



Monitoring various health parameters using wireless technology

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ABSTRACT

Health telematics can play a major role in improving the lives of patients, particularly in the weaker sections of the society including disabled, elderly and chronically ill patients. However, mobile health-monitoring devices offer great potential help for such patients who may be able to afford good healthcare without having to regularly visit their doctor. These technologies bring potential benefits to both patient and doctor; doctors can focus more on priority tasks by saving time normally spent with consulting chronically ill patients and patients can move about in their environment without having to make extensive trips to the doctor – especially if they reside in a remote location.

Due to the advancement in the wireless technology, new emerging smart phone, the application of the phone is not limited to only voice communication or SMS sending. Due to the reduction in the cost of SMART Phone everyone is having mobile so we can use smart phone to monitor the health of the person.

The concept of the project taken from Telemedicine. It is a rapidly developing application of clinical medicine where medical information is transferred through interactive audio-visual media for the purpose of consulting, and sometimes remote medical procedures or examinations.

Care at a distance (also called in absentia care), is an old practice which was often conducted via post. There has been a long and successful history of in absentia health care which, thanks to modern communication technology, has evolved into what we know as modern telemedicine.

Keywords: Mobile health monitoring; Smart phones; Network; Telemedicine.

I. INTRODUCTION

Mobile Patient Monitoring with Positioning System is a model which can incorporate different sensors to measure various parameters of a body like Temperature, Heart Beat rate, Co₂, Blood Glucose, ECG Etc. 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. There are many emergency response services striving hard to save the lives

of people during emergencies, though they are successful at few times. But sometimes they fail to race against time

to reach the victim. All over the globe, emergency response service is the need of the hour. India has the highest incidence of heart related diseases in the world and the number of those affected is likely to double in the coming years. If no initiative is taken to check the disease, the most predictable and also preventable among all chronic diseases, India will have 62 million patients with heart disease. And in the future what if due to lack of urgent service we are not able to save the patient? The answer to such a problem is that the patient needs to be "monitored constantly". 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 when he is not along with them, this can really provide quick service and be beneficial in saving a lot of lives. We have made a prototype of an automated electronic system comprising a Bluetooth module and ARM 7LPC 2148 microprocessor which is capable of measuring the Body Temperature and Heart Beat and Carbon dioxide (Co₂) of a moving Patient no matter where the patient is and in case of emergency sends wireless plea for the rescue/emergency help. This gives an advantage when compared to the wired system in the view that the doctor can get immediate information about the parameters as well as location of the patient so that instant medication can be provided. Thus the system helps in tracking down the patient without getting the patient into any sort of communication. Undue mishaps can be avoided within the golden hours after a patient is struck with a heart attack.

II. BACKGROUND OVERVIEW

Mobile based Primary Health Care Management System - CDAC, Electronics City, Bangalore has initiated the development of "Mobile based Primary Health Care Management System" for deployment in the PHCs for betterment of management of Primary Health Care specifically in the rural and urban slums of India. The system will capture of complete information related to an individual patient treated by a PHC. The Software components under development are Patient Database management, Interaction between doctor and a patient,

capture of Medical data acquisition- such as ECG, images of heart & lung, eye etc and Scheduling management. The project involves development of the following:

- A Web based Information system for Management of Primary healthcare.
- SMS interface for integrating SMS messages from the patients using 2nd Generation mobile systems (GSM/CDMA) with the Information system.
- WAP Gateway for Web access Applications using WML for integrating 3G/4G Mobile devices of Doctors and Nurses with the Web server.
- Development of Localization Support to National and other Indian languages in mobiles by providing interface for translation.

A. Remote Patient Monitoring in China

- A low cost, real-time patient monitoring platform designed to improve the current medical services in China's community healthcare system for the (Bottom of the Pyramid) BOP Population is basically implemented through community and village doctors (C/VDs).
- In this project data is gathered by the sensor unit and transmitted to the server through a medical hub. The data is then stored in the server and displayed in the Medical Assistant's (MA) system. C/VDs analyze the data with available functions and make the preliminary diagnosis while requesting assistance for remote consulting with specialists located in higher-tier hospitals.
- Data collection using mobile technology was found to be implemented using SMS, voice, and electronic forms. Increasingly, as mobile technology advances, GPS information is being used to tag data to specific locations. Further studies are required that investigate the effectiveness of different data collection methods using mobile phones.

B. Problem definition

In the existing system, it is difficult to keep track on abnormalities in heartbeat count for patient itself manually. The average heartbeat per minute for 25-year old ranges between 70-120 beats per minute while for a 60-year old it is typically between 115-140 beats per minute and body temperature is 37degree Celsius or 98.6 Fahrenheit. Patients are not well versed with manual treatment which doctors normally use for tracking the count of heartbeat. So there must be some device which would help patient to keep track on their health by themselves. There are various instruments available in market to keep track on internal body changes.

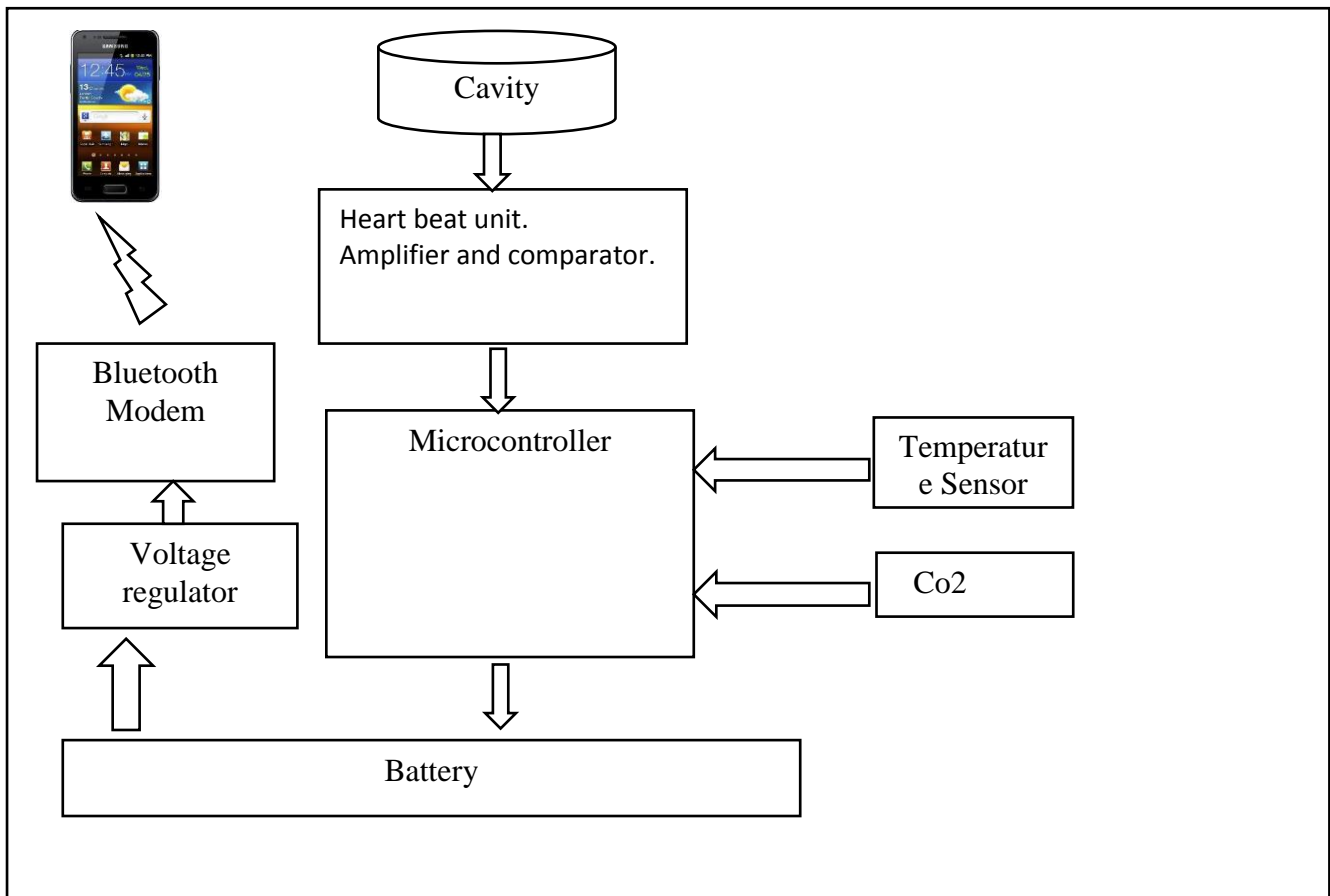
But there are many limitations regarding their maintenance due their heavy cost, size of instruments, and immobility of the device. Because of which the patient cannot keep their continuous health track when they are mobile. Most of the existing systems make use of wired communication which becomes too tedious for long distances. Such systems are more prone to errors. Wired monitoring system requires maintenance very often which is costly. The existing systems make use of latches to acquire data and at a time only one latch is used for each parameter. As the number of parameters to be acquired increases, the number of latches increases, due to which the processing speed of the system decreases. This tends to be a drawback in real time applications. Also the hardware complexity increases with the increase in the number of latches.

C. Proposed System

In our system we are using voltage regulator IC Arm7 LPC 2148 Processor, Bluetooth Modem (RN42A), Temperature sensor (LM35), Heart beat sensor, Co2 Sensor (MQ 135), Voltage Regulator IC, LCD 16x2 and Battery. We are using 8 volt battery which is directly connect to diode. switch and IC 7805 which regulates the voltage to 5 V which is input voltage to LCD 16x2, LM358 heart beat sensor, and co2 sensor.

III. THE PROPOSED SYSTEM

The implementation of the system has been described using block diagram and Algorithm for microprocessor Programming and Algorithm for mobile software programming as follows:



A. Explanations of Blocks

The following are the brief explanations of the working principle of the various major blocks or sections used in the system.

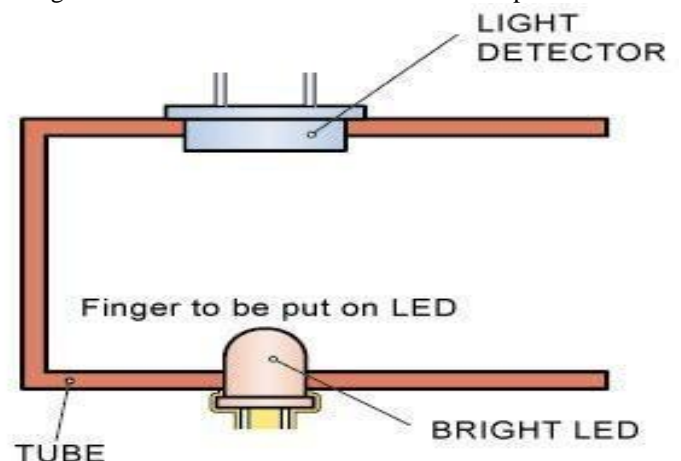
• ARM processor

ARM is a general purpose 32-bit microprocessor. The parameters to be monitored are sensed using respective sensor and data is feed to ARM. 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 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 is written in Embedded Linux and is burned or programmed into the code memory using a programmer.

• Heart 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 each pulse. ICLM358 is used for this 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 reach at the detector. With each heart pulse, the detector signal varies which is converted to electrical pulse.



• 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 three legs IC that directly gives analog output. This unit requires +5VDC for it proper operation

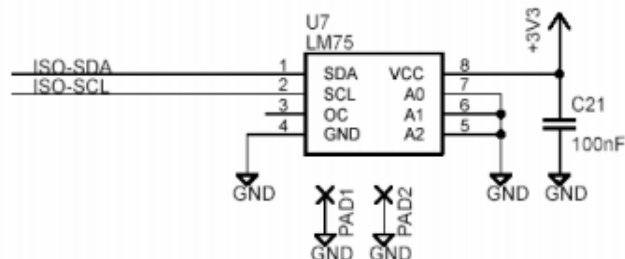
• **Co2 sensor**

Air quality sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-135 have 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current

The interface is very simple; a LM75 temperature sensor is connected to the I2C interface. Note that the jumpers on J25 must be mounted to connect the I2C interface with the LPC2148.

• **Bluetooth Modem**

Bluetooth Modem is a device that acts as mediator between any embedded system and the Bluetooth communication, medium. It has built-in protocol for serial communication i.e. Serial Port Profile. Thus it provides an ideal solution for developers who want to integrate Bluetooth wireless technology into their design with limited knowledge of Bluetooth and RF technologies. This unit requires +3.3VDC for it proper operation



• **LCD 16x2**

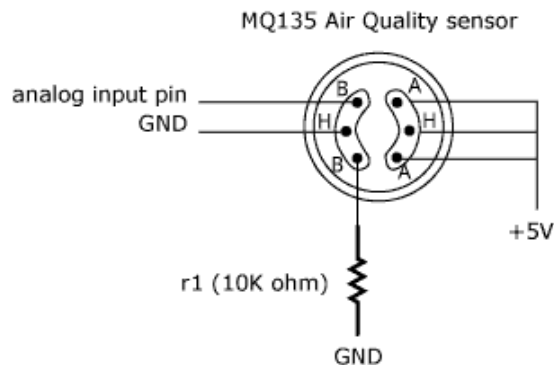
It is called Liquid Crystal Display. We are going to use 16x2 character LCD. This will be connected to microcontroller. The job of LCD will be to display all the system generated messages coming from the controller. LED will provide interactive user interface. This unit requires +5VDC for it proper operation.

c). **Arm7 processor with Co2 sensor**

Its Working voltage is DC 5V Working with Current 150mA. Preheat time of MQ135 is over 20s and dimension is 32mm x 22m x 27mm (HIGH 27mm). Below figure showing is connections of MQ135.

• **Power Supply**

This unit will supply the various voltage requirements of each unit.

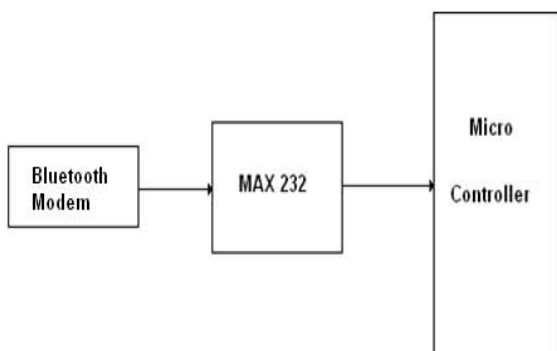


B. **Hardware Interfacing**

- a) Arm7 processor to Bluetooth module.
- b) Arm7 processor with Temperature sensor (LM35)
- c) Arm7 processor with Co2 sensor
- d) Arm7 processor with Heat beat sensor unit.
- e) Arm7 processor with LCD

a) **Arm7 processor to Bluetooth module.**

Bluetooth technology handles the wireless part of the communication channel, it transmits and receives data wirelessly between these devices. It delivers the received data and receives the data to be transmitted to and from a host system through a host controller interface (HCI). The most popular host controller interface today is either a UART or a USB. Here, I will only focus on the UART interface; it can be easily show how a Bluetooth module can be integrated on to a host system through a UART connection.

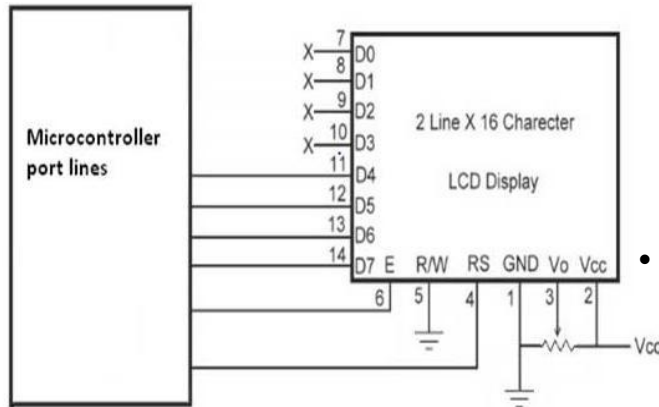


d). **Arm7 processor with Heat beat sensor unit.**

By placing the finger in between a LED and LDR, we can detect the pulses of heart, the analog voltages are further processed with all operational amplifier LM358, and this chip has two built in OPAMPs. One will act as amplifiers and another will be used as comparator. The output of comparator will be fed to the microcontroller. This unit requires +5VDC.

e). **Arm7 processor with LCD**

The 2x16 character LCD interface card with supports both modes 4-bit and 8-bit interface, and also facility to adjust contrast through trim pot. In 4-bit interface 7 lines needed to create 4-bit interface; 4 data bits (D0 – D3), three control lines, address bit (RS), read/write bit (R/W) and control signal (E).



powerful, integrated environment in which to build Android applications. ADT extends the capabilities of Eclipse to let the Developers quickly set up new Android projects, create an application UI, add packages based on the Android Framework API, debug their applications using the Android SDK tools, and even export signed (or unsigned) .apk files in order to distribute their applications.

C. Features

The Following are the prominent features of the above discussed system...

- Two level of data protection i.e. Hardware & Software,
- Password Protected Storage,
- Password based Encryption,
- Data can be retrieved only with the same hardware software combination along with both passwords,
- No system can detect the existence of data on the SD/MMC card.
- No change in the blank space shown by the operating system- hence no one can predict if there is some information on card or not.

D. Technology & Programming Languages

Software to be used:

- KEIL Software
- Eclipse
- J2ME (Java 2 Platform Micro Edition)
- Eagle software

• Keil Software

Keil is a cross compiler.

Keil ARM tool kit includes three main tools, An assembler is used to assemble your ARM assembly program connected in the system A compiler is used to compile your C source code into an object.

0 is +10V.This unit will provide interface that is required to communicate microcontroller with RS232 based devices using serial communication link A linker is used to create an absolute object module suitable for your in-circuit emulator.

ARM project development cycle Using Keil

- Create source files in C or assembly.
- Compile or assemble source files.
- Correct errors in source files.
- Link object files from compiler and assembler.
- Test linked application

• Eclipse

Android Development Tools (ADT) is a plugin for the Eclipse IDE that is designed to give The Developers a

• J2ME (Java 2 Platform Micro Edition)

J2ME is the short form for Java 2 Micro Edition. J2ME is meant for tiny devices such as mobile phones, TV set top boxes, Vehicle telematics, pagers, PDAs etc. There are many differences between J2ME and other Editions of Java. The reason being the target devices of J2ME are very much different from the Computers

• Eagle software

The Eagle PCB layout software enables you to produce a schematic, turn this schematic into a PCB board, and, optionally, have an auto router lay out the signal traces on the PCB for you.

Steps:

- Creating a schematic file
- Creating of a board file
- Auto routing
- Making Custom Parts

E. Project Development Methodology or Steps

Algorithm for microprocessor programming:

- Initialize all the system variables
- Initialize ADC and Bluetooth modem
- Select appropriate ports for the reception of digital signals representing temperature and heartbeat
- Store the value of temperature in a variable
- Wait for the pulse and when encountered, collect 5 consecutive pulses and measure the delay between them
- Average the value from the pulses and store the average value as the heart-beat measured.
- Display the values on LCD screen
- Create a data packet and send the data to the mobile phone using Bluetooth modem.

Algorithm for mobile software programming:

- Initialize system variables
- Create a GUI for mobile user
- Connect to Bluetooth using JSR-82
- Connect to SMS server using JSR-120
- Get GPS data using JSR-179
- Wait for data packets containing information to arrive
- If data packets found, display them on the screen
- Check for the limit value set for both the kinds of data
- If limit value is crossed, the GPS co-ordinates should be fetched
- Create an SMS packet containing Heart-beat, Temperature, Longitude and Latitude
- Send this SMS to Family member/ Doctor

IV. SCOPE & APPLICATIONS

This technique presents a system to upgrade existing health monitoring systems in the hospitals by providing monitoring capability and a thus a better cure. This system is based upon wireless technology i.e. Bluetooth module using cell phone providing low cost effective solution. 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 be overcome. This intelligent monitoring system provides long term monitoring capability useful for the staff in the hospitals and reduces their workload. Future work may include more number of sensors in a single system to provide flexibility.

Hence the main goal 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.

V. RESULT AND ANALYSIS

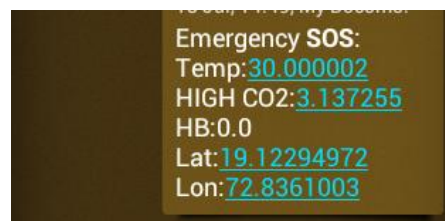
According to Strategy Analytics' latest report, Android is getting dangerously close to worldwide dominion with a record 80% of all smartphone running the mobile OS. As we developed an Android based system, it becomes much easy for us to have a constant eye on your health.

The main aim of any health application is simply motivate you towards maintaining a healthy and good health. If you get motivation towards your goal, it becomes easy for you to achieve your goal. We provide very friendly GUI over the application developed. Which will help patient to keep track of temperature, Co2 and heartbeat. As previously stated it will send as instant message to your Doctor and family in case of any anomaly observed. Using Android application we can easily informed Doctor with all the accurate real time data using SMS service of our service provider. Below are the examples of auto generated messages when the readings crossed set limit. Developed system not only provide the real time data of monitors but also provides the exact location of patient with accurate latitude and longitude.

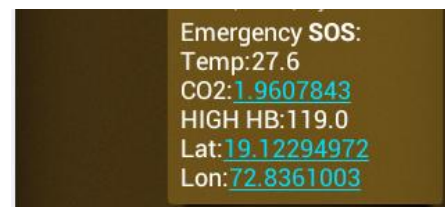
1. In case of high temperature



2. In case of high Co2 :



3. In case of high heart beat observed.



1. ADVANTAGES OVER EXISTING SYSTEM.

Easy and Reliable for Doctors: 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.

Increase efficiency: The number of nurses required for keeping a check on patients in ICU can be reduced to a large extent

Future work may include more number of sensors in a single system to provide flexibility. Hence the main goal 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

VI. CONCLUSION

From the above designed project we can conclude that we are able to transmit the data which is sensed from remote patient to the doctor's Cell phone by using wireless transmission technology. Using Cell phone at receiver the data is received and displayed on the Doctor's Cellphone. Also, if doctor is not present in campus, he will receive a SMS on his mobile phone in case any of the parameter 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. All other sensors should also be calibrated properly for precise measurement of parameters and in order to facilitate immediate action by the doctor to provide proper medication and treatment to the patient in case of any emergency situation

Features

The staying of specialist is eliminated.

- It is a multipurpose so that overall conditions are easily measured.
- Easy to operate.
- Compare with compact sensor it gives better performance.

- Modern technologies have developed that promotes comfortable and better life which is disease free.
- PREVENTION IS BETTER THAN CURE

Future Modifications

Along with Heart Beat and Temperature many new parameters can get incorporated in this system which will only give more importance to the project and its implementation.

So the parameters along with their reason for implementation are given below:

Pulse Oximeter Introduction: The Pulse oximeter is a medical instrument for monitoring the blood oxygenation of a patient. By measuring the oxygen level and heart rate, the instrument can sound an alarm if these drop below a pre-determined level. This type of monitoring is especially useful for new born infants and during surgery. This implementation of a single chip portable pulse-oximeter is possible using the ultra-low power capability of the Microcontroller. Because of the high level of analog integration, the external components can be kept to a minimum. Furthermore, by keeping ON time to a minimum and power cycling the two light sources, power consumption is reduced.

ECG: Electrocardiography (ECG) is a interpretation of the electrical activity of the heart over time captured and externally recorded by skin electrodes. It is a noninvasive recording produced by an electrocardiographic device.

Diabetes (Blood Glucose Monitoring): Blood glucose monitoring is a way of testing the concentration of glucose in the blood (glycaemia). It is particularly important in the care of diabetes mellitus which is a condition in which a person has a high blood sugar (glucose) level, either because the body doesn't produce enough insulin, or because body cells don't properly respond to the insulin that is produced. Insulin is a hormone produced in the pancreas which enables body cells to absorb glucose, to turn into energy. If the body cells do not absorb the glucose, the glucose accumulates in the blood (hyperglycaemia), leading to vascular, nerve, and other complications.

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