RESEARCH ARTICLE OPEN ACCESS

# A Zigbee Based Patient Health Monitoring System

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**Abstract:**
This paper, presents a Wireless Sensor Network (WSN) for monitoring patient's physiological conditions continuously using Zigbee. Here the physiological conditions of the patient's are monitored by sensors and the output of these sensors is transmitted via Zigbee and the same has to be sent to the remote wireless monitor for acquiring the observed patient's physiological signal. The remote wireless monitor is constructed of Zigbee and Personal Computer (PC). The measured signal has to be sent to the PC, which can be data collection. Although Bluetooth is better than Zigbee for transmission rate, Zigbee has lower power consumption. The first procedure of the system is that the wireless sensors are used to measure Heart rate, temperature and fall monitoring from human body using Zigbee. Next procedure of the system is to measure saline level in bottle using zigbee. The measured signal is sent to the PC via the RS-232 serial port communication interface. In particular, when measured signals cross the standard value, the personal computer will send a message to the caretaker's mobile phone.
**Keywords:** Wireless Sensor Network, physiological signal, GSM, MEMS

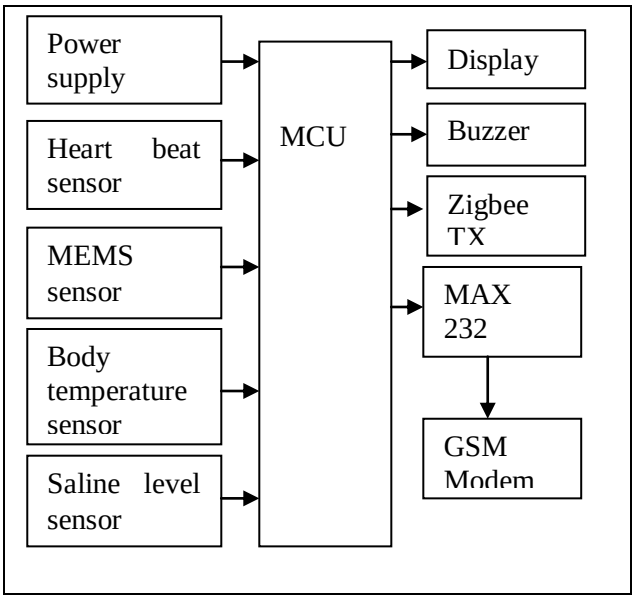
## I. INTRODUCTION

The present patient monitor systems in hospitals allow continuous monitoring of patient vital signs, which require the sensors to be hardwired to nearby, bedside monitors or PCs, and essentially confine the patient to his hospital bed. Even after connecting these systems to a particular patient, a paramedical assistant need to continuously monitor and note down all the vital parameters of a given patient by keeping track of all of his/her records manually. Adopting such a method is error prone and may lead to disaster in the case of a human error. In the current proposed system the patient health is continuously monitored by the Mobile multi patient monitoring system and the acquired data is transmitted to a centralized ARM server using Wireless Sensor Networks. A ZigBee node is connected to every patient monitor system that consumes very low power and is extremely small in size. These are specifically designed for low power consumption, with minimal circuit components intended for small packet, long distance range applications and typically consist of a low power processor with minimal resources and interface capabilities. They also have a conservative transceiver that is capable of transmitting 8 bytes of data at a time and has a moderate transmitting range of about 130 m. Therefore, WPANs seem to be a perfect fit for remote patient monitoring.

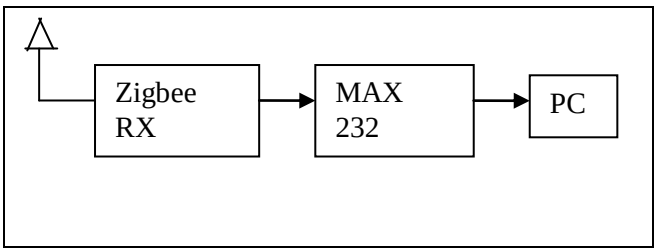
To improve the accuracy and to increase the efficiency of the above processes a real time patient monitoring system based on Wireless Sensor Networks (using IEEE 802.15a) and a centralized ARM Server integrated with GSM module is designed. This paper describes an independent system that automatically logs vital parameters of patients for easy access. The data is accessible to doctors through mobile device for convenience if needed.

## II. HARDWARE AND SOFTWARE DESCRIPTION

Fig. 1 shows the functional block diagram of the system hardware. The system has been designed to take several inputs to measure physiological parameters of human such as temperature, heart rate, detection of any fall and the saline level. The inputs from the sensors are integrated and processed. The results are sent through the Zigbee Module to a host computer, which stores the data into an Access Database. The values can then be displayed on the Graphical User Interface (GUI) running on a computer. If it is inferred that the person is medically distressed, an alarm may be generated. The program is a user interface, allowing a report on the current status of the individual.




Patient section




Monitoring section

Fig1. Functional block diagram of the system hardware

Once the user has connected to the receiver unit, data is automatically updated on the screen. Beats per minute (BPM), body temperature, impact (in both axes) and saline level is given on the display. The design is modular which makes it rather easy and straight forward to add extra sensors for measuring and monitoring other parameters.

The proposed system consists of four sensors: a temperature sensor, heart rate sensor, MEMs sensor and saline level sensor. The description of individual sensors follows.

**2.1. Temperature Sensor**

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 is rated to operate over a −55°C to +150°C temperature range.

**2.2. Heart Beat Sensor**

The system consists of an infrared (IR) LED as transmitter and an IR photo-transistor as a receiver that acts as a fingertip sensor. The sensor consists of a super bright red LED and light detector. The LED needs to be super bright as the maximum light must pass spread in finger and detected by detector. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified through an amplifier which outputs analog voltage between 0 to 5V logic level signal. The illustration of fingertip sensor is shown in fig 2.

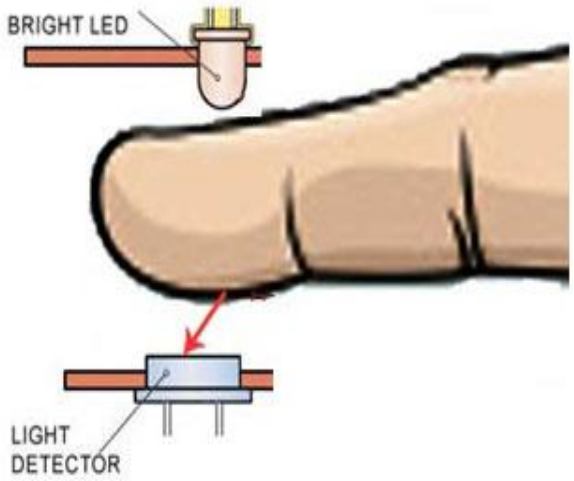



Fig 2. Illustration of Heart beat sensor

**2.3. MEMS Sensor**

The MMA7260QT low cost capacitive micro machined accelerometer features signal conditioning; this provides two-axis response, measuring accelerations up to +/- 2g. This was fitted into the wrist strap. This device provided a digital voltage, the amplitude of which was directly proportional to acceleration. The acceleration can be determined by measuring the length of the positive pulse width (t1) and the period (t2).

**2.4. Saline level sensor**

Saline level sensor is used to measure the IV fluid levels. This sensor detects the saline level in the bottle and sends a message to the doctor and at the same time an alarm will indicate that the saline has completed. This sensor uses a 555 timer in the transmitting section and TSOP1738 IR sensor in the receiver section. This sensor is placed at the neck of the bottle so that it detects the IV fluid level.

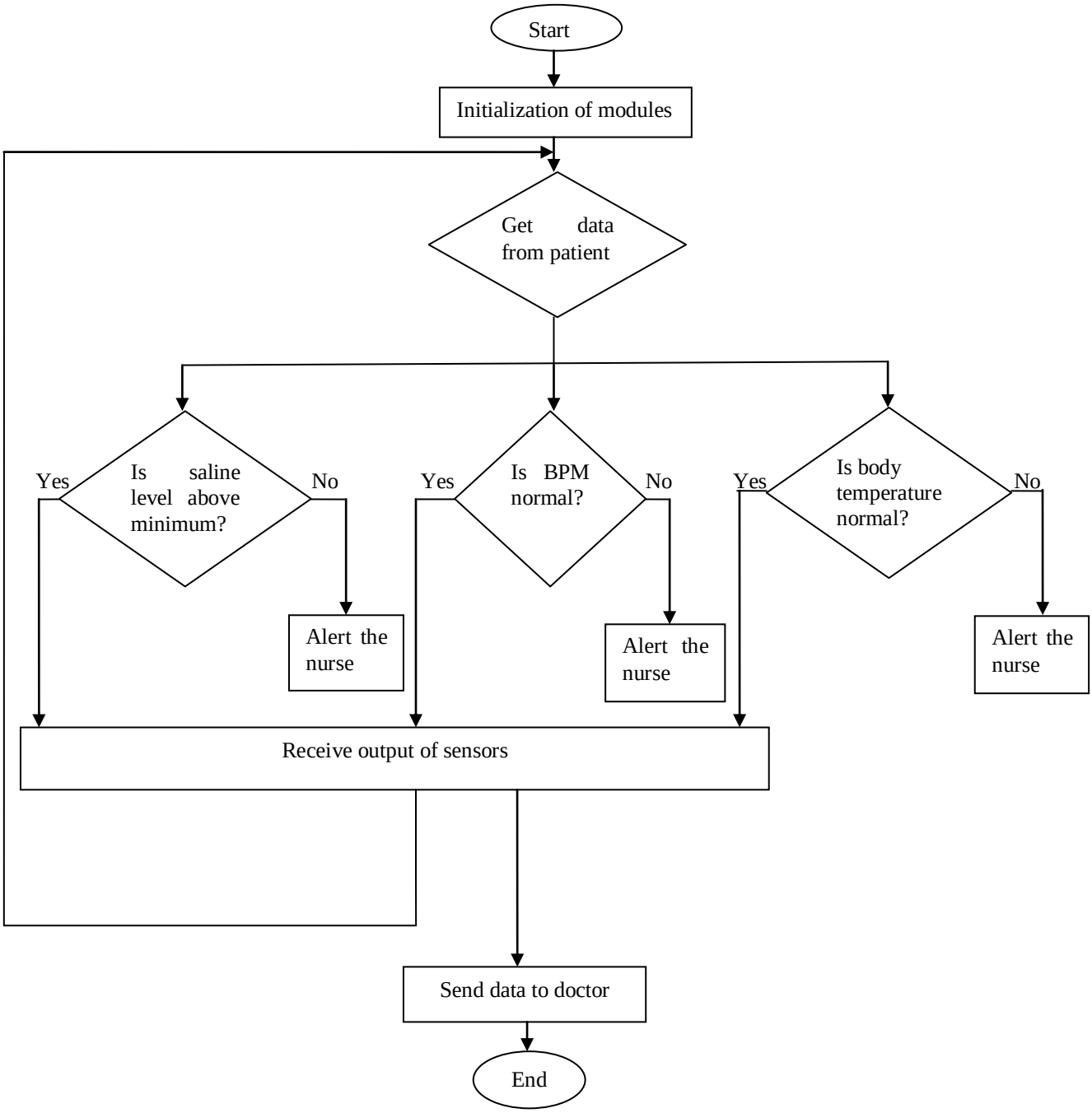



Fig 3. Flowchart of the system

## III. RESULTS AND DISCUSSION

The analog processing circuitry and the sensors were assembled on PCBs which were placed within the wrist strap. Fig 3 shows the flowchart of the system & Fig 4 shows the prototype hardware. The prototype was powered with a 9 V battery. The RF transmission using Zigbee has been tested to operate successfully at 30 meters range through obstacles such as concrete walls. When in operation, the wrist unit consumes 20 mA of current at 3.3 V power supply. The microcontroller is powered by 9 V battery.

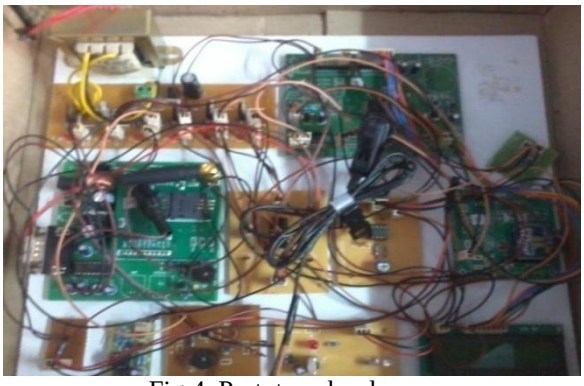


Fig 4. Prototype hardware

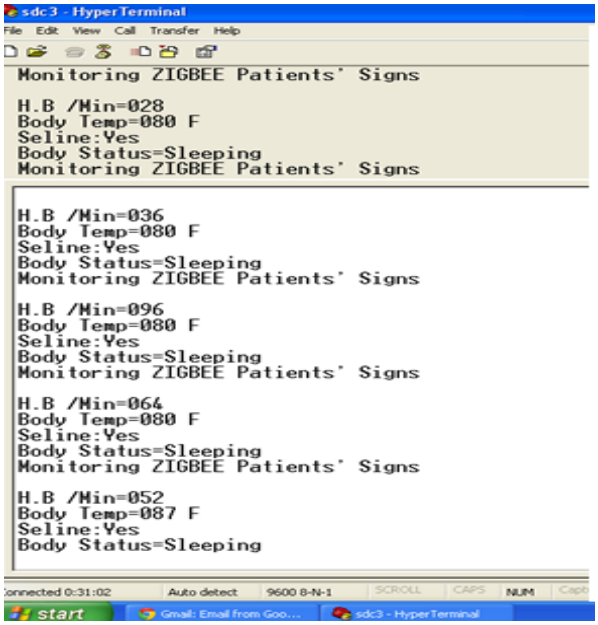


Fig 5. Output shown in the hyperterminal window

## IV. CONCLUSION

In this paper, the physiological parameters such as Body temperature, heart rate, body impact and saline level are monitored. Low-power operational amplifiers were used to minimize battery consumption. The design of the IR sensors could be improved to decrease its susceptibility to noise, to a point where it could be moved onto the wrist unit. The unit is designed for use by the elderly, within the house, where a caretaker is present but is not able to be constantly in visual contact with the patient.

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