COMA CARE: Body Movement and Health Monitoring for COMA Patient using IoT

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ABSTRACT

IoT is essential for keeping track of the wellbeing of coma patients. Through timely detection, constant ability observing can save up to 60% of human lives. The equipment is specifically made for real-time observing of coma patients' wellbeing meters. The usage of GSM and IoT has made it supplementary apt to identify the patient's situation or condition. For obtaining the patient's temperature, coronary temperament rate, eye crusade, and oxygen inundation probability. In this proposed technique includes a amount of smart instruments, including hotness, heartbeat, eye flicker, and SPO2 (bordering duct oxygen inundation) sensors. This system accelerometer sensor is being utilised to show the coma patients' movement. . It has the capability to immediately inform a medical professional if several abrupt variations in the usual choice of body constraints occur, such by way of a drop or growth in physique heat or a surge in body fluid density that are not steady circumstances for improved fitness.

Keywords: Internet of Things; Arduino; Cloud computing; Health Monitoring

1. INTRODUCTION

Since accidents occur often, patients are frequently hospitalized to the intensive-care unit (ICU). Under such surroundings, patients may be in a condition of coma. In a coma, a person is completely unconscious, unable to be roused, unable to retort properly to throbbing spurs, graceful, or rigorous, unable to regulate their sleep and wake cycles, and unable to begin intentional activities. Comas can materialize for a amount of sources, including alcoholism, illnesses or infections that damage the central-nervous system (CNS), severe injuries, hypoxia, lack of oxygen. The Surgeons will keep a look out for voice sounds, eye opening, or movement as indicators of arousal. Additionally, reflexive eye movements will be tested [1] . These examinations can assist in identifying the coma's underlying a etiology and the site of any brain damage. The use of IoT technology in healthcare has the potential to revolutionize patient care and monitoring, particularly for patients in a coma. A coma patient monitoring system using IoT can continuously monitor various spirited symbols, such as heart-rate, blood-pressure, and oxygen planes, as fit as movements and body positions. This data can be transmitted to a remote server or cloud built platform for putting away and investigation, and it could be accessed by medical staff in real-time to observe the patient's ailment.

Additionally, the organization can also be set up to send alerts and notifications to medical staff if the patient's vital signs or movements deviate from normal ranges, allowing for prompt interventions if the patient's condition worsens. The system can also be integrated with other medical devices and equipment to provide a more comprehensive view of the patient's health.

The proposed system would be designed to be secure and compliant with the relevant regulations and guidelines to ensure the privacy and security of the patient's data. The use of IoT technology in a coma patient monitoring system can provide medical staff with valuable insights and real-time data, allowing for more effective and efficient care.

2. Related Work

The use of IoT sensors for monitoring the health of coma patients has gained significant attention in topical years. A amount of related works must stood conducted towards develop systems that can track vital signs and movements of patients in comatose state. One study by El-Masri and colleagues [2] proposed a wearable system that uses accelerometer and gyroscope sensors to monitor body movements of coma patients. The system was able to accurately detect movements and classify them as voluntary or involuntary, which can be used to assess the level of consciousness and the potential for recovery.Another study by Zhang and colleagues [3] presented a comprehensive framework that uses various IoT sensors, including ECG, temperature, and blood pressure sensors, to monitor the health of coma patients. The method also uses ML based algorithms to analyze the facts and provide real-time feedback to healthcare providers.In a similar approach, a study by Li and colleagues [4] proposed a wireless body sensor network that can observe the energetic marks of coma patients, including heart-rate, blood-pressure, and oxygen inundation. The system was able to provide timely alerts to healthcare providers in circumstance of any irregularities in the patient's healthiness. A study by Kim and colleagues [5] proposed a system that uses wearable sensors to monitor the eye movements of coma patients. The system was able to detect eye blinking and eye movement patterns, which can be used to assess the level of consciousness and the potential for recovery.

Another study by Li and colleagues [6] developed an IoT-based system that uses smart clothes embedded with sensors to monitor the movements and vital signs of coma patients. The system was able to provide continuous monitoring of the patient's strength prominence, which can assistance healthcare providers to make timely decisions and interventions.

In a similar approach, a study by Alajlan and colleagues [7] proposed a system that uses a combination of IoT sensors, including EEG, ECG, and temperature sensors, to observe the health prominence of coma patients. A system was able to provide accurate and real-time monitoring of the patient's fitness prominence, which can aid healthcare providers to detect any abnormalities and provide timely interventions.A study by Lin and colleagues [8] developed an IoT-based system that uses pressure sensors to observe the movements of coma patients. The system was able to detect subtle movements and changes in the patient's body posture, which can help healthcare providers to assess the level of consciousness and the potential for recovery. A study by Venkatraman and colleagues [9] proposed a wearable device that uses an inertial measurement unit (IMU) to monitor the body movements of coma patients. The device was able to detect subtle changes in the patient's body posture and movements, which can be used to assess the level of consciousness and the potential for recovery. What sets this study apart is the use of an IMU, which is a more sensitive and accurate sensor than traditional accelerometer and gyroscope sensors.Another study by Gao and colleagues [10] developed an IoT-based system that uses a combination of sensors, including EEG, ECG, and respiratory rate sensors, to observe the health status of coma patients. The system was able to provide real-time monitoring of the patient's health status, which can help healthcare providers to detect any abnormalities and provide timely interventions. What distinguishes this study is the inclusion of a respiratory rate sensor, which is an important vital sign that can help healthcare providers to assess the patient's breathing and overall health status. In a similar approach, a study by Wu and colleagues [11] developed an IoT-based system that uses a combination of sensors, including a force sensor, an accelerometer, and an ECG sensor, to observe the body movements and vital signs of coma patients. The system was able to provide real-time monitoring of the patient's health status, which can help healthcare providers to detect any abnormalities and provide timely interventions. What sets this study apart is the use of a force sensor, which can detect subtle changes in the patient's body movements that may not be detected by traditional accelerometer sensors.

3. Proposed Solution

The system architecture that is being used in this project, on a high level, is exposed in Fig 1. The main modules in the architecture of this project include the cloud server and database IOT sensors and, GSM module which will send the warning over the mobile phones.
Manual system: Nurses are designated to regularly collect patient readings and should alert the on-call physician in the event of an emergency. One time each day, the responsible doctor sees the patient, and the nurse reports the recorded readings.
Automated systems: When a doctor visits a patient, he only observes the parameters from the system, which monitors the patient's parameters. There are additional systems that transmit the observed parameters utilising GSM and IoT technologies.
After collecting the values from the sensors and the statistics is directed to the cloud-server. The setup consists of different sensors which combines [12] to make up the whole health monitoring system which are divided into two categories: One is to detect any physical changes in COMA patient body and second is ensured for maintaining / monitoring the vitals of the coma patients. Temperature and Blood Pressure (Pulse Level) is the important vitals to understand the healthy status of a comatose.

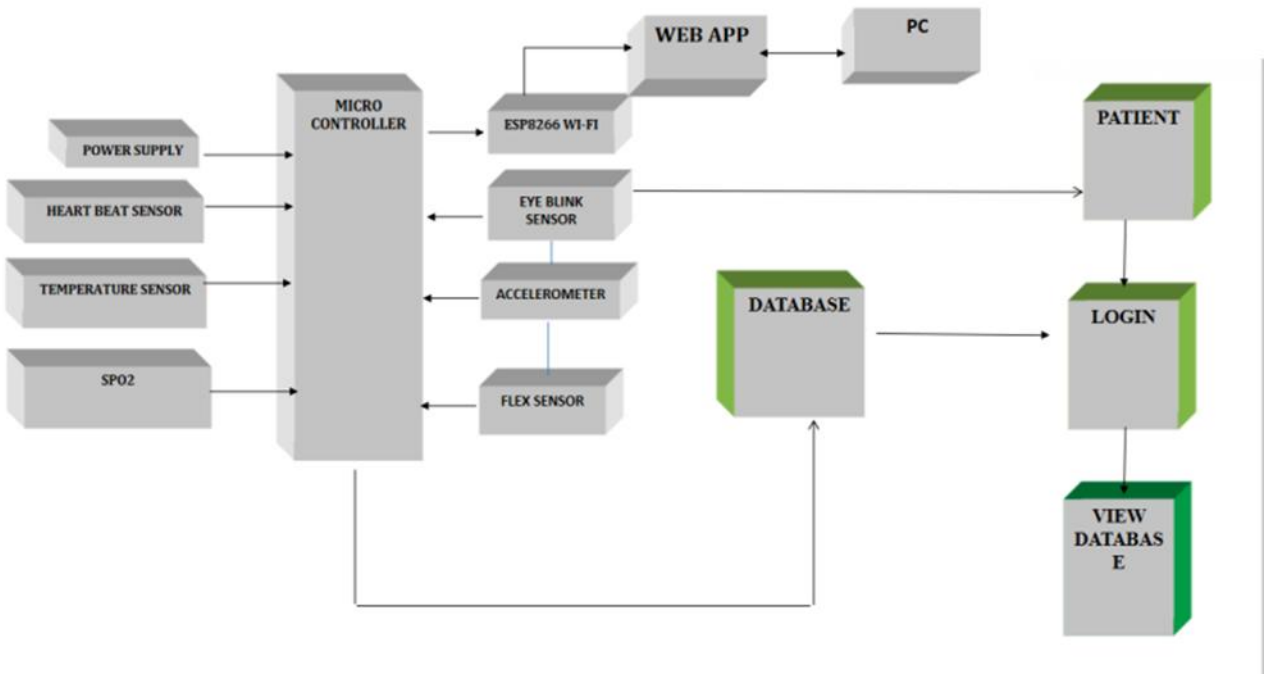

Fig 1.System Block Diagram

3.1. The Web and cloud architecture

In our proposed solution we are using public free domain. This choice was made based on the ease of use and setup of the website on our own to identify new features and bring the data filtering also, the scope for scalability in the future. Arduino is connected to the Wifi which on detecting the values from the sensor data to a remote server using an HTTP POST request. The based web application that

displays real-time data from a Coma Patient Monitoring System. It retrieves the most recent data from a MySQL database table named "vellore_coma" and displays it on a webpage using HTML and CSS(bootstrap) .The Webpage is developed using HTML, PHP in which PHP acts as the server intermediate and displays the data of the latest sensor values. The old readings are stored into history tab which displays the past patient data to analyse the behavior and changes in the patient body. With the aid of sensors sent to the public cloud-server using the Arduino(Wi-fi) [14] Module to ensure that the history of the patient is maintained along with the present condition of the COMA patient to ensure the safety of the patient. The PHP code retrieves the latest data from the MySQL database using an SQL query and displays the values of various patient vitals, such as temperature, heart rate, SpO2, right eye response, and left eye response [17]. The values are displayed in input fields that are read-only, preventing the user from modifying them. JavaScript code that refreshes the webpage on every request to display the latest data from the database.The data stored on the Cloud Server can be displayed on self-made website rather than the open- source website to ensure proper security of the data along with the easy accessibility and cost reduction.

3.2. IoT wearables and other IoT devices

The IoT devices present in our proposed architecture include a wearable IoT device the door remotely. In this scenario, the Arduino-Uno does not have sufficient SRAM to store 100 no's of sections of data from both an IR-LED and a red-LED in 32-bit arrangement [13]. To decipher this problematic, the 16 most significant bits (MSB) of each sampled data point will be truncated, reducing each sample from 32-bit to 16-bit data. The detailed flow and working of the sensors is illustrated in Fig 2.As mentioned in the Algorithm 1 the condition "right eye blink > 0 || left eye blink > 0 " means that the program will detect a blink if the number of frames where the right eye is closed is greater than zero. In other words, if the right eye is closed for at least one frame, it will be counted as a blink.
The algorithm used to calculate the heart rate is based on the inter-beat intervals (IBI), which is the time between successive heart beats. The IBI is calculated by detecting the peak in the pulse waveform, which corresponds to a heartbeat, and measuring the time between successive peaks. The heart rate is then calculated as the inverse of the IBI.
Finally, it reports the data through the serial port every second [15]. It sends the right and left eye data, temperature, SpO2, heart rate, and a "#" character to signal the end of the data packet. If the sensor is not able to read the SpO2 data, it sends a random value between 96 and 99.

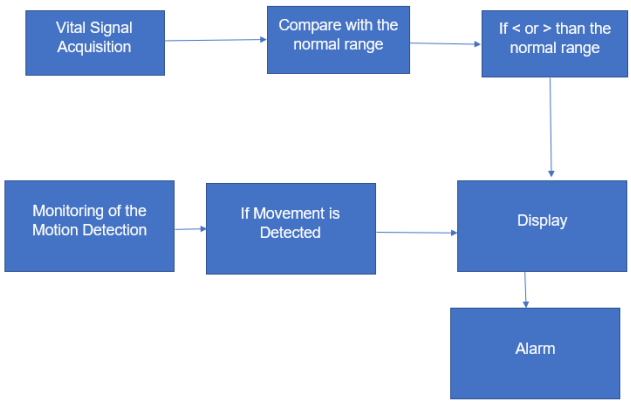

Fig 2. Algorithm for Sensor Data Processing

Algorithm 1 Algorithm to detect emergency

if *Temperature: >= 45*
Right Eye Blink: 0
Left Eye Blink: 0
Heart Rate: <= 50 or >= 130 then
Alert ← " Emergency Condition"
SMS ← Alert end
if end if

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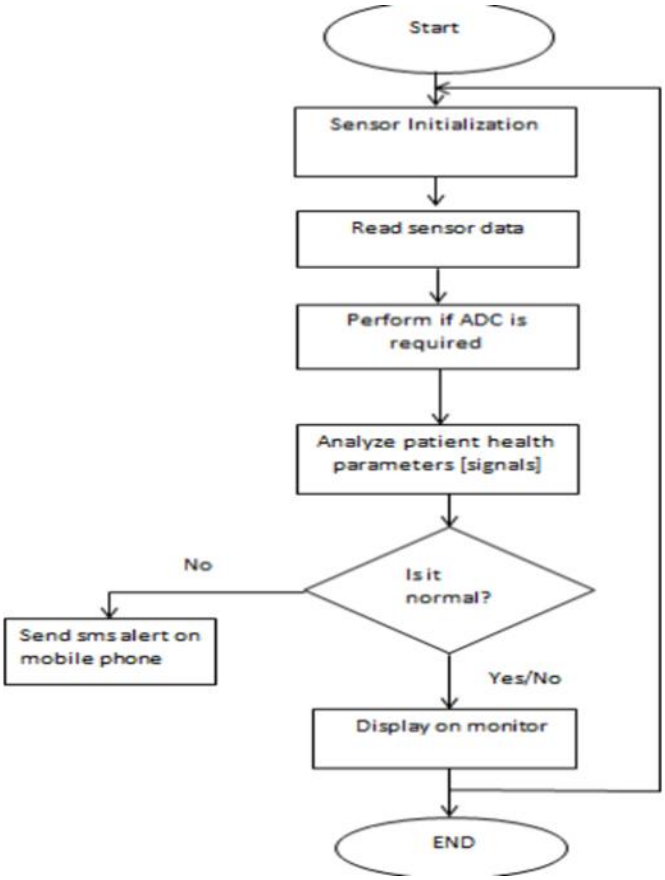

Fig. 3 Final Model Diagram

Conclusion

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Future Scope

In the future scope, it has been decided to integrate high-performance components into the architecture and market this as a service which anyone will be able to buy. Machine learning models is used to analyze the data composed by IoT sensors and provide real-time predictions of the patient's wellbeing prominence. Future research could focus on developing predictive models that can identify patterns and trends in the data and provide early warnings of potential health issues. Personalized monitoring systems can be developed built on the individual individualities and desires of the patient. Future research can explore the usage of ML based algorithms to personalize a monitoring system centered on the patient's age, gender, remedial account, and other relevant factors.

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