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Wireless Stand-alone Real Time Remote Patient Health Monitoring System

Rubina.A. Shaikh, Sajid Shaikh

Abstract: Statistics reveal that every minute a human is losing his/her life across the globe. More close in India, everyday many lives are affected by heart attacks and more importantly because the patients did not get timely and proper help . Care of critically ill patient, requires spontaneous& accurate decisions so that life-protecting & lifesaving therapy can be properly applied. This paper is based on monitoring of remote patients, after he is discharged from hospital. I have designed and developed a reliable, energy efficient remote patient monitoring system. It is able to send parameters of patient in real time. It enables the doctors to monitor patient's parameters (temp, heartbeat, ECG) in real time. Here the parameters of patient are measured continuously (temp, heartbeat, ECG) and wirelessly transmitted using ZigBee.

Keywords: Sensors, ARM7 microprocessor, GSM modem, ZigBee

I. INTRODUCTION

In the field of health monitoring the current most important user groups are those aged 40 and more. The group of 40+ users shows more diversity in their health conditions than younger people. There are ring-type pulses monitoring sensor available in the market in which the measured data are displayed in the LCD and cannot be transmitted out of the ring. Thus, it is not possible to continuously monitor the vital parameters such as temperature, pressure and pulse from a distant location. In a hospital either the nurse or the doctor has to move physically from one person to another for health check, which may not be possible to monitor their conditions continuously. Thus any critical situations cannot be found easily unless the nurse or doctor checks the person's health at that moment. This may be a strain for the doctors who have to take care of a lot number of people in the hospital. In order to keep in track of critical health conditions, a real time health monitoring system of patient based on ZigBee, GSM, and SMS is designed and developed in this project. This finds vast application in the remote places where the people are out of reach from the experienced doctors; keeping this factor in mind best effort is done to implement some of the basic test of pathological data on the system[3][5]. Hence the entire project can be broadly divided into four sections firstly, the parameters measured from the patient and transmitted, secondly the signal processing and conversion to digital form; thirdly decision making with the help of an algorithm where they obtained signal values are compared with the standard values and finally the transmission of the condition of the patient to the doctor.

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A real time health monitoring system of remote patient developed is a wearable device. This device will be wearied by the patient and parameters such as ECG, Temperature and Heart Beat will be continuously transmitted and monitor through wireless technology ZigBee [4][5].At the receiver side (doctor side) the data will be wirelessly received using ZigBee. The doctor will monitor the measured parameter on the GUI designed using Visual Basic on PC. The data from the patient is collected continuously and stored in the database designed using SQL (Structured Query Language) if the doctor is not present at that instant of time, he will be intimated through an SMS (Short Messaging Service)also the relatives will receive a message in case of abnormalities . On detecting the type of abnormality the doctor can call the patient and let him know the further course of action.

II. PROBLEM STATEMENT

Fig .1: Existing Systems

There are some shortcomings present in existing system. Currently there are number of health monitoring systems available for the ICU patients which can be used only when the patient is on bed. This system is wired everywhere. The patient is monitored in ICU and the data transferred to the PC is wired [3]. Such systems become difficult where the distance between System and PC is more. The available systems are huge in size. Regular monitoring of patient is not possible once he/she is discharged from hospitals. These systems cannot be used at individual level. The other problem with these systems is that it is not capable of transmitting data continuously also range limitations of different wireless technologies used in the systems. So to overcome these limitations of systems I have proposed a new system. This system is able to transmit the parameters of patient continuously and over long distance wirelessly [5]. Due to which we would be able attend the patient immediately. Therefore by developing a system that can constantly measure the important parameters of patient's body and which can alert the closed ones and the doctor on any time when the patient's condition gets bad, this can really provide quick service and be beneficial in saving a lot of lives.

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III. PROPOSED SYSTEM

The system which we proposed to develop shown in figure.1 would not only help in monitoring the patient when he is in the bed but also when he is not in the bed i.e. when he is mobile. Such a system would constantly monitor important body parameters like temperature, heartbeat, ECG and would compare it against a predetermined value set and if these values cross a particular limit it would automatically alert the doctor and relatives of the patient via a SMS. In such case the patient will get a very quick medical help and also would save time and energy of the relatives who would not be with them all the time.

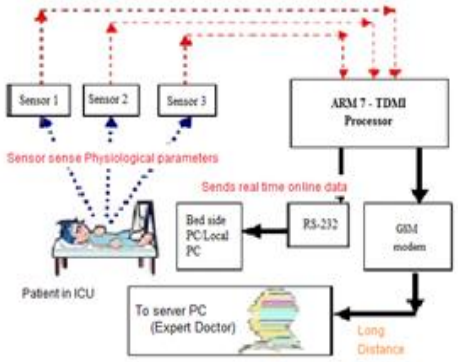

Fig .2: Proposed System

This system provides a continuous health monitoring service for patient. Temperature, ECG and Heart Beat pulse signals are measured from the temperature, ECG and heart beat sensors and are processed by a built-in ARM processor.

The processed data are then transmitted by ZigBee wirelessly. Finally the received data is sent to the PC. The graphical user interface programs on the PC are coded using Visual Basic language. In the PC a coding is written using Visual Basic for transmitting the information of any abnormal health conditions to the specified mobile number (of the doctor in charge) in the program through a GSM modem. Embedded C is used for programming the ARM processor. Using GSM modem message is transmitted to the programmed mobile number to the doctor in charge when the measured temperature exceeds the allowable value or if the pulse measured is abnormal.

1. ARM--7 Processor:

The ARM7TDMI-S is a general purpose 32-bit microprocessor, offers high performance and very low power consumption. ARM architecture is based on RISC principles, instruction set and related decode mechanism are simpler than CISC Pipeline techniques employed ARM Processor supports both 32-bit and 16-bit instructions via the ARM and Thumb instruction sets. The 3 parameters to be monitored are sensed using respective sensor and data is feed to ARM7 .Traditionally, embedded devices include two types of processors: a Microcontroller and a DSP to process signals. However, with the development of ARM processors, last two can be replaced by one single processor. This unit is the heart of the complete system. It is actually responsible for all the process being executed. It will monitor & control all the peripheral devices or components connected in the system. In short we can say that the complete intelligence of the project resides in the software code embedded in the ARM 7. The code will be written in Embedded C and will be burned or programmed into the code memory using a programmer.

2. ECG Sensor:

ECG is primarily a tool for examination of cardiac diseases. An ECG sensing device commonly consists of a group of electrodes to detect electrical events of a heart. The ECG is the electrical manifestation of the contractile activity of the heart, and can be recorded fairly easily with surface electrodes on the limbs or chest. The rhythm of the heart in terms of beats per minute (bpm) may be easily estimated by counting the readily identifiable waves. The amplifier takes the input from 3 electrodes which are connected to the patient.

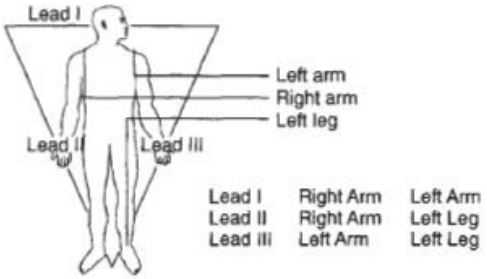

Fig .3: Three Lead ECG Measuring System

3. Temperature Sensor:-

LM35 series are precision integration-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies. This is 3 legs IC that directly gives analog output. This unit requires +5VDC for it proper operation.

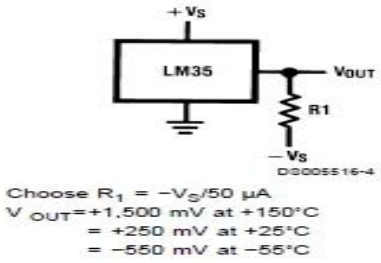

Fig .4 : IC LM 35

4. Heart Beat Sensor:-

Heart beat sensor is designed to give digital output of heat beat when a finger is placed inside it. This digital output can be connected to ARM directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

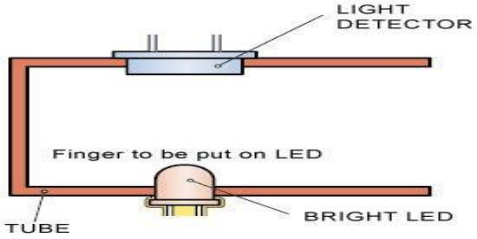

Fig .5: Heart Beat Measurement System

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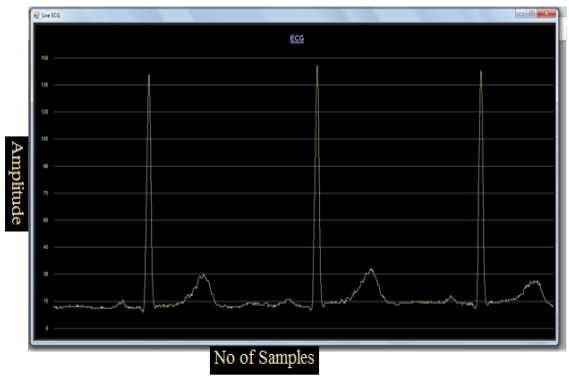
ICLM358is used for Heart Beat Sensor. Its dual low power operational amplifier consists of a super bright red LED and light detector. One will act as amplifiers and another will be used as comparator. LED needs to be super bright as the light must pass through finger and detected at other end. When heart pumps a pulse of blood through blood vessels, finger becomes slightly more opaque so less light reached at the detector. With each heart pulse detector signal varies this variation is converted to electrical pulse.

5. Zigbee:-

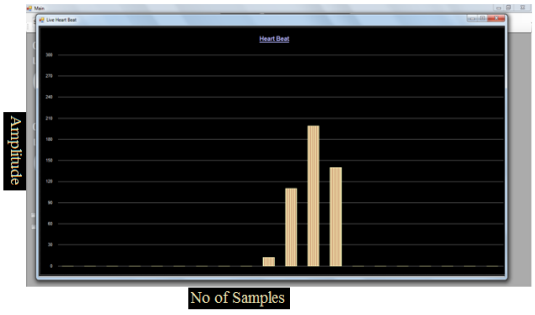
ZigBee is 'Wireless Networking Technology' and is an established set of specifications for wireless personal area networking (WPAN), i.e., digital radio connections between computers and related devices. This kind of network eliminates use of physical data buses like USB and Ethernet cables. We are using ZNet 2.5 (Series 2) modules. The XBee-ZNet 2.5 modules from Digi are more advanced than the popular XBee Series 1modules, but they require a little additional work to set up.

IV. RESULTS

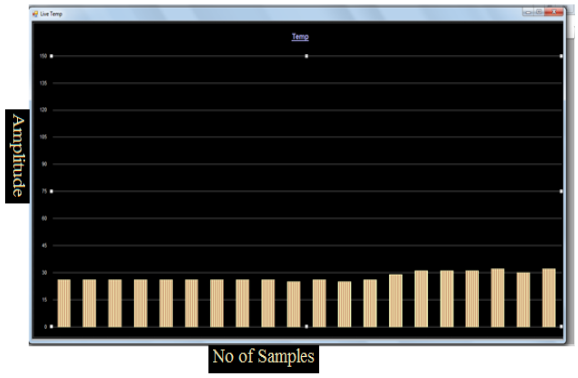
1. For ECG:



2. For Heart Beat:



3. For Temperature:



V. CONCLUSION

From the above designed project I can conclude that we are able to transmit the data which is sensed from remote patient to the server PC by using wireless transmission technology ZigBee.

Using ZigBee at receiver the data is received and displayed on the PC of doctor. Also if doctor is not present in campus he will receive SMS on his mobile phone in case any parameter of the goes beyond the normal range. The leads of the ECG sensor must be stick properly to the patient, which is nearest to the chest side of patient. So that we get more and more correct ECG.

VI. FUTURE ENHANCEMENT

There is always chance to improve any system as research & development is an endless process. Our system is no exception to this phenomenon. The following future enhancement can be done in the existing project in future:-

1. The following measurements can be done in future: Blood pressure, oxygen saturation and, Galvanic-Skin Resistance Amenia.
2. Using GPS the exact location of the patient can be detected so that help can be provided in case of emergency from nearest hospital.

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