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A ZigBee Based Wireless Health Monitoring System

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Abstract: The existing health monitoring systems do not have the privilege of central monitoring via wireless media .Hence the following paper proposes an advanced wireless health tracking system. This system uses the low power ZigBee wireless trans-reception technology along with an ARM based micro-controller. Vital health signs like heart rate, temperature & blood sugar level can be monitored in real time using this system. It also employs unique feature of sleep (physiological not biological) tracking with gesture monitor using an accelerometer. Monitoring is done at a central node which is connected in a Star topology with the wireless patient modules.

1. Introduction

The existing health monitoring systems in nursing homes and significant health care facilities including hospitals employ continuous collection of vital health data that is needed to be monitored by a paramedic or a doctor on a periodic basis. Such periodic checking of the data may sometimes neglect the cases of emergency. Also such offline monitoring needs to be done at the cost of much precious and expensive human resource. The vital health parameters can be collected by forming a wireless sensor network which is robust and very reliable since real-time monitoring and alarming is provided in case of any observed discrepancy or anomaly. The main goal of our system is to remotely sense the data gathered by WSN. The data gathered will be collected in a central database which will be available to a health care professional to be monitored continuously.

2. System Overview

We have hence proposed the system that consists of two parts mainly- The patient side module and the observing module of which the latter will be a database consisting of vital health related data. The hardware involved in implementation of the system uses an ARM based micro-controller –FRDM KL25Z along with ZigBee module which is created by Digi International. The sensors will send analog data that will be sensed by the ADC of the micro-controller and calibrated data will be sent over the ZigBee's wireless channel. It is decided that to make the WSN robust and simple the topology used will be Star topology where one node is connected to a central monitoring node. Fig1 illustrates the Architecture of the proposed system.

A more robust and fail proof system can be achieved by using the mesh topology. However as the system is in its early stage of development a basic star topology will be favorable for its implementation.

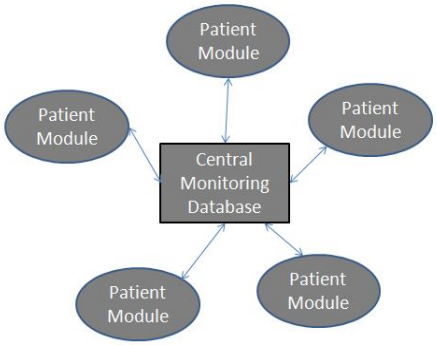


Figure 1 : System Architecture

3 Hardware and Software Description

The hardware used in the implementation of system is minimal which consists of three major components which is the ZigBee module , The ARM based micro-controller and the analog sensors. The following Section will provide some details about the analog sensors that will be used in the system.

3.1 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

3.2 Heart Rate 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 3.

3.3 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).

3.4 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.

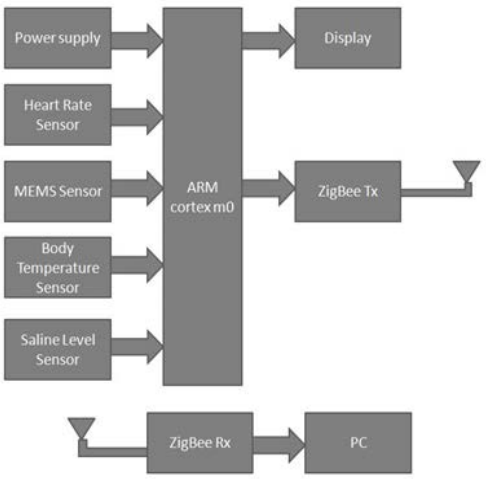
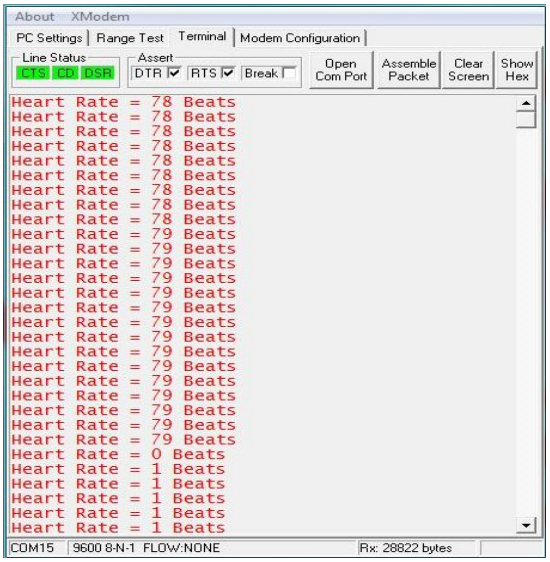


Figure2: Functional Block Diagram

4 Results

The data of one of the sensor has been calibrated and send to the doctor's computer as you can see below:



5 Conclusion

The parameter such as Body temperature, Saline level, Heart Beat, Gesture of the patients has been monitored and the data has been sent to the doctor's computer. The unit is designed from us for the patient , where a caretaker is present but is not able to be constantly in visual contact with the patient.

6 References

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