IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Vol. 3, Issue 6, June 2016

MICROCONTROLLER BASED PATIENT MONITORING SYSTEM USING WIZnet

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***Abstract*—The goal of this project is to continuously monitor the patient condition anytime, anywhere and inform to doctor by wireless communication. For a single doctor it is difficult to attend many patients and it is cumbersome job to keep informed the condition of each patient continuously. Which require manpower and moenypower and sometimes result may go wrong. The project provides a embedded device which will continuously monitors the medical parameters (electrocardiogram ECG, body temperature, blood pressure etc...) of patient and store the data to flash memory continuously. If patient condition is abnormal which requires doctors assistance then the device raises an alarm and communicates to doctor by sending notification on the webpage. Hence patient monitoring can be extended beyond the single hospital. This is the core technology for healthcare at home or mobile application with low cost and expert can monitor patients progress with ease of convenience and also reduces number of visits.**

***Keywords*—sensors, WIZnet module, ECG signal, Microcontroller**

I. INTRODUCTION

The heart pumps about 2000 gallons of blood each day and beats 100,000 times for a normal person, depends on age, lifestyle and gender of person. In abnormal condition of patient, heart loses its rhythm called arrhythmia [4]. If electrical impulses generated too fast (tachycardia), too slow (bradycardia) or murmurs present then it is abnormal function of heart. This abnormal function of heart can be displayed or raises an alarm. Arrhythmia can be detected by embedded software. [4]

Heart activity is regulated by electrical impulses across the cellular membrane, due to difference in charge between inside and outside muscle cells. When blood is pumped by atria and ventricle contraction and expansion then it produces electrical pulses.[5] We are going to acquire this pulses via sensors and show it on LCD display and store the record in flash memory as well.

The device is mainly distributed in four parts: sensors, microcontroller, display keyboard unit and WIZnet module for data transmission. From all the parts of the device microcontroller unit is the heart of entire system. Sensors are used to take the patients response and convert it into electrical data. Keyboard is used to enter patient ID or to change the mode etc Display continuously shows the task performing, time, temperature and other details. WIZnet module is used to transmit the data to the web server by wireless or Ethernet communication. We can able to connect the number of devices via LAN network and monitor the patient in control room.

II. BACKGROUND

Lot of research is done on this topic and going on from many years by some reputed organizations. But we have to pay attention to wireless transmission of patients information to the experts.[3] ECG monitoring Bio-shirt (in 2005) wearable device, which detect ECG and acceleration signals in exercise situations such as marathon, and signal was stored in the memory of device or transferred wirelessly to the web server. There were many garment type wearable devices like outdoor jacket, dress etc available. This project is similar to this but with the low cost and for both home and hospital use.

III. ECG MEASUREMENT

It measures hearts electrical activity from the body surface of patient. Heart performs function of pumping blood through circulatory system.[3] Typical ECG consist of 12 leads or 15 leads and 3 leads. In our project, three leads provide the accurate indication of projection of cardiac vector at which one connected at each of three vertices of Einthoven triangle.

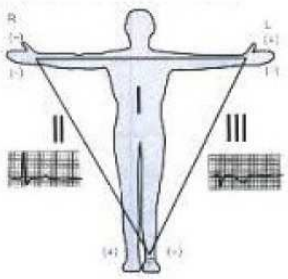

Fig. 1. ECG Einthoven triangle

Einthoven's triangle is an imaginary formation of three limb leads in a triangle used in electrocardiography, formed by

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the two shoulders and the pubis. The shape forms an inverted equilateral triangle with the heart at the center that produces zero potential when the voltages are summed. It is named after Willem Einthoven, who theorized its existence.

Lead-I : Potential between right arm(RA) and left arm (LA)

Lead-II : Potential between right arm(RA) and left leg (LL)

Lead-III: Potential between left arm(LA) and left leg (LL)

IV. BLOCK DIAGRAM

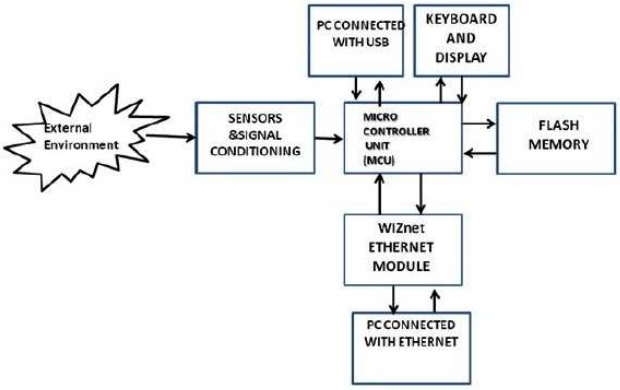

Fig. 2. Block diagram of Patient Monitoring System

A. Sensors

1) ECG Measurement Sensor
2) Temperature sensor
3) Blood pressure sensor

We are using 3-lead Einthoven triangle sensor as explained. LM35 temperature sensor and Pressure Transducer (Honeywell ASDX 015PDAA5) to measure blood pressure.
All the electrodes of sensors are properly connected to the body of patient. This electrode converts ionic signals from human body into electrical signals. Since the data transmission is wireless patient is free from large cables and instruments near him.

B. Signal Conditioning

The ECG requires the (I.A.) amplification and filtering to provide the enhanced signals. [3] ECG amplifier consist of Low pass, High pass, Instrumentation and notch type filters. The unwanted frequencies in ECG signal are removed by LPF and HPF. The noise due to power lines is rejected by notch filter.

C. Keyboard Function

We are implementing a project which has inbuilt alarm and clock. For the patient it is essential to take medicines time to time for quick recovery. Hence we are designing inbuilt clock and alarm which can be set by patient very easily. To enter the patient ID alphanumeric characters are required but we are restricted to cost and size of the device. So the keyboard is multiplexed by using different mode operation in column 3. We are using 16 key 4*4 matrix keyboard but to increase the number of keys to operate we are using LET mode. So we developed 16 key keyboards into 52 key keyboard but which increases burden on the processor and user.

No. 1 _AB	No. 2 CDE	No. 3 FGH	LET 1 (LET 1+ No. takes 1st letter)
No. 4 IJK	No. 5 LMN	No. 6 OPQ	LET 2 (LET 2+ No. takes 2nd letter)
No. 7 RST	No. 8 UVW	No. 9 XYZ	LET 3 (LET 3+ No. takes 3rd letter)
TIMER EDIT 1. Check temperature 2. Check ECG signal 3. Check B.P.	No. 0 -@#	Emergency 1. Enter Patient ID 2. Enter Treatment 3.Send Report to Dr.	Control Room 1. Clock and Alarm 2. Room cleaning 3.

Fig. 3. Keyboard Functions

D. LCD Display

In this project we are using 16 *4 LCD display. LCD display can display maximum 64 characters in 4 lines with maximum 16 characters on each line. LCD continuously displays the body temperature of patient and time. LCD also displays the task performing and key press.

E. Flash Memory

Flash memory is used for data logging. Microcontroller stores and restores the data to flash memory. The data from the flash memory is also transferred to the PC via USB.

F. WIZnet Ethernet/Wi-Fi Module

The WIZNET module is an integrated circuit with a built in hardware tcp/ip stack, hence making it easy to develop any web or socket based (active/passive) application without the need to implement any type of TCP/IP model or OSI models using software. By simple socket programming data can be transferred to the web server. The web server can be designed by using LabVIEW.

G. Microcontroller Unit

The selection of microcontroller is very important in this project. We have to consider the cost, burden on processor, ease of programming, processing speed etc trade off of the processor to speed size and cost is difficult job. We have planned to use silicon labs C8051F340 8-bit microcontroller because of special features in it. Some ideal features of these controllers are USB, SPI, I2C, ADC 200ksps, temperature sensor, all are inbuilt and also consists of 5 ports hence ideally suitable for our application but coding is cumbersome job. For the easy coding we can switch to arduino controller as well.

H. Microcontroller Processes

1) Collect data from sensors through ADC.
2) Run Clock with alarm.
3) Store and restore data to/from flash memory.
4) Display task performing, time and temperature continuously.
5) Send data to USB if required.
6) Execute keyboard functions.
7) Keyboard scanning and bouncing

DOI 10.17148/IARJSET.2016.3636

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V. FLOWCHART

following figure shows the flow of model from user end.

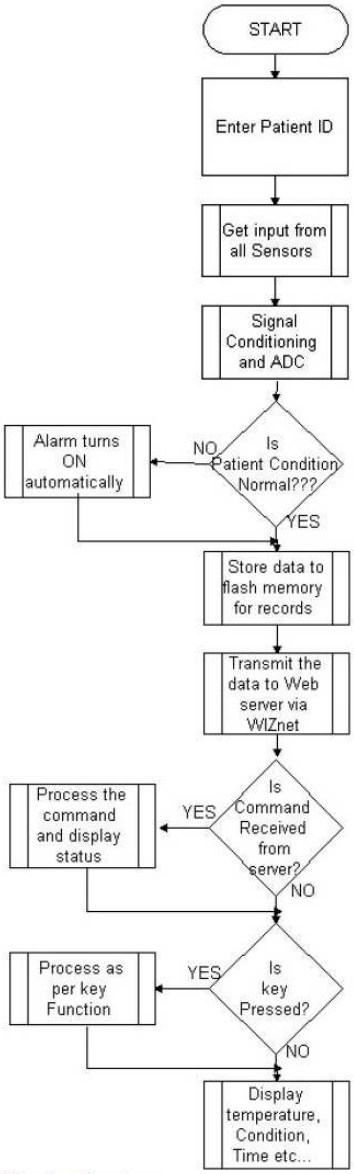

Fig. 4. Flowchart

VI. DESIGN CHALLENGES

Sensors are designed for patients to wear while pursuing normal daily activities, so the sensors should be small and light weight as possible. Selection of microcontroller as it performs number of tasks burden on the processor is huge.

As the project deals with the medical application reliability should be a very important aspect.

CONCLUSION

More number of sensors could be added so that it ideally suits for ICU patients. As technology improves patient monitoring system becomes smaller and powerful. Such a monitor would be better service to patients and ready information for doctors. We are working on WIZnet which is operating system less module. It consists of hardware protocols of TCP/IP, by simple socket programming we can code the module and transmit the data via ethernet easily and efficiently.

The system monitors status of all patients continuously in control room with the help of IP address allocated uniquely for each patient through ethernet. So number of visits of doctors reduced which saves the valuable time of doctors, So that remaining patients will get quick treatment. This project can further enhanced or improved by adding extra parameters like oxygen percentage in blood.

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