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IOT based health monitoring system for comatose patients

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Abstract :

The monitoring of vital signs in comatose patients renders appropriate and timely care. This research paper has presented the development of a comprehensive multi-sensor system to provide continuous monitoring for key physiological parameters like oxygen saturation levels, blood pressure, eye blinks and body temperature of a comatose patient. The pulse oximeter will be used for monitoring oxygen saturation, while the blood pressure will be measured by a non-invasive cuff sensor. Neurological activity is assessed by monitoring eye blinks.. The temperature of the body is continuously monitored for fluctuations towards fever or hypothermia. All the data from this system could be made available in real time to the medical people for their close monitoring of the condition of the patient and to make timely interventions. These parameters, integrated into the system, significantly improve the manageability and prognosis in patients who are in a coma.

Keywords: Comatose patients, Multi-sensor system, Real-time data, Patient car, Prognosis improvement

Introduction :

A coma is a state of prolonged unconsciousness in which a patient is unresponsive to their environment, posing significant challenges for continuous monitoring and care. This research introduces a multi-sensor monitoring system tailored for comatose patients, designed to measure and track critical physiological parameters, including oxygen saturation levels, blood pressure, eye blinks and body temperature.

Oxygen saturation is monitored with a pulse oximeter sensor for the early detection of hypoxia. Blood pressure is monitored using a non-invasive cuff-based sensor and provides continuous updating information about episodes of hypotension or hypertension. Eye blink detection is measured to assess neurological activity, indicating if a patient is conscious or not. A temperature sensor is an important aspect for body temperature tracking in detecting fever or hypothermia. Information drawn from these sensors is then communicated to the central monitoring system, processed, and represented in an easily understandable manner for the healthcare professional. For instance,[1] Yang et al. (2018) explored the use of IoT-enabled systems for real-time health monitoring, particularly focusing on wearable technology for stroke rehabilitation.[2] the work of Sultana et al. (2021) on IoT-based integrated health monitoring systems informed our design, particularly in the continuous monitoring of blood pressure.[3] We also considered the findings of Haider et al. (2020), who developed an automated robotic system for patient assistance, to enhance our system's ability to assess neurological activity through eye blink detection.[4] insights from the work of Brown and Green (2019) on digital communication principles have been integrated into the system's design, particularly in how data from temperature sensors is processed and transmitted. This system provides for continuous monitoring of a patient: Comatose patient condition changes are detected instantly, which should help medical personnel take quick action to save such a patient.

Methodology:

The methodology involves the design, development, and implementation of a multi sensor monitoring system tailored for comatose patients. This system will be responsible for integrating a number of different sensors into the system in such a way as to measure some of the key physiological parameters in people, allowing for its continued monitoring in real-time. The process can thus be broken down into a number of key stages:

1. **Design and Selection of the System and Sensors**
    a. Oxygen Saturation Measurement: The pulse oximeter sensor will be applied to monitor oxygen saturation levels that are very important in detecting hypoxia.

b. Blood Pressure Monitoring: Continuous, non-invasive monitoring of the patient's blood pressure, using a cuff-based sensor, provides data on hypotensive or hypertensive conditions.
c. Eye blink detection is carried out by infrared sensors indicate neurological activity and consciousness level.
d. Body Temperature Measurement: This device is equipped with a digital temperature sensor, ensuring continuous monitoring to establish the existence of either fever or hypothermia.

2. Data Acquisition and Transmission

a. Long-Term Sensor Data Collection: Each sensor continuously collects data related to the specific physiological parameter it monitors.
b. Data Transmission: The data collected is then transmitted without wires to the central monitoring system through IoT protocols, be it Wi-Fi or Bluetooth.

3. Data Processing and Analysis

a. Threshold Analysis: The system takes up a comparison between the readings of sensors against the predefined threshold values to detect any abnormality.
b. Alert Generation: In case any parameter breaches upwards or downwards from the set thresholds, the system shall automatically raise alerts for medical personnel.

4. User Interface

a. Central Monitoring Dashboard: The processed data will then be displayed on a central dashboard, accessible by the healthcare provider, providing an overview of the patient's physiological status.
b. Mobile Notifications: The same shall be sent to mobile devices used by the treating medical team so that all of them are able to respond promptly for any change in condition of the patient.

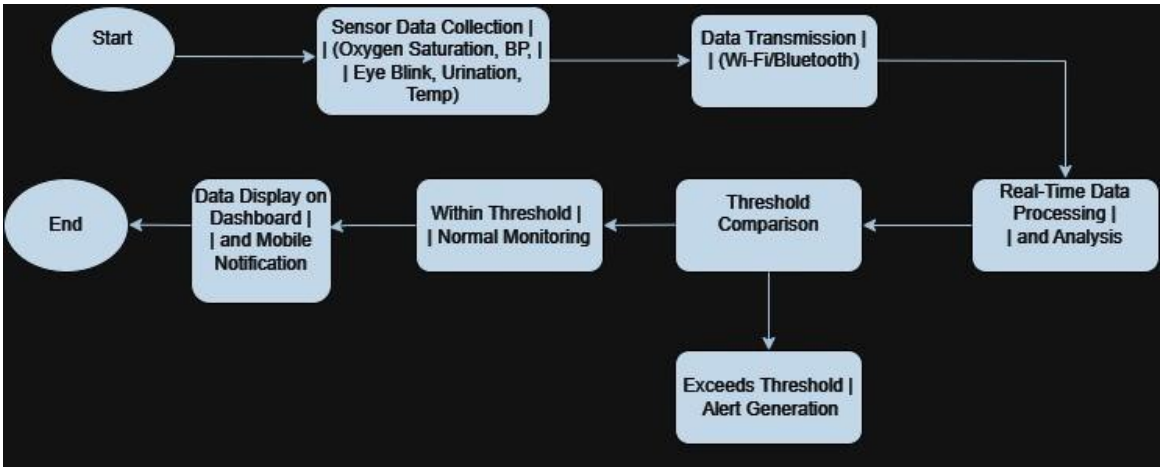

Fig 1. Complete block diagram of the process

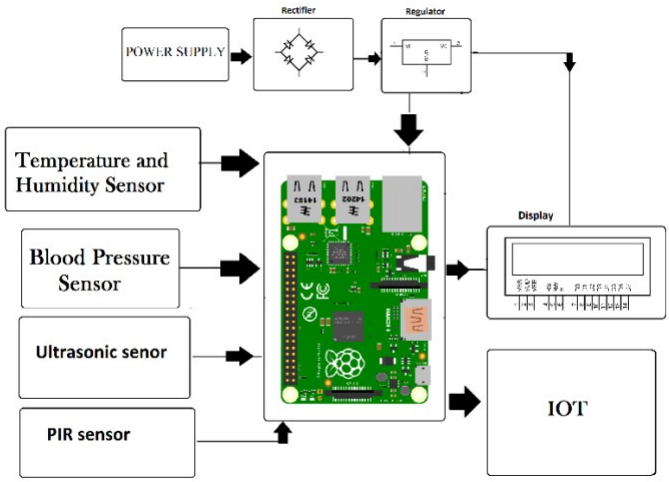

Fig 2. Circuit Diagram

Results and Outcomes for Comatose Patient Monitoring System:

1. Accurate Monitoring of Vital Signs:

   a. Blood Pressure: The system continuously displays real-time blood pressure readings. Any serious deviation from the normal blood pressure range in a patient is, therefore, instantly recognizable. Medical intervention at the earliest possible moment can be implemented if any abnormal patterns are noticed.

Fig 3. Blood pressure sensor STEMMA QT LPS22

Fig 4. Body Temperature sensor DS18B20

Fig 5. Eye Blink sensor

b. Body Temperature: This facilitates the early detection of either fever or hypothermia in the patient and makes sure that the patient gets proper care to maintain stable and optimal body temperature.

c. Eye Blink Rate: Eye blink rate is one of the indicators of neurological status and change in the comatose patient. This would allow changes over time to be watched for regarding the patient's level of consciousness and their responsiveness.

2. Improved Care of Patient:

a. Early Detection of Complications: Continuous monitoring enables the timely notice of early manifestations of complications, such as infection, autonomic dysregulation, or renal issues. This is a proactive approach that enables early medicinal responses and interventions in dealing with the complications. medicinal responses and interventions in dealing with the complication.

Fig 6. Monitoring information via SMS

Improved Treatment Planning: Information from the monitoring system allows health providers to make informed decisions on treatment plans and their adjustment to optimize strategies for patient care.

3. Data-Driven Insight:

a. Trend analysis: This functionality of the system in tracking and analyzing trends in the patient's vital signs and other parameters is useful in the monitoring of a condition that is improving or progressing. This trend data will carry significant value when planning and reviewing long-term care.

b. Customization: These alert thresholds and parameters can be adjusted in consideration of a single patient to accommodate the needs of the monitored and cared-for patient.

Timestamp	Systolic_BP	Diastolic_BP	Body_Temperature	Movement	Eye_Blink
8/1/2024 0:00	122.321636	82.15310786	37.1446826	0	0
8/1/2024 0:01	112.9221275	90.48145531	36.50940949	0	0
8/1/2024 0:02	116.6427897	72.76909441	36.82597233	0	0
8/1/2024 0:03	136.7241747	92.20907561	36.77544206	0	0
8/1/2024 0:04	103.8547416	81.91512091	36.82596483	0	0
8/1/2024 0:05	116.4194863	70.19491281	37.13135528	0	0
8/1/2024 0:06	137.64999	78.86319565	36.48563051	0	0
8/1/2024 0:07	108.1183184	91.68042833	36.67741539	0	0
8/1/2024 0:08	103.6271928	94.0172067	37.32703068	0	0
8/1/2024 0:09	124.5622798	80.88136279	37.43380869	1	0
8/1/2024 0:10	123.2540459	77.18636287	36.54414279	0	0
8/1/2024 0:11	119.9667875	70.16913463	37.18777624	0	0
8/1/2024 0:12	129.0947596	79.20238635	37.09487628	0	0
8/1/2024 0:13	120.554237	68.99033197	37.08477357	0	0
8/1/2024 0:14	112.3242824	85.58152023	36.74899836	0	0
8/1/2024 0:15	127.314494	78.62392331	37.13117761	0	0
8/1/2024 0:16	135.6427354	66.4118438	37.06885933	0	0
8/1/2024 0:17	118.0747267	78.68050412	37.18561619	0	0
8/1/2024 0:18	123.6686877	81.26659037	37.34930952	0	0
8/1/2024 0:19	137.1816766	88.78435695	37.68967355	0	0
8/1/2024 0:20	117.5685835	74.40119687	36.99877886	0	0
8/1/2024 0:21	104.36659	78.14219809	37.83832957	0	0
8/1/2024 0:22	100.8219154	76.71810735	36.61073653	0	0
8/1/2024 0:23	133.6374589	84.12108539	36.36671767	0	0
8/1/2024 0:24	116.2551705	77.22753407	37.39958212	0	0
8/1/2024 0:25	117.1286266	86.58785573	36.75626776	0	0
8/1/2024 0:26	125.9825401	76.18697311	37.02017075	0	0
8/1/2024 0:27	114.6727523	69.87594982	38.17621955	0	0
8/1/2024 0:28	129.8078177	90.73334329	37.18357086	0	0
8/1/2024 0:29	120.2808735	92.84553411	37.40401192	0	0
8/1/2024 0:30	130.8706137	68.34377544	36.92211009	0	0
8/1/2024 0:31	129.9187126	66.18163749	36.89842051	0	0
8/1/2024 0:32	114.2990326	78.2450215	36.36354584	0	0
8/1/2024 0:33	118.3886051	87.41331097	36.09832711	0	0
8/1/2024 0:34	135.4656361	85.3651924	36.48138062	0	0
8/1/2024 0:35	120.2695123	84.55869453	36.87171498	0	0

Table 1. Collection of Data from sensors

Conclusion

This paper presents the development of an IoT-based system designed to monitor the health of comatose patients in real-time. By continuously tracking key vital signs such as blood pressure, body temperature, and urine levels, alongside detecting any physical movements, the system provides a crucial tool for medical professionals. The integration of various sensors with a Raspberry Pi platform allows for automated, around-the-clock monitoring, significantly reducing the workload on healthcare staff.

The system's ability to send instant alerts in response to any abnormal changes ensures that medical personnel can act swiftly, potentially improving patient outcomes. Moreover, the affordability and ease of deployment make this solution accessible, offering peace of mind to both healthcare providers and the families of patients.

In summary, this IoT-based health monitoring system offers a practical and effective approach to managing the care of comatose patients, making continuous and reliable monitoring feasible and enhancing overall patient care.

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