

Wireless Reliable Embedded System for Patient Monitoring

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ABSTRACT

Care of critically ill patient requires prompt & accurate decisions so that we can protect as well as save the life. Due to such requirements, ICUs have become widely established in hospitals. In most hospitals difficulty is that expert has to regularly visit the patient & assess his/her condition by measuring different parameters. These systems work when there is any emergency by using different wireless technologies. This paper is mainly based on continuous monitoring aspect of home patients. This requires a reliable, energy efficient patient monitoring system that can be able to send parameters of patient in real time. So the doctors can monitor patients parameters easily (temp, Pulse rate, Blood Glucose). The major goal of the final proposed system is that it detects processes and sends patients data (temp, Pulse rate, Blood Glucose) over a wireless.

General Terms

Diabetes, Temperature, Pulse Rate.

Keywords

Blood Glucose, Real time, wireless technology, Glucometer Syringe pump.

1. INTRODUCTION

There is extensive interest in using wireless technologies in patient monitoring in various environments including hospitals and nursing homes. Due to wireless technology it provides superior treatments to patients though they are physically not present in hospital. This system is more useful for elderly people as they are more prone to chronic diseases and need continuous health monitoring. Now a day there are different products are developed which supports the wireless health monitoring system. They provide real time current health condition of patient to doctor immediately [5]. The System offers faster, reliable, effective and cost saving therapy so it becomes more popular. The system requires three key aspects: accessibility to information, convenience of use and cost effective. [6]

The sensors are fitted on patient's body to collect body parameters like pulse rate, body temperature, blood glucose [5]. From these sensors the signal is transmitted to personal computer, microcontroller. The wireless or wired transmission is used for communication between sensors and PC. The collected signals are transmitted to doctor or hospital for further analysis. And accordingly medical treatments are given to patients.

In home patient monitoring system needs to satisfy the criteria like the size and weight of the wearable devices which needs to be small and should not affect the daily activities of the patient [1]. Also radiation concern should be considered. Power consumption should be low and lifetime of devices should be more. Moreover the system should support security and privacy concern. As patient's health records have sensitive

data and they should be stored securely and transmitted to remote server. Also if patient moves away from home environment system should not affect the monitoring process.

In our project we mainly focused on diabetes and its cure. Diabetes is a worldwide common health problem. According to World Health Organization statistics, the global prevalence of diabetes is approximately 155 million, which is expected to increase to 300 million by the year 2025.

This disease is body's inability to produce enough insulin or by the inability to properly metabolize the insulin hormone which is produced in the pancreas. Insulin is responsible for allowing cells to absorb glucose from food. There are two types of diabetes: Type 1 diabetes is caused by an autoimmune disorder that mistakes beta cells for invaders and attacks them; this prevents the body from being able to take energy from food since no insulin is produced. Symptoms of diabetes appear when beta cells are destroyed en masse. For type 2 diabetes, the beta cells are still able to produce insulin, but the cells are not able to respond to the insulin or the naturally produced insulin might not be enough to meet the body needs. Type 2 diabetes is easier to deal with than type 1. Type 1 requires the patient to have insulin injections administered regularly while type 2 can be kept under control by losing weight, changing the patient's diet and increasing exercise. Eventually most of these patients will require insulin shots. [18]

2. ACTUALLY DEVELOPED SYSTEM

2.1 Block Diagram

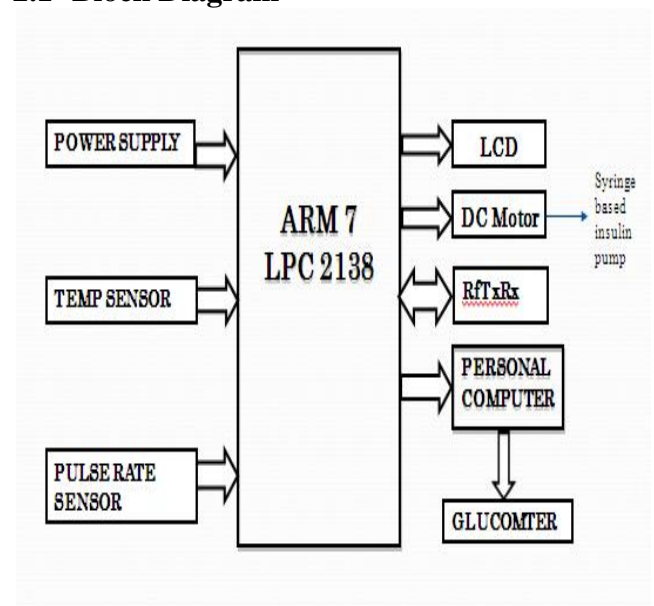


Figure 1. Patient's Side

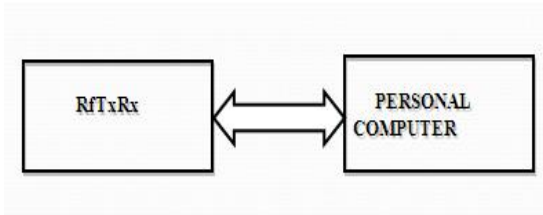


Figure 2. Doctor's Side

3. DESIGNING

The designing part includes basically three sections

- Hard ware design
- Ready to use hardware modules
- Software design.

3.1 Hardware Design

It includes Power supply design, Temperature sensor, Pulse Rate sensor, Design of Insulin Pump.

3.1.1 Power Supply circuit

In our system most of the components used require 5 V as operating voltage such as micro controller, MAX 232, MCT2E etc. Also we have designed 3.3 v power supply as the output voltage of ARM.

3.1.2 Temperature Sensor

For temperature sensor I am using LM35. It is directly calibrated in degree Celsius. Sensitivity is +10mv/°. Output current and voltage is 60µA and 4 to 30 volts respectively. The range is in between -55 to +150 degree Celsius.

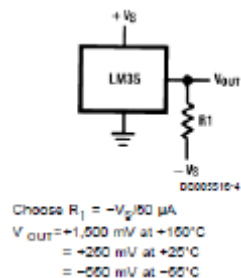


Figure 3. Temperature Sensor [1]

3.1.3 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.



Figure 4. Pulse Rate Sensor [2]

3.1.4 Insulin Pump Model

For designing of insulin pump in our project we are using a 12v DC motor which is Bipolar, which means that the DC motor can rotate both the sides. For this we are using a DC motor driver IC L293D. This driver IC can drive 2 DC motors. In our project we are connecting only 1 DC motor so we are connecting only the 1st pair of the DC motor (in1 and in2 of L293D). The DC motor will be connected at OUT1 and OUT2 of L293D respectively.

Here we are interfacing a 8 diodes at the o/p side of DC motor which are grounded. So it will keep DC motor safe from the back emf.

The main function of Insulin pump is it will inject correct amount of insulin into patient's body depending on glucometer readings



Figure 5. Insulin Pump

3.2 Ready to Use Hardware Module

3.2.1 Glucometer

For this section I am using One Touch Ultra Johnson and Johnson's glucometer which is readily available in market.



Figure 6. Glucometer

It facilities users to transfer blood glucose readings directly from meter to computer. For transferring data from meter to computer USB version of an OneTouch® Interface cable is used. The USB cable will work only Windows 98SE, Windows ME, Windows 200, Windows XP and Windows Vista™ operating system.

3.3 Software Design

This includes the coding of ARM 7 processor and for GUI (Graphical User Interface).

For ARM 7: Embedded c using Keil software.

THE uVision IDE from KEIL combines project management, make facilities source code editing, program debugging, and complete simulation in powerful environment. The uVision development platform is easy to use and helping you quickly creates embedded programs that work. The uVision editor and debugger are integrated in a single application that provides a seamless embedded project development environment.

For GUI: VB.Net- 3.3.2 for GUI:

For graphical user interface I am using Visual studio 6.1. I have designed a GUI using VB.Net. This code generates a GUI which includes blocks for Temp, Pulse Rate & Sugar; connect RF module, Received data, system error message.

4. RESULTS

4.1 Results of ARM7 Code Compilation

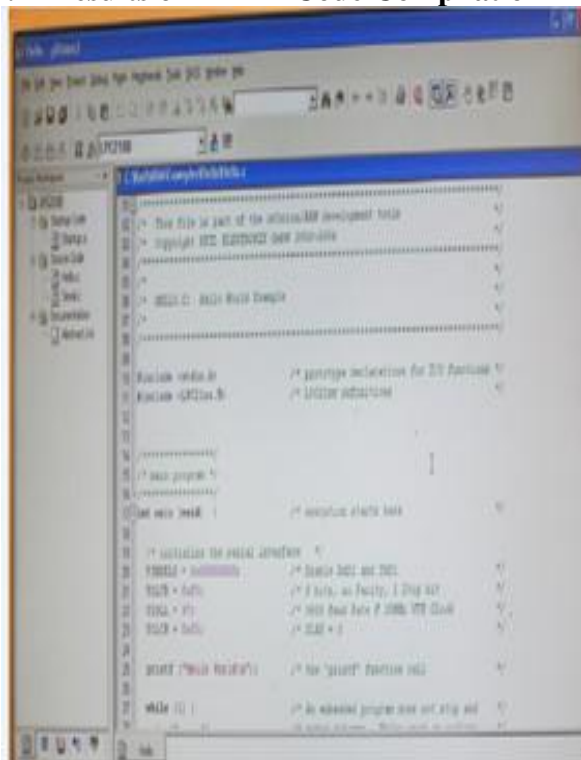


Figure 7. ARM Code Compilation

4.2 Results of Glucometer

After testing the blood sugar with the help of Glucometer and Test Strips user can easily download the glucometer reading to PC via special USB data Cable, which is provided by company. The software which is available with the glucometer gives many facilities, after results are downloaded successfully.

We can enter the data manually also. From the results we can represent it in graphical form too.

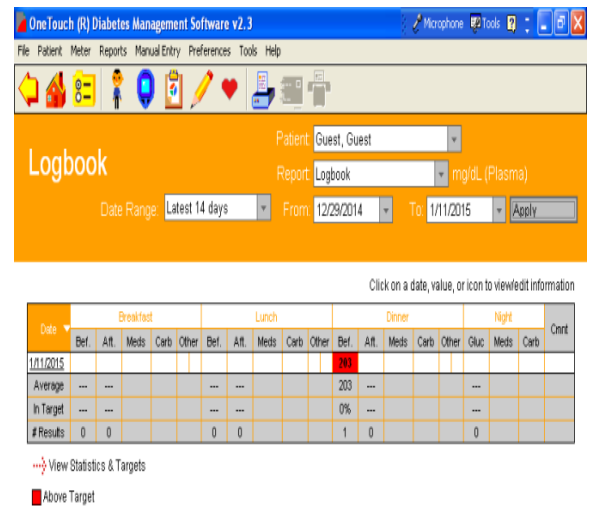


Figure 8. Glucometer Readings

4.3 History of Temperature, Pulse Rate and Blood Glucose readings saved in Excel format

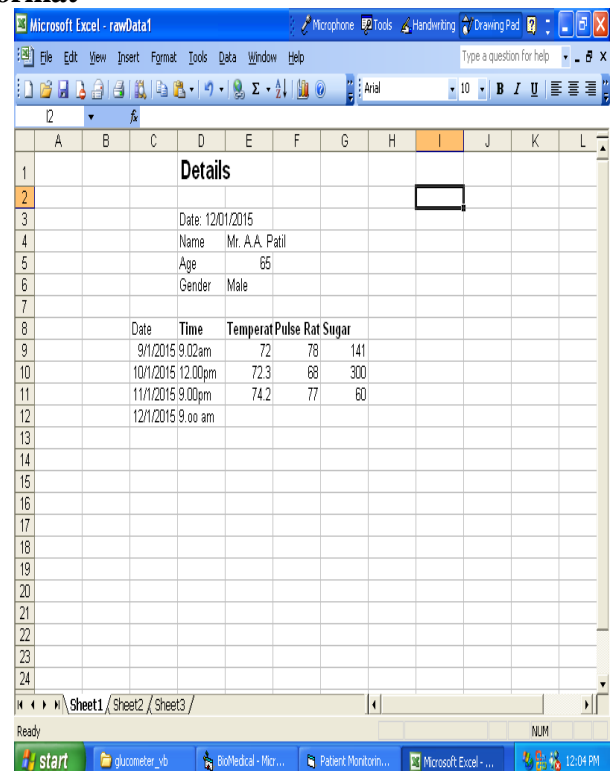


Figure 9. Report Generated in Excel.

4.4 Final Hardware

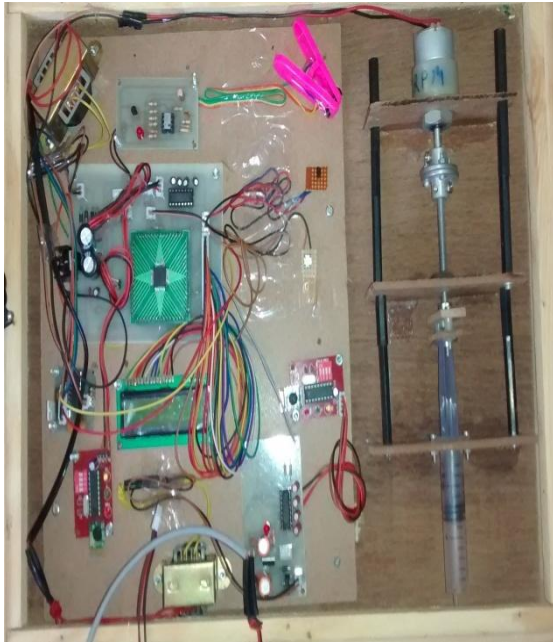


Figure 10. Final Hardware.

5. CONCLUSION

From the above designed project I can conclude that we are able to transmit the patient's data to the server (To Doctor) by wireless communication. The glucometer strips should be inserted properly, so it will give correct readings. The glucometer readings are easily downloaded and from that reading insulin pump operate which will inject the correct amount of insulin to the patients. The report of temperature, pulse rate and blood sugar is generated in the form of excel sheet at doctor as well as patient's side.

This system only gives the suggestions on diet and medications based on the predefined parameters set by the doctor. Also we can programmed insulin pump to communicate with doctor's device and can send message to mobile phone or send email to the doctor regularly and as and when any abnormal events happens, like abnormal glucose levels high/low read by Glucometer or alarms associated with insulin pump.

We can also test differ parameters of patients like BP,Heart rate etc.

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