

Zigbee Based Wireless Patient Monitoring

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Abstract: Patient monitoring systems are gaining their importance as the fast-growing global elderly population increases demands for caretaking. These systems use wireless technologies to transmit vital signs for medical evaluation. This paper describes the design of a wireless sensor network based on zigbee technology using master and slave communication. It is mainly used for collecting and transferring the various monitoring information about the patients in hospitals or in their homes. This application consists of Zigbee based network, four types of sensors, master, and two submaster and slave combination. Since the whole area cannot be covered by a single Master slave combination. For this purpose a master and slave combination is used. Also the cooperative communication technique is used to make sure that the slave is always in range of the master. For this purpose two sub masters units are used. Here the main PC master terminal has the Visual Basic software on it. The PC master terminal is used to monitor the status of all the slaves which covers the whole area. Hence the transmission scheme ensures the successful transmission of these critical messages. It is fast and reliable.

Keywords: Wireless Patient Monitoring, ZigBee technology, Electrocardiography (ECG), Temperature.

I. INTRODUCTION

Now a day's wireless sensors are use for home-care systems. There are many different technologies such as Infrared, Bluetooth, ZigBee are available for transmission purpose. There are many limit problems of Infrared, so it is not use in commonly for physiological transmission purpose. Although Bluetooth is better than ZigBee for transmission rate, but ZigBee has lower power consumption than Bluetooth so it use in long term monitoring of patient. ZigBee is use for 24 hours for monitor of communication transmission system as compared to Bluetooth. ZigBee provides higher network flexibility and a larger number of nodes, and a better transmission range with low power consumption. Patient monitoring system is useful for medical practitioners to do proper and better treatment; also it is useful to improve disease monitoring. The patient is monitored from ICU and the data transferred to the PC is wired. Patient parameters such as ECG, Temperature and heart beat will be continuously transmitted and monitored through wireless technology ZigBee. A ZigBee node is connected to every patient monitor system that that consumes low power with minimum circuit requirement. To improve the accuracy and to increase the efficiency of this monitoring system Wireless Sensor Network and a central RAM microcontroller is used. The data exchange between the patient monitoring system and the microcontroller will be containing individual patient parameters like heart beat, temperature etc. The response includes the complete patient record of the patient. This technique is less expensive than other technologies such as Bluetooth.

II. SYSTEM OVERVIEW

Fig 1 shows the functional block diagram of the system hardware. The system has been designed to measure physiological parameters of human such as temperature, hear rate and detection of any fault. The inputs from the sensors are integrated and processed. The results are sending to computer ad controller which stores the data into an Access Database. The values can be displayed on

GUI running on a computer. The program is a user interface, allowing a report on current status of the patient. Once the user is connected to receiver, data is automatically updated on the screen.

The design is modular which makes it easy and state forward to monitoring other parameters. The blocks are explained in full details in a later section.

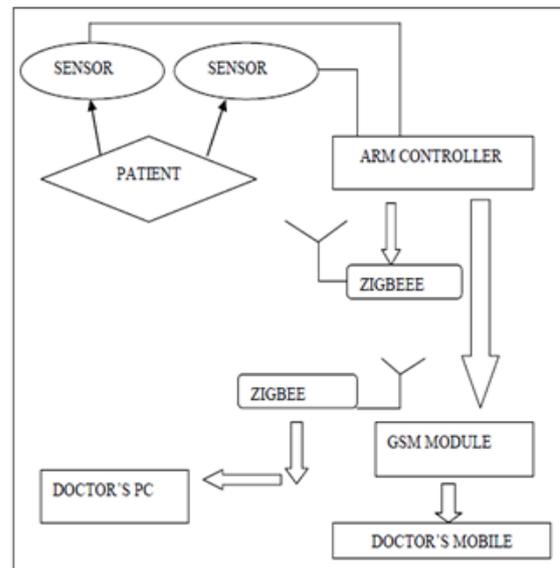


Fig. 1 Patient Monitoring Systems

A. Hardware

ZigBee is a low-cost, low-power; wireless mesh network standard targeted at wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. ZigBee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB flash memories. ZigBee operates in the industrial, scientific and medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; 784 MHz in China, 868 MHz in Europe and 915 MHz in the USA and

Australia. Data rates varies from 20 kbit/s (868 MHz band) to 250 kbit/s (2.4 GHz band).The ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level. ZigBee builds on the physical layer and media access control defined in IEEE standard 802.15.4 for low rate WPANs.

The specification includes four additional key components: network layer, application layer, ZigBee device objects (ZDOs) and manufacturer-defined application objects which allow for customization and favor total integration. ZDOs are responsible for a number of tasks, including keeping track of device roles, managing requests to join a network, as well as device discovery and security .ZigBee is one of the global standards of communication protocol formulated by the relevant task force under the IEEE 802.15 working group. The fourth in the series, WPAN Low Rate/ZigBee is the newest and provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Other standards like Bluetooth and IrDA address high data rate applications such as voice, video and LAN communications [3].

III.SENSORS

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A. ECG Sensor

An ECG sensor is the best way to measure and diagnose abnormal rhythms of the heart, particularly abnormal rhythms caused by damage to the conductive tissue that carries electrical signals, or abnormal rhythms caused by electrolyte imbalances. In a myocardial infarction (MI), the ECG can identify if the heart muscle has been damaged in specific areas, though not all areas of the heart are covered. The ECG cannot reliably measure the pumping ability of the heart, for which ultrasound-based (echocardiography) or nuclear medicine tests are used. It is possible for a human or other animal to be in cardiac arrest, but still have a normal ECG signal (a condition known as pulse less electrical activity). The ECG device detects and amplifies the tiny electrical changes on the skin that are caused when the heart muscle depolarizes during each heartbeat.

B. Title Temperature Sensor

Temperature sensor is used to sense the temperature. It can sense the temperature of the atmosphere or the temperature around it or the temperature of any machine o to which it is connected or even can give the temperature of the human body. It is an analog sensor and gives the output into form of analog signal. This signal is feed to ADC which will convert it into digital form. Once converted into analog form the microcontroller can process the digital temperature signal as per the application.

C. Pulse Rate Sensor

The pulse rate sensor is basically used to keep track on the pulse rate of the person. In programming the maximum and the minimum set point are provided for the pulse rate. If the pulse rate goes below or above the set point then the alert will be immediately issued by the microcontroller.

D. Software

These include coding for ARM 7in embedded Linux, for database in MYSQL and the GUI (graphical user interface) PC.

The basic application software architecture of the system is split into four major modules:

- Coding of ARM 7 is done in Embedded Linux. It is required for interacting with both GSM and Zigbeemodule.GSM module is required for interaction of the ARM microcontroller with the doctors mobile while Zigbee module is used for the transfer of sensor outputs corresponding to health parameters over required distance.
- The data from the patient is collected continuously and stored in the database designed using MYSQL.
- Graphical user interface is prepared on Visual Studio for processing, displaying and storing real time Patients information and maintaining a log file.

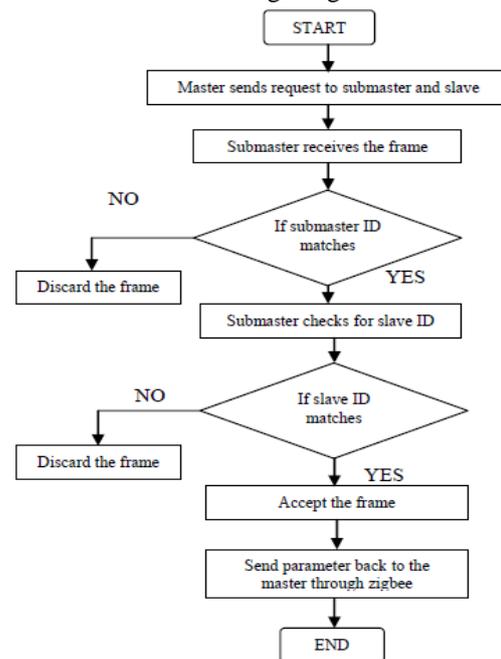


Fig. 2 Flowchart of Wireless Patient Monitoring

E. Applications

- As it is wireless device, the cost of cables is reduced here. It provides continuous monitoring of the vital signs of the patient over long periods of time until an abnormal condition is captured and hence critical situations can overcome.
- According to availability of sensors for development in biomedical trend more parameter can be sense and monitor which will drastically improve the efficiency of ZigBee system in biomedical field. Main objective of this paper is to develop a patient health monitoring system to alert the staff in the hospitals so that immediate care is provided to patients.

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IV. CONCLUSION

In this paper, we have presented the research, done to monitoring physiologically parameters such as body temperature, hear rate, ECG and body impact displayed on LCD and transmitted to the master terminal PC i.e. hospital on receiver side using visual basic software wirelessly through ZigBee. This system promotes the development of the wireless medical system and provides technological solutions to help decrease the Fetal monitoring rate. This system proposed to minimize power consumption and costing issue. It is fast, reliable and more secure.

ACKNOWLEDGMENT

I am thankful to my entire supporter to motivate me for such type of work. Also I am thankful to my whole family.

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