STUDY OF BIOMEDICAL MONITORING SYSTEM

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Abstract- Care of critically ill patient, requires spontaneous & accurate decisions so that life-protecting & lifesaving therapy can be properly applied. 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 .This paper is based on monitoring of remote patients, after he is discharged from hospital. 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. There is a vast growth of VLSI technology and GSM communication in these days. This project deals about the implementation of GSM technology in Medical applications. This wireless communications would not only provide them with safe and accurate monitoring but also the freedom of movement. In this, heart beat and temperature of patient are measured by using sensors as analog data, later it is converted into digital data using ADC which is suitable for wireless transmission using paging messages through GSM modem. AT89S52 micro controller device is used for temporary storage of the data used for transmission

Keywords: Heart Beat Sensor, LM35, GSM module, AT89S52 Microcontroller. Sensors, ARM 7 microprocessor, GSM modem, Zigbee

INTRODUCTION

In this paper biomedical monitoring systems has been studied. 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.

This project is useful in medical applications and offers less cost and size than ECG (Electro Cardiogram). In the case of emergency for old people who are suffering with heart diseases continuous monitoring of the patient[1,2] is required which is sometimes not possible in the hospital, or the patient location is far away from the hospital. In such a case this prototype circuit is useful to measure the heart rate[3] as well as temperature of the person[4] and the information is transmitted to the medical advisory for the preliminary precautions so that patient can be under control, prevented from serious situation before reaching to the hospital.

A. 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.

B. 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.

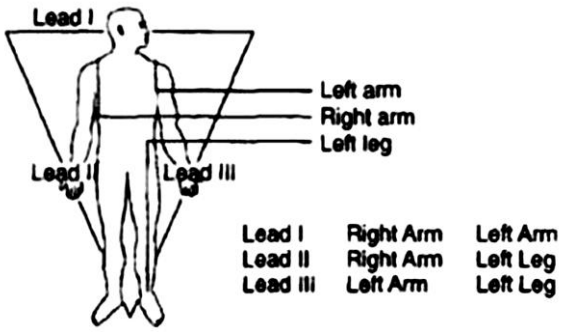
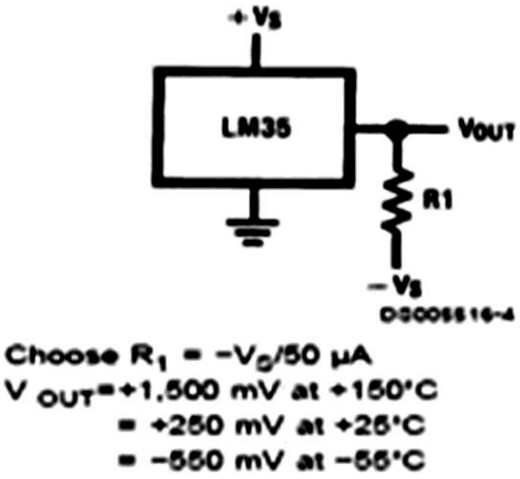


Fig .3 Three Lead ECG Measuring System

C. 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.



D. 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.

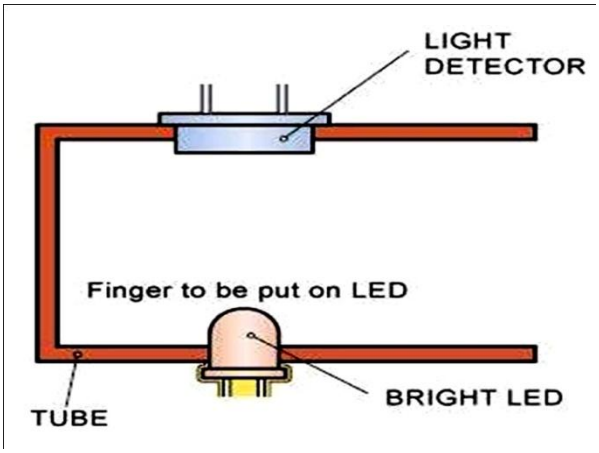


Fig .5. Heart Beat Cavity Measurement System

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.

E. 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.

GSM BASED MONITORING SYSTEM

System Hardware and Working Principle

The system majorly consists of three components like Heart rate sensor circuit5, GSM modem and MCU (AT89S52). Let us see the brief explanation of circuitry.

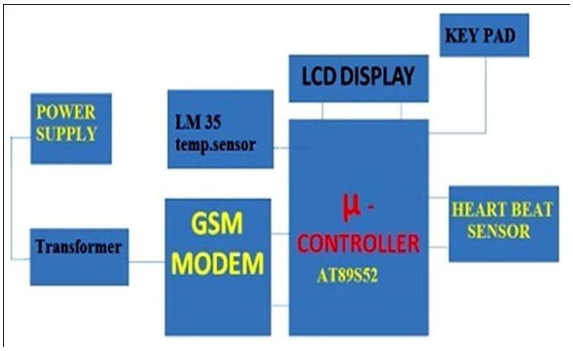


Figure-1 Block Diagram of Prototype

system majorly consists of three components like Heart rate sensor circuit[5], GSM modem and MCU (AT89S52). Let us see

Heart Rate Sensor and Temperature Unit

It consists of LED (light emitting diode) and LDR (light detection resistor) which are placed parallel to each other. LED emits IR (Infrared) rays so that, when the finger is placed in between LED and LDR so that there exists some systolic pressure [6,7]. LED emits IR rays which are travelled through finger and blood flows with arteriole pressure. Whenever systolic pressure is applied, normal pressure of blood flow is disturbed at finger tip which is high and IR rays penetrate through blood and are received by LDR. The signals are analog which are converted into digital by ADC (Analog-Digital Converter), suitable for the MCU. LM35 temperature sensor[8] is used to measure the temperature and connected to MCU. This sensor unit works under low power DC input of 5V which is controlled by a mini transformer.

Microcontroller

This system uses AT89S52 MCU[9] featuring ultra low power, small volume and high in performance and it consists of CMOS 8-bit CPU with registers A and B. It has on chip EPROM of 8Kbytes and Internal RAM (Random Access Memory) of 128 bytes. Crystal oscillator generates continuous cycles and can be reset by RST.

ALE/PROG is used to latch the address to during accesses of external ROM (Read Only Memory) and for controlling timing pulses. PSEN is activated while reading data from external memory. XTAL1 and XTAL2 are used as oscillatory input and output for controlling timing signals.

MAX232: Since GSM supports digital data transmission, MAX232 is used to convert the digital data in the serial form using parallel-in-serial-out shift registers suitable for wireless communication. UART IC chip allows the digital data transmission in the form of bits (bits per second) in asynchronous manner (characters transmission). RS232 standards are used for serial communication[9], which are not TTL (Transistor-Transistor-Logic) compatible.

GSM: GSM is abbreviated as Global System for Mobile Communication10. GSM modem has a slot for inserting SIM (Subscriber Identity Module). GSM network contains Mobile Station, Base station subsystem and Network subsystem. Mobile station contains IMEI number and SIM has IMSI number. Base station subsystem contains Base Transceiver Station which has antennas for communication and Base Station Controller which controls multiple base stations. Network subsystem contains

VLR (Visitor Location Register), HLR (Home Location Register), AuC (Authentication Center) and EIR (Equipment Identity Register). MSC (Mobile Switching Center) is the major part which is the gate way for communication between mobile station and PSTN. HLR stores the information about the subscriber and the current location of subscriber. VLR provides the services to the subscribers of HLR who are visitor users. AUC gives the security of the user and to identify the location of the subscriber. EIR is also for security purpose and to identify the mobile station. MAX232 is connected to GSM modem so that it is useful for serial data transmission. OSS (Operation Support System) is used to control the traffic of users.

SMS at Commands: In order to communicate with the GSM modem we have a special set of commands called SMS AT- Commands.

AT+CMGD	Delete SMS Message
AT+CMGF	Select SMS Message Format
AT+CMGL	List SMS Messages
AT+CMGR	Read SMS Message
AT+CMGS	Send SMS Message
AT+CMGW	Write SMS Message To Memory
AT+CMSS	Send SMS Message From Storage
AT+CMGC	Send SMS Command
AT+CNMI	New SMS Message Indication
AT+CPMS	Preferred SMS Message Storage
AT+CRES	Restore SMS Settings
AT+CSAS	Save SMS Settings
AT+CSCB	Select Cell Broadcast SMS Messages
AT+CSDH	Show SMS Text Mode Parameters
AT+CSMP	Set SMS Text Mode Parameters
AT+CSMS	Select Message Service

LCD: LCD is a liquid crystal display[9] and there are 14-pin and 16-pin displays. Among them 16-pin display is used which has additional features than 14-pin like background color transition and more than 80 characters are displayed. RS pin resets the display after some delay, 4 data lines are connected to MCU.

Software: Initially after switch on the hardware circuit we designed, program variables are initialized, LCD is initialized[9] by using cmd_lcd( ) and GSM modem is initialized using (AT+CMGF) command. On the LCD we get the message as "CHECK HB/Temp". After pressing the Reset Switch the Heart beat and Temperature calculation takes place. Heart beat sensor gets the beats count for 10sec and converts it beats per minute value (bpm) by using the formula mentioned below

Count = 6 * Count/ / it is a heartbeat in bpm

In order to get the accurate value of heart beat, we've measured three readings and displaying the average value of three readings on the LCD.

Simultaneously the hardware we designed calculates the body temperature of the concerned patient in ^{o}C (Celsius)

Finally the measured readings of Heartbeat and Temperature are sent to the concerned medical expert by using AT+CMGS command[10].

After sending sms, on the LCD we obtain the message as "message sent".

CONCLUSION

By using this prototype circuit containing AT89S52 MCU, GSM Modem, LCD and other hardware circuit so that the page messages can be transferred at fixed time intervals to the corresponding medical expert to give necessary precautions to take care about the patient. This system has the following features: i. AT89S52 MCU consumes low power with suitable devices for interconnection. ii. Auto alarm system is provided which sounds only when the reading exceeds or reduces than the normal level. iii. Continuous monitoring of patients is done which is simple by using GSM network.

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