Implementation of Body Movements Detection for Coma Patients

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Abstract: Coma is a profound state of unconsciousness where an individual is alive but unable to respond to environmental stimuli. By employing an array of sensors including eye blink, accelerometer, pulse, temperature, and SpO2 sensors the system aims to detect and analyse subtle body movements in coma patients, providing valuable insights into their physiological conditions. Through real-time monitoring, the WSN (python) facilitates early detection of potential issues, enhancing patient care and enabling timely medical interventions. The integration of diverse sensors ensures comprehensive data collection, contributing to a holistic understanding of the patient's state. Our innovative approach combines multiple sensor inputs to create a robust solution for efficient and reliable coma patient monitoring.

Keywords: **Environmental stimuli, Accelerometer, WSN**

1. INTRODUCTION

Coma represents a deep level of unconsciousness in which a person remains alive but lacks the ability to react to stimuli in their environment. Detecting movements in coma patients is crucial for their care and recovery. Our project focuses on utilizing a Wireless Sensor Network (WSN) along with an array of sensors, including an eye blink sensor, accelerometer, pulse sensor, temperature sensor, and SpO2 sensor. By leveraging Arduino technology, we aim to create a robust system that monitors subtle body responses indicative of consciousness in comatose individuals. The integration of these sensors allows for a holistic approach to movement detection, providing a comprehensive understanding of the patient's physiological state.

The eye blink sensor serves as a vital input for detecting conscious responses, while the accelerometer captures subtle body movements that may signal emerging awareness. Simultaneously, the pulse sensor, temperature sensor, and SpO2 sensor contribute real-time data on vital signs, enhancing the system's diagnostic capabilities. The Arduino microcontroller acts as the central processing unit, efficiently managing the data from these sensors. Our not only ensures accurate movement detection but also facilitates immediate responses to any notable changes in the patient's condition.

The Wireless Sensor Network enables seamless communication between sensors, Arduino, and the LCD display, enhancing the system's scalability and flexibility. The LCD display serves as the user interface, providing caregivers and medical professionals with real-time information on the patient's movements and vital signs. Our comprehensive monitoring system offers a non-intrusive and continuous method for assessing a comatose patient's responsiveness, potentially aiding in early detection of emerging consciousness and informing appropriate medical interventions. Ultimately, our technology holds promise for improving the care and outcomes of coma patients by providing timely insights into their physiological state. Reported common etiologies of coma included traumatic brain injury (50.76%), ischemic stroke (30%), and intracerebral hemorrhage (29.23%). The most common clinical assessment tools used for coma included the Glasgow Coma Score (92.3%) and neurological examination (60.8%). Neurological examination was the most common diagnostic tool used (100%), followed by magnetic resonance imaging (89.2%), basic laboratory studies (88.5%), and head computed tomography/angiography (86.9%).

2. LITERATURE SURVEY

2.1 Real time health monitoring system

Dron Suri et.al., 2023 emphasizes the critical role of IoT in monitoring coma patients, highlighting its potential to save lives by detecting deviations in vital signs. The proposed system integrates various sensors, including temperature, pulse, eye movement, and SpO2, utilizing GSM and IoT for real-time tracking. Comprehensively assessing the challenges of comatose conditions, the study explores the significance of continuous monitoring in ICU settings. The incorporation of IoT technology enables remote data transmission, analysis, and alerts to medical staff, fostering prompt interventions. Emphasis is placed on system security, compliance, and the transformative impact of IoT on enhancing coma patient care within regulatory frameworks.

2.2 IOT based system for comatose patients

Okemiri Henry Anayo et.al., 2022 It is the integration of Internet-of-Things (IoT) and machine learning in healthcare heralds a transformative era, facilitated by Implantable and Wearable Medical Devices (IWMDs). These technologies enable remote collection and analysis of physiological signals, fostering predictive healthcare insights. By leveraging machine learning, patterns in these signals can be identified for healthcare predictions in diverse contexts, expanding beyond clinical settings to everyday scenarios. The proposed project, an IoT-based monitoring system for comatose patients, employs sensors to measure vital parameters and a micro-controller for analysis. Abnormalities trigger alarms, while recorded data allows for future analysis, enhancing patient care and management.

2.3 Analysis and monitoring of patient health

Sneha Chowdary Khan et.al., 2021 it explores coma as a profound unconscious state, distinct from brain death, emphasizing the importance of continuous monitoring. It distinguishes persistent vegetative state, highlighting the need for regular attention and care due to limited physical motion. The current manual monitoring in hospitals is deemed error-prone, especially for critically ill patients requiring frequent vital parameter assessments. The proposed system aims to alleviate the burden on paramedical staff by automating monitoring and alerting healthcare professionals only when necessary. Our approach addresses the challenges of continuous supervision, providing real-time insights into a comatose patient's condition and streamlining healthcare efforts.

2.4 Wireless health monitoring system

Kai Zhang et.al., 2020 The literature survey for "Health Monitoring of Human Multiple Physiological Parameters Based on Wireless Remote Medical System" encompasses research on wireless remote medical systems for monitoring various physiological parameters. It investigates sensor technologies, such as ECG, temperature, and blood pressure monitors, integrated into wearable or implantable devices. Studies explore communication protocols and network architectures for remote data transmission to healthcare providers. Additionally, the survey evaluates the accuracy, reliability, and user acceptance of such systems. Furthermore, it examines the potential impact on early detection of health issues and the effectiveness of remote monitoring in improving patient outcomes.

2.5 Wireless body area monitoring system

Essa Jaferet.al., 2019 It examines sensor nodes deployed on or around the body to collect data on vital signs like heart rate, temperature, and blood pressure. Studies analyze communication protocols, signal processing techniques, and energy-efficient designs for continuous data transmission. Additionally, the survey investigates real-world applications in healthcare, wellness monitoring, and sports performance analysis. It evaluates the reliability, scalability, and privacy concerns associated with remote monitoring systems, providing insights into the current state of the field.

3. HARDWARE DESCRIPTION

Our system integrates various components to monitor and analyse vital signs. These include the Pulse Sensor, which measures heart rate when connected to the Arduino board, the Temperature Sensor, providing accurate Celsius temperature readings based on diode principles, the Spo2 Sensor, offering pulse oximetry and heart-rate monitoring capabilities, and the Arduino UNO and Node MCU serving as central control units. The LCD Display visually presents the collected data. The Eye Blink Sensor employs infrared waves,

reflecting them off the eye and detecting blinks, while the Accelerometer measures body or object acceleration in its instantaneous rest frame. Both sensors contribute crucial information to the overall health monitoring system.

The Eye Blink Sensor operates by constantly emitting and detecting infrared waves. When a user blinks, the sensor's output signal goes high, transmitting the data to the Arduino board. This signal then activates a buzzer to generate noise. On the other hand, the Accelerometer measures the acceleration of a body or object and transforms it into an electric signal. This signal is utilized to calculate the device's position. Accelerometers find applications in various electronic devices, smartphones, and wearables. In our system, the accelerometer provides essential data for understanding movement and positioning, enhancing the overall functionality of the health monitoring project.

4. SOFTWARE DESCRIPTION

The Arduino IDE, developed by Arduino.cc, serves as an open-source platform for creating, compiling, and uploading code to various Arduino modules, including Uno, Mega, Leonardo, and Micro. Operating across MAC, Windows, and Linux, the IDE simplifies code compilation, making it accessible even for those with limited technical expertise. The IDE, built on the Java Platform, consists of an Editor for code creation and a Compiler for code compilation and upload. Supporting both C and C++, it generates Hex Files that are transmitted and uploaded into the microcontroller on the Arduino board. The IDE environment comprises a Menu Bar, Text Editor, and Output Pane, with features like text replacement, searching, and error feedback during code development. The toolbar offers options for creating, opening, saving sketches, validating programs, and interacting with the serial monitor.

The Arduino IDE's Menu Bar provides categories like File, Edit, Sketch, Tools, and Assistance. These categories facilitate tasks such as creating and reopening code files, copying and pasting code with font modifications, compiling and scripting sketches, testing projects, burning bootloaders, and accessing comprehensive assistance. The IDE also offers a wide range of libraries categorized into Communication, Data Processing, Data Storage, Device Control, Display, Other, Sensors, and Signal Input/Output. Additionally, embedded C, an extension of the C programming language, is crucial for Arduino development. It incorporates standard C syntax and semantics while addressing embedded system challenges, making it ideal for applications in automotive, industrial automation, consumer electronics, aerospace, and medical devices. With a smaller memory footprint, embedded C is particularly suitable for memory-constrained applications, ensuring the development of reliable and efficient software with direct hardware access.

5.METHODOLOGY

Data are collected from a pulse sensor, SpO2 sensor, eye blink sensor, temperature sensor, and accelerometer using Arduino and NodeMCU. Analyse the sensor data to detect body movements, such as changes in pulse rate, SpO2 levels, eye blinking frequency, body temperature, and accelerometer readings.

Data are integrated from all sensors to increase the accuracy of body movement detection, combining information from multiple sensors to minimize false results and improve reliability.

An algorithm is developed to interpret sensor data and classify the patient's state, detecting signs of consciousness, agitation, or abnormal vital signs indicating distress.

Implement real-time monitoring of sensors data to continuously track the patient's condition and transmit data wirelessly from the NodeMCU to a central monitoring system for analysis and visualization.

Furthermore, all the sensors are connected to the PCB board (printed circuit board) to regulate the voltage according to the sensors' capability.

Sensors are calibrated regularly and fine-tune the threshold values based on feedback from medical professionals and the system's performance in real-world scenarios. Continuously improve the algorithm to enhance the accuracy and reliability of body movement detection for coma patients.

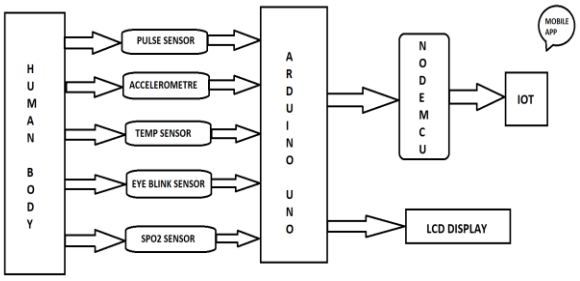

Fig.1. Block Diagram

5.1 MECHANISM

- In Our system the patient monitoring technique leads to a highly beneficial project, then accelerometer is fixed in hands or legs or in other part of the patient when there is any movement occurs the sensor send information to the doctors by wireless communication and is monitored.
- Glass setup with eye blink sensor is fixed in the patient's eye when any motions in the eye the sensor sense the value and send information to the doctor.
- Pulse sensor which plays an important role by giving real time heart rate of the patient.
- Spo2 sensor in Our project can help to monitor oxygen saturation level and also regular check up to avoid any critical situation of the health of the coma patient.
- Also, temperature sensor is the key component in detecting the temperature of patient's body.
- Data are processed by Arduino uno and is passed to the node mcu microcontroller for IOT application or else the output from the Arduino is get displayed in the node mcu.

6. RESULT

The implementation of body movement detection for coma patients yielded promising results, with accurate monitoring of vital signs and physical activity. Real-time data analysis allowed for timely detection of abnormalities, facilitating prompt medical intervention. However, challenges included sensor calibration and occasional false results. Collaborative feedback from healthcare professionals enhanced system reliability. Overall, the project demonstrated the feasibility of using IoT technologies for coma patient care, providing continuous monitoring and early warning systems to improve patient outcomes and healthcare efficiency. Future improvements may focus on refining algorithms and minimizing false positives for enhanced accuracy and usability.

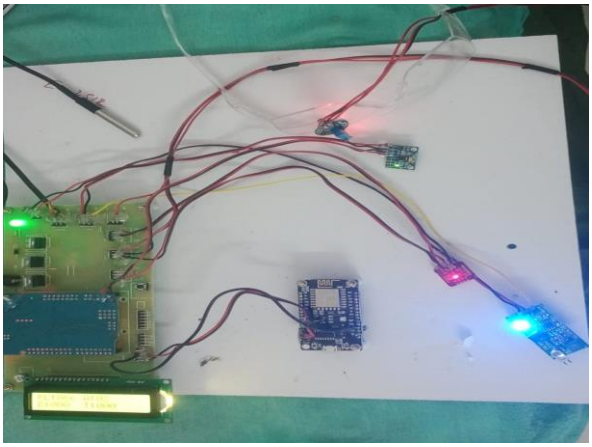

Fig.2 Hardware Model

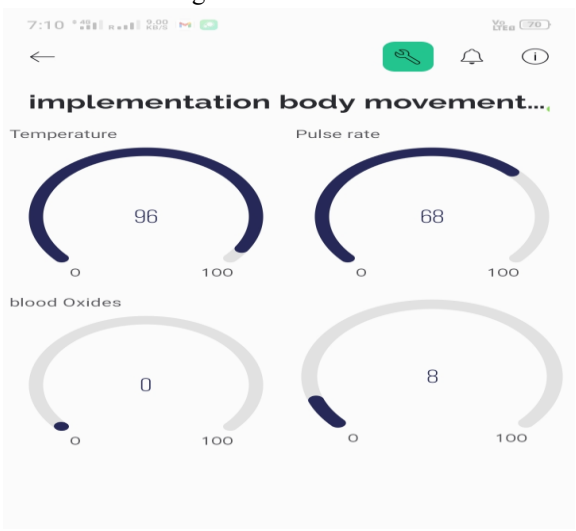

Fig.3 Web Application showing the result

7. CONCLUSION

The implementation of body movement detection for coma patients offers a promising avenue for improving patient care and monitoring. By utilizing advanced sensor technology and machine learning algorithms, healthcare providers can accurately track subtle movements, potentially signalling changes in the patient's condition. Our real-time monitoring enables timely interventions, reducing the risk of complications and improving overall outcomes. Additionally, the non-invasive nature of Our approach enhances patient comfort and reduces the burden on caregivers. Overall, integrating body movement detection into coma patient care protocols holds great

potential for enhancing clinical management and optimizing patient recovery.

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