Remote Monitoring of COMA Patients Using Zigbee

D Vijendra Babu¹, K Sitaram², Venkata Akhil Reddy², Pavan Kumar³, Ramki² and T Rajesh Kumar³

¹ Vice Principal & Professor, ECE, Aarupadai Veedu Institute of Technology, Vinayaka Mission’s Research Foundation, Chennai, India
² UG Student, ECE, Aarupadai Veedu Institute of Technology, Vinayaka Mission’s Research Foundation, Chennai, India
³ Department of CSE, Koneru Lakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur, Andhra Pradesh, India.

E-mail: vijendrababu@avit.ac.in

Abstract. It is essential to monitor Coma patients continuously for understanding their health status. Smart sensors are used in gesture recognition in biomedical applications. The proposed system is designed with Flex sensors, Eye blink sensors, MEMS body sensor for monitoring continuously. Flex sensor detects the movements in hands and sends information in wireless. Eye blink sensors detects in any motions in the eye & MEMS detects the patient’s leg movements. Sensor signals are transmitted by Zigbee and viewed in PC in the absence of Physician. Detection of change due to movements in real time video is very important tool change may be usually made the patients in the absence of the doctor, with the help of frames comparison approach. The proposed system will assist the Physician and sends alerts whenever it is required.

Keywords: Zigbee, Health, Sensor, Microcontroller

1. Introduction

Patient monitoring system is more familiar globally from the year 1625 for monitoring blood pressure and body temperature. The increase of aged people in Society and need of monitoring them becomes crucial in current scenario [1]. Further, the system has been extended to monitor various parameters & health related aspects until now. In current scenario of traditional health care system, Patients with chronic diseases are been monitored with wired systems with numerous patients in a room. The disturbance caused by the system leads to focus on patient monitoring device which is done at individual level. This paper proposes a patient monitoring system with Flex sensors, Eye blink sensors and MEMS body sensor [11] for monitoring continuously. Flex sensor detects the movements in hands and sends information in wireless. Eye blink sensors detects in any motions in the eye & MEMS detects the patient’s leg movements. Sensor signals are transmitted by Zigbee, Wireless transmission technology operated in Personal Area Network and been viewed in PC in the absence of Physician.

Zigbee is preferred over Bluetooth as it is close proximity, low power & low data rate. Zigbee is suitable in various applications such as Medical device data collection [12], Home automation and low power, low bandwidth needs. Detection of change due to movements in real time video is very important tool change may be usually made the patients in the absence of the doctor, with the help of frames comparison approach. The changes viewed may be either unexpected behavior or unusual changes occurred in the Doctor’s absence. This paper describes the concepts of patient movement monitoring system for Coma patients. A Wearable device setup is
used, which is placed in the patient’s eye for capturing any motions and then transmitted by Zigbee. The proposed system has various merits as high accuracy and ease of operation with many parameters embedded in single system.

2. Literature Survey

Remote patient monitoring of various physiological parameters takes a significant scenario in current trends in providing healthcare for aged and diseased people [2-3]. Real-time Patient monitoring systems are designed to enhance the medical services for poor people with various units such as sensor, main processing and network communication [4]. Zigbee network plays a major role in Remote patient monitoring with its low power consuming sensors and also with augmented mobility [5].

Data collected from the Patients on continuous mode by Wearable devices are used for predictive monitoring and to result in sending alert messages on abnormal situations [6]. Technological advancements has resulted in Smart Home Health care system in to realization by monitoring Patients conditions using multimodal inputs and transmitting it in to Cloud [7]. Near Field Technology caters the Patient information through an Android application in monitoring their health parameters [8]. Pre-diagnosing and monitoring diabetes patients has increased in numbers due to current scenario [9]. Various diseases are measured in real time such as QRS detection of ECG signal using Smart phones effectively [10, 13].

3. Objective

A Wearable device becomes the best option to monitor the COMA patient’s to monitor their eye movement and for capturing the eye motions for analyzing their status. Also, the captured movements to be transmitted through a trusted protocol for diagnosis by the Physician. Also, the prototype needs to be precise, accurate, minimized delay with easy to handle the integrated process for effective monitoring.

4. System Design

PIC16F877A is the most popular PIC Microcontroller used. It uses of various sensors. Heartbeat rate sensor produces a digital output of heart beat when finger is placed on sensor. LED flashes with heart beat which is connected to Microcontroller for measuring beat per minute (bpm). Flex sensor measures the quantum of bending and its resistance is directly proportional to bending. Eye ball sensor is used to detect the movement of eye's ball direction. At receiver, if no infrared light received then there is an eye blink. Dynamic acceleration and Static acceleration can be sensed by MEMS sensor. Fig. 1 displays Transmitter section & Fig.2 displays Receiver section of the proposed system.

![Figure 1. Transmitter Section](image-url)
5. Hardware Details

Various parts of the system are been discussed in this section. Experimental setup for detection of Coma patient is displayed. Fig. 3 & Fig. 4 are working model & its interface with PC respectively. Fig. 5 & Fig. 6 are wearable device and Heartbeat sensor respectively. Fig.7 is Eye blink sensor setup is displayed.

![Receiver Section](image1)

**Figure 2.** Receiver Section

![Parent Device](image2)

**Figure 3.** Parent Device

![Working model interfaced with PC](image3)

**Figure 4.** Working model interfaced with PC
Figure 5. Working model interfaced with PC

Figure 6. Heartbeat sensor

Figure 7. Eye blink Sensor Setup
6. Results & Discussions

The results obtained from pulse rate, eye blinks, body temperature and hand movements will assist Doctors to monitor Coma patient’s health status continuously with high accuracy. It is vital for the unconscious patients whose health should be continuously monitored. Current system overcomes the manual measurement and monitoring process which is tedious. Fig.8 & Fig. 9 are LCD at initial stage and pressure on Flex sensor. Fig.10 & Fig.11 are Flex sensor parameter display and Heartbeat measurement. Fig.12 & Fig.13 are Eye blinks and Eye blink detection. Fig.14 & Fig.15 are MEMS sensor detection and Temperature sensor detection respectively.

The parameters of Flux sensors, Eye blink status, Body temperature & MEMS sensor are measured and displayed in the prototype. If the fingers of the patient are in displacement, the sensors captures the acceleration and alerts in the display. The heart beat is measured by the principle of light modulation by blood flow through finger at each pulse. LM35 sensor is used to measure the body temperature, which operates on the principle of output voltage directly proportion to the patient body.

Figure 8. LCD at Initial stage

Figure 9. Pressure on Flex sensor
Figure 10. Flex sensor parameter display

Figure 11. Heartbeat measurement

Figure 12. Eye blinks
Figure 13. Eye blink detection

Figure 14. MEMS Sensor detection

Figure 15. Temperature Sensor detection

7. **Conclusion**

The proposed system plays a major role in assisting Physicians in COMA patient’s health condition continuously with high precision also it overcomes the existing manual monitoring and measurement process which is time consuming and cumbersome. Also, the proposed system is of low cost and less power consumption. All the significant parameters of the COMA patient are measured, monitored and alerted on critical situations to the Physicians. Unconscious state patients are effectively monitored by the proposed system.
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