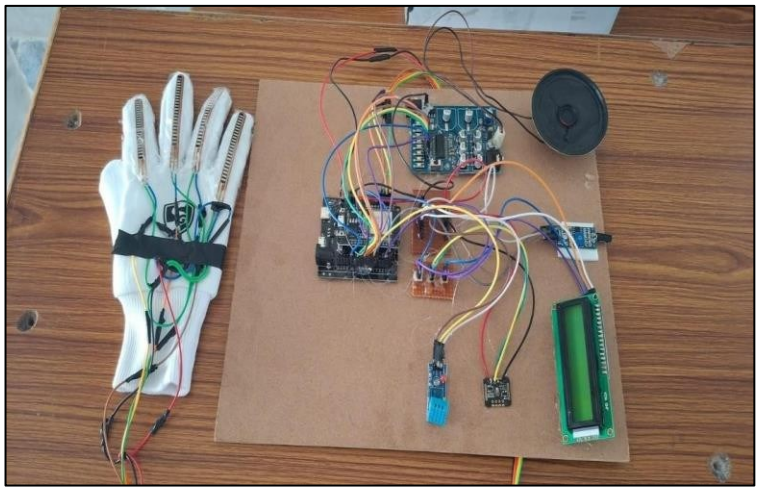

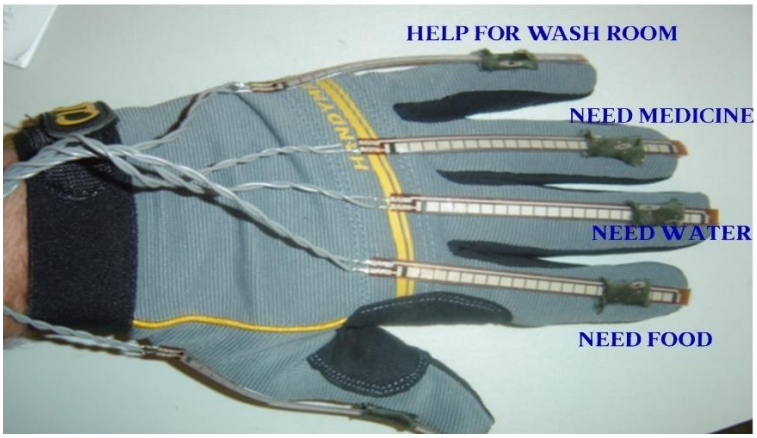

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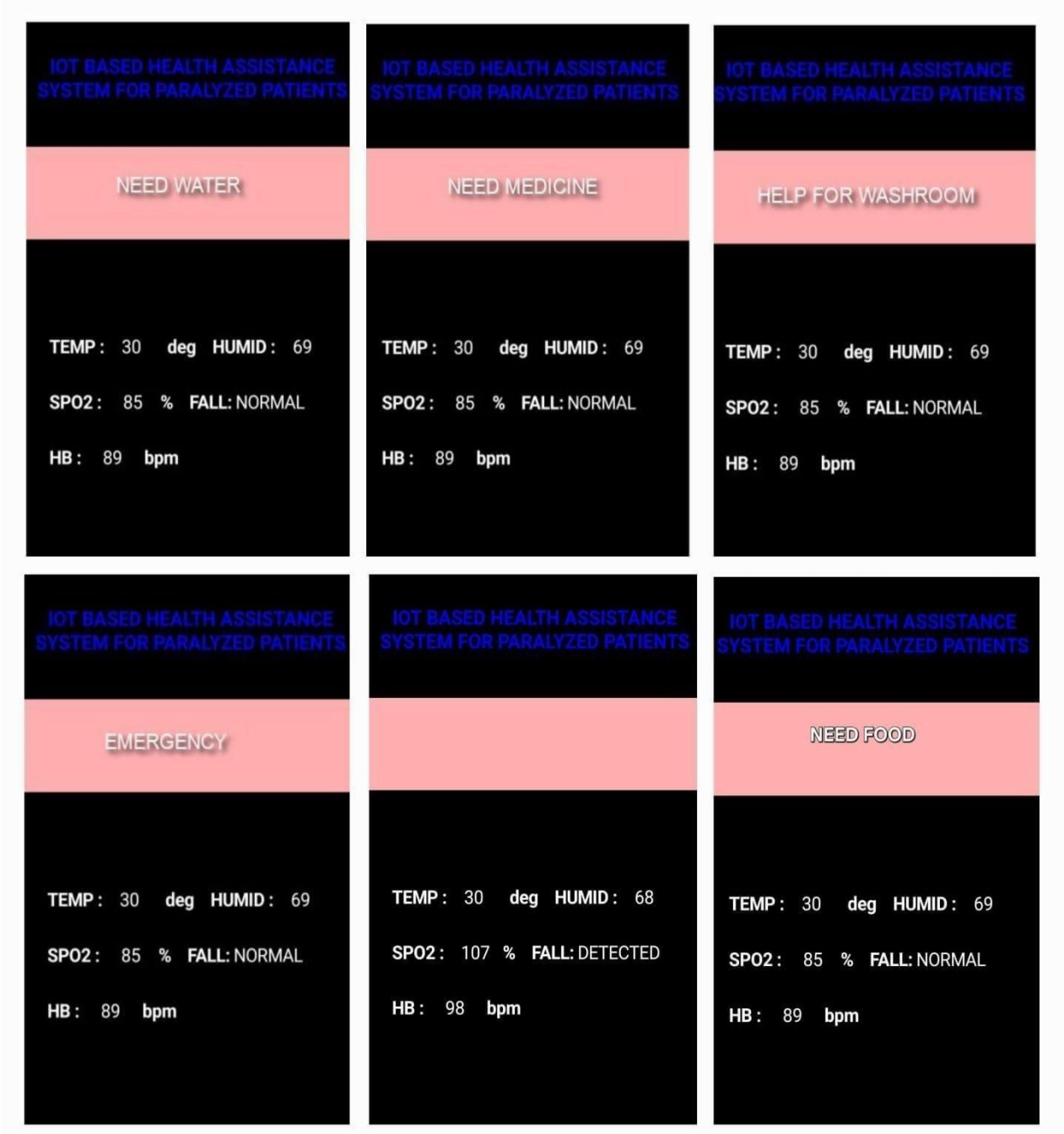

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5. CONCLUSION

The IoT-Based Health Assistance System for Paralysis Patients is an innovative and effective solution designed to enhance patient care through real-time health monitoring and emergency alerts. By integrating flex sensors, heartbeat sensors, temperature sensors, and fall detection modules with Arduino and GSM technology, the system ensures continuous tracking of vital parameters and provides immediate assistance in case of emergencies. This system enables gesture-based communication, allowing patients to convey essential needs such as requesting food, water, or medical attention. Additionally, the real-time SMS alert mechanism ensures that caregivers are promptly informed about critical conditions, enabling quick response and improving patient safety. The use of an LCD display for status updates further enhances the usability of the system. By automating health monitoring and reducing reliance on manual caregiving, this system enhances the quality of life for paralysis patients and provides caregivers with a reliable and efficient way to manage patient needs. The proposed technology-driven approach demonstrates significant potential for improving healthcare accessibility, making it a valuable contribution to modern patient assistance solution

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