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Patient Health Care Monitoring System Using Wireless Sensor Network

¹Mr. D.Balaji, B.E.,M.E., ²Mr.B.Vinod, B.E.,M.E and ³S.Sharmila

¹Assistant Professor, Department of ECE, Mahendra College of Engineering, Minnampalli, Salem

²Assistant Professor, Department of ECE, Ganesh College of Engineering, Karipatty, Salem

³ Student, Department of ECE, Mahendra College of Engineering, Minnampalli, Salem

Abstract: Monitoring the health of the patients, infants and elderly people continuously is a tedious task. In hospitals every patient needs a companion to take care of them or to call doctor in emergency situations. But this compact wearable device will continuously monitor the children or patient's body temperature, pulse rate and also senses whether the patient has excreted by using odour sensor and also finds that a person has fallen down due to giddiness using a gyro and accelerometer and sends all the information to the central monitoring unit using wireless module. When an abnormal condition occurs it gives an alarm so that a timely action can be taken and it is sent to the central monitoring unit using wireless sensor network.

Keyword: *Temperature Sensing, Odour Sensing, Fall Detection, Heart Pulse Rate Sensing, ZigBee Module, Central monitoring unit.*

I. Introduction

In recent scenario, the continuous monitoring of patient becomes very essential as problem can arise at any point of time. The device should also be adaptable and compactable for the patients. Towards this aim a new device which continuously monitors the heartbeat, activity of a person, sanitation problems and also senses temperature of the patient and reports to the central monitoring unit. This is being designed as a wearable device by which the patients feel better to wear [2]. The device in patient's hand acts as wireless nodes which is responsible for transferring the data to the central monitoring unit. The data is transmitted from the wireless node to the monitoring unit by using the ZigBee technology [1]. The monitoring unit consists of a LCD display which displays the sufficient data. If any of this data crosses the predefined threshold level it gives an alarm to alert the care taker indicating that particular patient's temperature or heart rate is abnormal or the person has fallen down or sanitation problem has occurred.

II. Related work

A numerous projects have focused on monitoring the health condition of a person by using wearable health devices [2]. These projects are undertaken by government agencies and other private organizations.

But these projects cover many areas in healthcare like ECG monitoring, glucose level monitoring, position monitoring, foetal monitoring, stress monitoring, and cancer detection and so on. In existing system, RF Transmitter Receiver, Bluetooth, Wi-Fi, Wi-Max, etc., are used for data transmission [3].

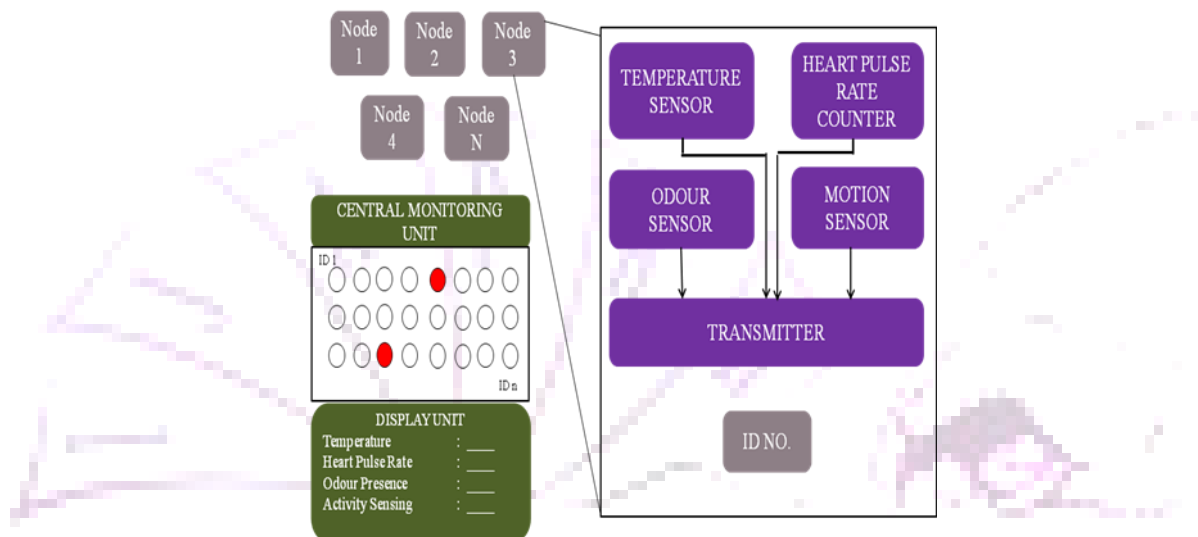
III. Proposed system

In our wearable unit, we use four sensors and it is integrated as a single unit [2]. Sensors used are temperature sensor to sense the body temperature, pulse rate sensor to monitor the working of the heart, odour

Sensor to detect the urination and excretion, fall detector to detect the sudden change in body posture due to fall.

In this unit Zigbee Technology is used for data transmission which has no line of sight barrier.

BLOCK DIAGRAM



TEMPERATURE SENSOR

The body temperature varies for infants and adults. The temperature sensor is a low self heating device which senses the temperature of body and gives the accurate results. The LM35 is the integrated circuit temperature sensor, with an output voltage linearly proportional to the temperature [6]. It doesn't require any external adjustment to provide characteristic accuracies. It consists of eight pins where the first pin is used for output, eight pin is used for supply and the fourth pin is used for ground.

For one degree Celsius rise in temperature the output is increased by 1mv. The temperature range over which it functions is -55°C to 150°C. It operates from 4 to 30 V. The typical accuracy is ±0.25°C at room temperature and ±0.75°C at rest of the places [4].

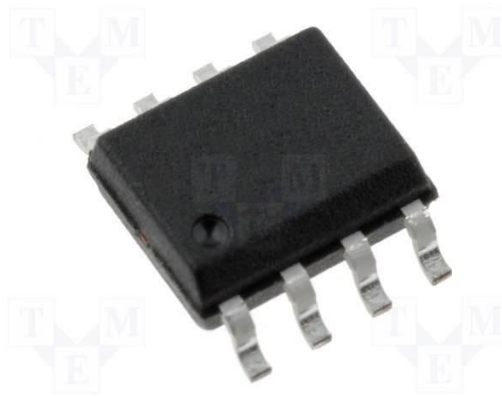
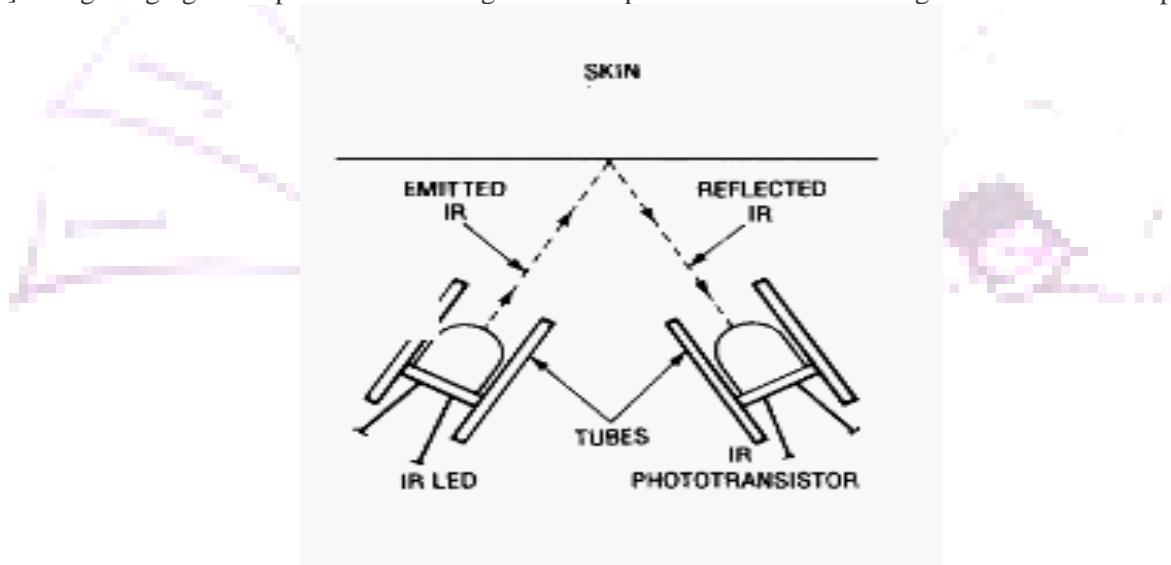


Figure1: Temperature sensor LM35.

PULSE RATE SENSOR

The main component in this work is Infrared Sensor. The heart pumps the blood throughout the body through veins and arteries. So the volume of blood in the arteries will change. This fluctuation of blood can be detected by optical sensing mechanism. So we go for IR sensor.

This sensor consists of the Infrared Light Emitting Diode (IR-LED) and a photodiode which acts as transmitter and receiver respectively. The IR LED transmits an infrared light into the arteries and the part of this light is reflected back by the blood in the arteries. This reflected light is received by the photo diode [7]. Using a high gain amplifier small change in the amplitude of the reflected light is converted to a pulse.



The number of pulses per minute is measured and this gives the pulse rate of the person.

FALL DETECTOR

Many fall detection systems use only accelerometers to detect fall but sometimes it gives false results because it uses only 3-axis to detect the fall. Hence we use a fall detector with **gyroscope** and **accelerometer**. We use MPU6050 which combines both 3-axis gyroscope and 3-axis accelerometer [6]. The accelerometer and gyroscope produce certain voltage for every change in the acceleration and body orientation of the person.

If values on the accelerometer and gyroscope exceed the predefined values then it is detected as a fall and gives an alarm. This Motion tracking device consumes less power. The main advantage is its low cost and high reliability.

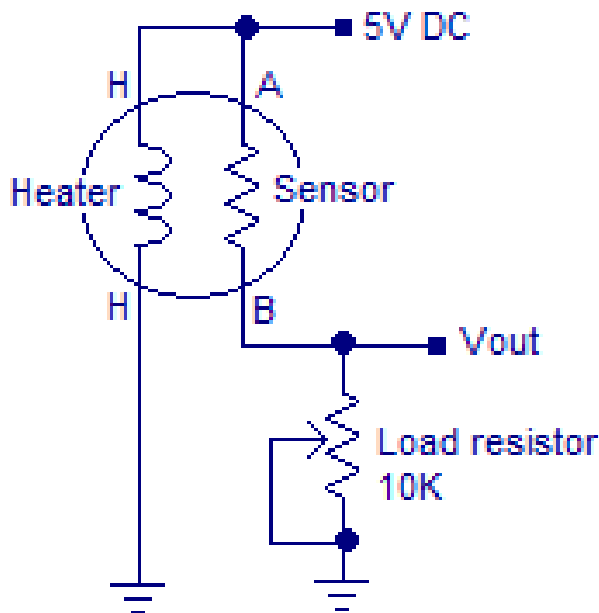


Figure 3: Fall Detector

ODOUR SENSOR:

Sanitation plays a vital role in the maintenance of human health. Improper urination and excretion leads to many problems which affect the human beings [4]. Infants have the habit of bed wetting and when it is not properly cleaned on time it leads to several diseases. Death resulting from diarrhoea are estimated to be more than a lakh every year because of poor sanitation problems.

When the person urinate, uric acid is released this is immediately converted into ammonia and carbon dioxide due to bacterial action. So the best way to detect excretion is to detect ammonia.



MQ135 gas sensor connection diagram

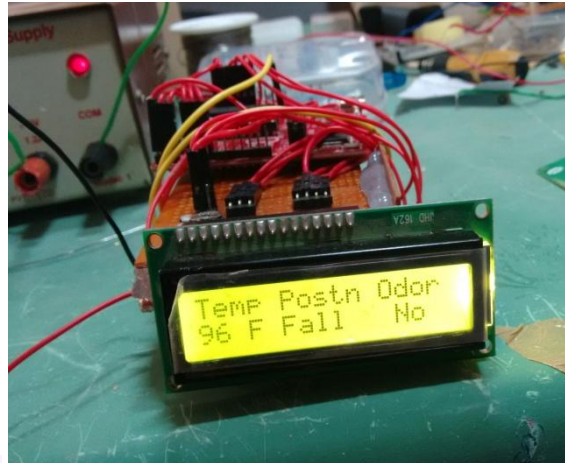
Figure 4: Gas sensor

Normally the resistance is measured at air and when the ammonia is present in the air, due to electron liberations the conductivity increases and the resistivity decreases [6]. So the change in the resistance is detected as ammonia. When the calibrated value crosses the threshold level it gives an alarm which indicates that some sanitation problem has occurred.

Table 1: Temperature and pulse rate for different age group

SENSOR	INFANT	ADULT
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TEMPERATURE	94 – 100 F	95 – 99 F
HEARTRATE(bpm)	80 – 140	60 – 100



WIRELESS MODULE

This system consists of several wireless relay nodes which are responsible for relaying the data sent by the coordinator node and forward them to control monitoring unit [2]. Before we implement this system in hardware we cross checked the output by simulating it using LabVIEW software. Among various wireless modules we have chosen ZigBee for the convenience of our project.

ZigBee

The main advantage of this system is to reduce the energy consumption to increase the network lifetime, and extends the communication coverage. Among various wireless modules we have used ZigBee for our required solution [2]. ZigBee is Wireless Networking Technology and it has an established set of specifications for Wireless Personal Area Network (WPAN) i.e. digital radio connections between computers and related devices [3]. This type of network eliminates use of physical data buses like USB and Ethernet cables. Transmitter section of this system consists of a ZigBee network which is made up of sensor nodes. This data sent by ZigBee module is received wirelessly by the other Zigbee Module at the receiver section [5]. Arduino microcontroller is used to embed the respective code in the ZigBee module. If any of the data received from a particular patient is out of range the LED starts blinking with an alarm. So the observer can immediately view the complete detail of the respective patient and takes the corrective measures.



IV. Conclusion

During the design of the circuit, great care has been taken to avoid hiccups at the final stage of the result. The objective of this project was to build a low power, low cost and reliable monitoring system that would accurately measure the vital signs. It is also easy to use and provides accurate measurements. It is being designed to save many people's life and take timely actions to prevent death and diseases.

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