

Design and Implementation of Wireless Patient Health Monitoring System

Prakash H. Patil ^{#1}

Pratyush Singh ^{#2}

Swatee Biradar ^{#3}

Prasad Rane ^{#4}

*E&TC Department, Pune University,
Indira College of Engineering and Management, Parandwadi, Pune 410 506, India.*

Abstract

In this paper we designed and implemented simple patient health monitoring system. This system can be implemented in hospitals as well as in residency of patient. The system monitors the vital health parameter: heart beat and temperature. These parameters are automatically monitored and stored simultaneously by system. If these parameters deviate from their nominal values, the alert message is sent to concerned doctor. The system promises cost effective, ease of implementation, automatic and continuous monitoring of patient.

Keywords— Wireless, Patient Health Monitoring, Telemedicine

1. Introduction

1.1 Need for Wireless System

In 20th century, personal health monitoring system like Holter monitors, were used only to collect data. In this system, analysis and data processing were performed offline, making such devices impractical and non real time for continuous monitoring. Also systems with multiple sensors for physical rehabilitation often feature unwieldy wires between the sensors and the monitoring system. These wires may limit the patient's activity and level of comfort and thus negatively influence the measured results.

It is also difficult to keep track on abnormalities in heartbeat count for patient itself manually. The average heartbeat per minute for 25-year old ranges between 140-170 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 mobility of patient.

To overcome these limitations a device use to keep track on heartbeat count of patient should be easy to use, portable, light

weighted, small size so that it give freedom of mobility for patient. The devices which can be carried everywhere to keep track on patient's health. This device that is a heartbeat sensor would help them to keep track on heartbeat counts of a patient and check for any abnormalities. If any varied change takes place it is notified. This notification would help to take an appropriate action at an instance of a time. This would save patients from the future health problem which would arise. This would also help patient's concern doctor to take an appropriate action at proper time.

1.2 The Existing System

Currently the system used for patient monitoring is the fixed monitoring system which can be used only when the patient is on bed. The available systems are huge in size and only available in the hospitals in ICU.



Fig.1. Existing systems

1.3 The Proposed System

System would constantly monitor important body parameters like temperature, heartbeat 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 neither would have to be with them all the time.

Remote monitoring enables medical professionals to monitor a patient remotely using various technological devices. This method is primarily used for managing chronic diseases or specific conditions, such as heart disease, diabetes, or asthma. These services can provide comparable health outcomes to traditional in-person patient encounters, supply greater satisfaction to patients, and may be cost-effective. In remote monitoring, sensors are used to capture and transmit biometric data.

For example, a heartbeat and temperature transmits that data to a specialist. This could be done in either real time or the data could be stored and then forwarded.

So a Remote Patient Monitoring System helps to continuously monitor important parameters of a patient like heart beat, temperature etc, with the help of sensors which track these parameters and sends a signal to the concern person in case of some abnormality in these parameters.

1.4 Parameters to be monitored

As the statistics revealed earlier that Heart Attack causes the most number of Deaths in the world, it was decided that have Heart Beat Monitoring as one of the Parameters. Below it is explained as to How Heart Beat is monitored:-

- The heart beat rate of the patient is constantly monitored.
- The normal range of heart rate is 60 to 135.
- If at all the rate increases above 145 or decreases below 55, it may be fatal.
- If the parameter(s) deviate from the standard range, it will indicate the doctor via a message consisting parameters of the patient.

Also High/Low Body Temperature can cause such illness that can prove Fatal. It plays a very important part in maintaining Blood Pressure etc.

Below it is explained as to How Body Temperature is monitored:-

- The temperature of the patient is said to be normal above 95°F and below 104°F .
- If the temperature falls below 95°F , that means the blood circulation has fallen below reqd. level and hence it may prove fatal.
- As soon as the temperature falls below 95°F the doctor is notified via SMS.

2. System Architecture

The following shows the system architecture. It shows that three sensors which are heart beat, pulse oximeter and temperature sensor are connected to patient and these values are sent by a transmitter module to a receiver module which is in turn connected to PC. This PC has database of patient and has software which keeps record of individual patient and

automatically monitors the patient's parameters automatically as programmed.

If any of parameter crosses over the nominal values of the patient under observation, then PC will send the entire data to remote doctor through SMS module which is connected to PC.

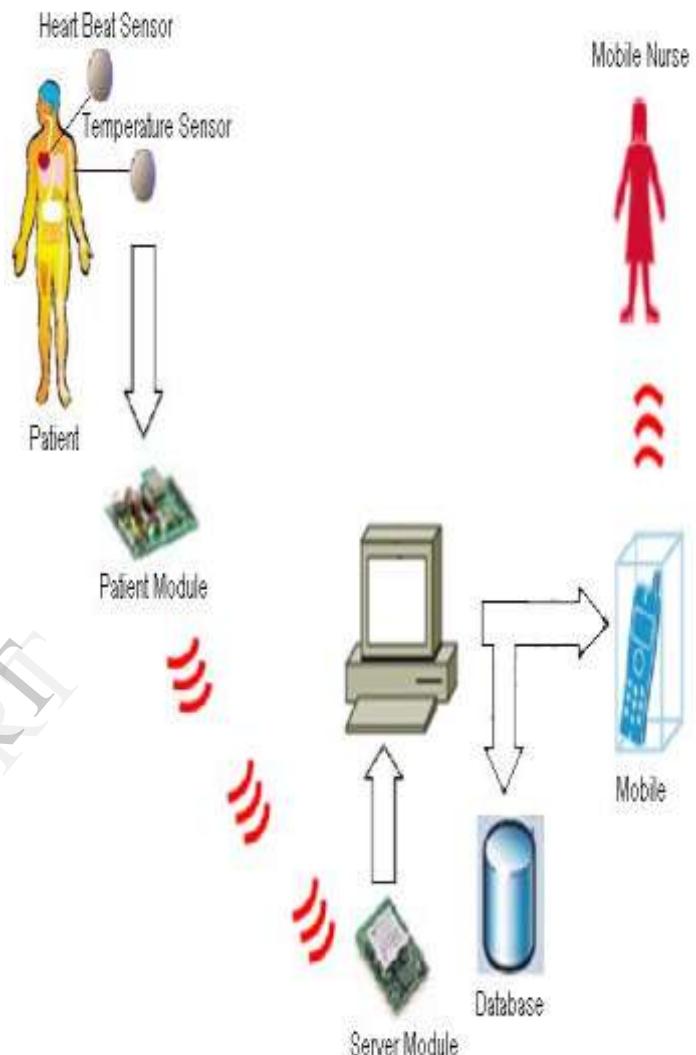


Fig.2. Systems Architecture

3. Block Description

Following are the two major blocks of the system:

- A. Transmitting model
- B. Receiving model

3.1 Transmitting model

The different parameters of patients such as heart rate, temperature and blood pressure are sensed by their respective sensors and send to microcontroller. This microcontroller displays the parameters on a LCD and simultaneously

transfers it to a remote PC via a TX module. TX module is interfaced with microcontroller using IC MAX 232.

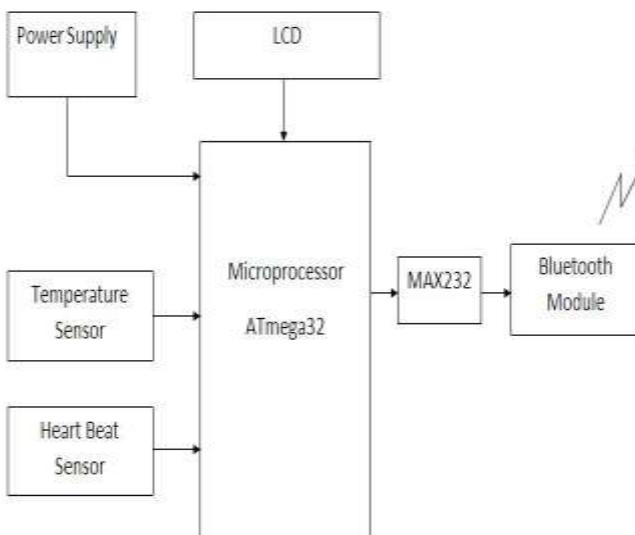


Fig.3.1 Transmitting Model

3.2 Receiving model

The remote PC continuously monitors these parameters and in case of emergency and dangerous situations we have to alert the doctor immediately

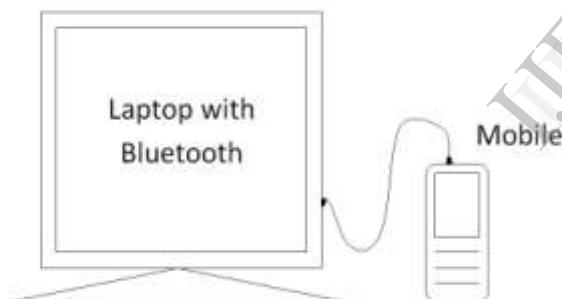


Fig.3.2 Receiving Model

4. Transmission Technology

Traditional health systems were connected using wired techniques, this were messy connections to the devices as well as it would confine the patient to bed only, that means even if patient is able to move in house itself (for e.g. one room to other room) the connections would need to be removed which is tedious job.

Thus solution was to make use of wireless technology as Bluetooth.

4.1 Bluetooth technology

Bluetooth technology is a wireless communications system intended to replace the cables connecting many different types of devices, from mobile phones and headsets to heart monitors and medical equipment.

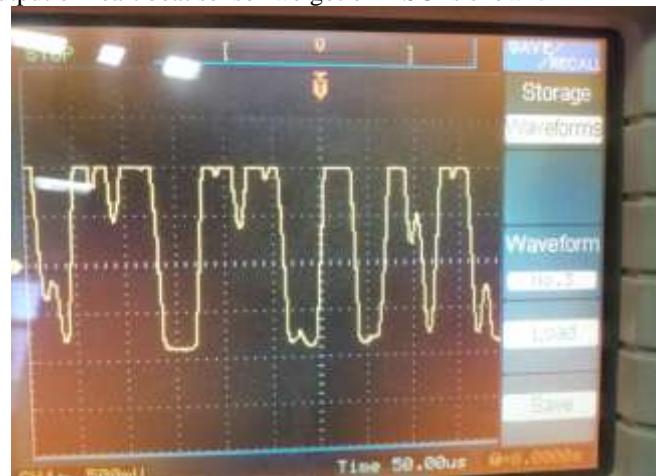
Bluetooth low energy technology is an evolution in technology that enables new applications in wireless devices able to last months or even years off a small, button-cell battery.

2.4 GHz Technology Comparison				
	Data Rate	Number of channels	Interference Avoidance Method	Minimum Quiet Bandwidth Required
Wi-Fi (802.11b)	11 Mbps	13	Fixed channel collision avoidance	22 MHz (Static)
Bluetooth	723 Kbps	79	Adaptive frequency hopping	15 MHz (Dynamic)
WirelessUSB	62.5 Kbps	79	Frequency agility	1 MHz (Dynamic)
Zigbee	128 Kbps	16	Fixed channel collision avoidance	3 MHz (Static)

5. Results and Discussion

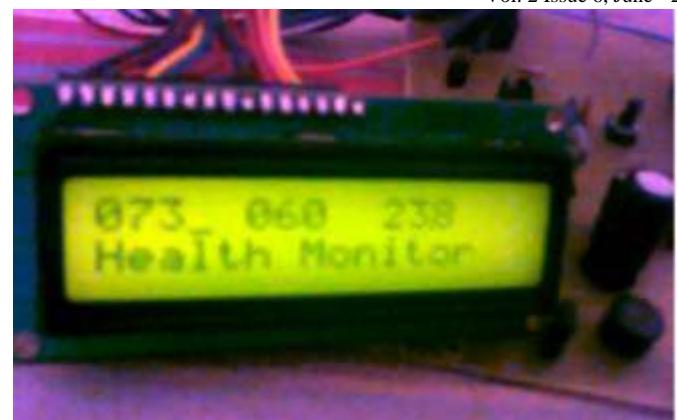
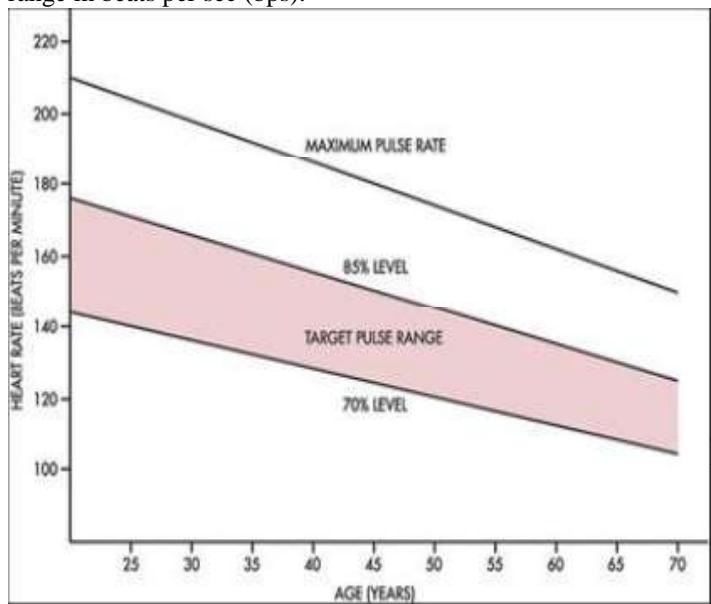
5.1 Heart beat sensor

It is based on simple LED and LDR. Whenever blood pumps into the finger tip it makes finger tip opaque and less light reaches to LDR from bright LED through finger. The output of heart beat sensor we got on DSO is shown:

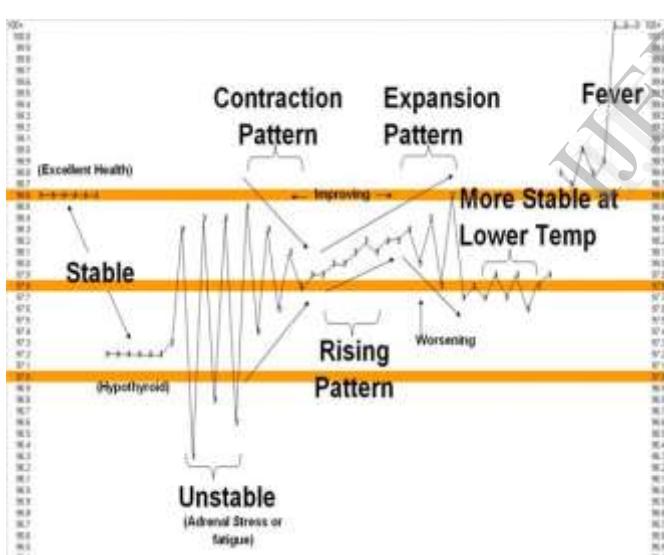


There are some distortions and glitches in the output of sensor which we tried to minimize by placing a RC filter circuit at the output.

The temperature ranges are also shown below with targeted range in beats per sec (bps).



This data is transmitted to laptop via Bluetooth and is displayed and stored with the help of VB6. The screenshot of the output result is shown below:



5.3 Results Display

The results are displayed on local LCD as shown in figure. The first 3digits shows the heart beats (in bps), second 3digits shows the time (in seconds) and last 3digits shows the body temprature of patient under monitor.

This front panel is not only useful to observe the parameters but also provides the way to send the data to remote doctor via SMS Also the SMS delivered is shown:

6. Conclusion

The most important part of the project is that it monitors a moving patient rather than a stationary or a bedridden patient.

This system ensures that the patient receives medical attention in the nick of time before it is too late.

Continuous monitoring of health and cost effective disease management is the only way to ensure economic viability of the healthcare system. This paper presents an integrated. Health monitoring mobile platform for connected.

7. Acknowledgement

First we would like to mention a special thank to our respected Prof. Prakash H. Patil who has really taken lot of efforts to get this project at individual level and also given us a continuous and immense support, suggestions and courage to complete this task. He has applied a constant guiding force to help us, prepare and complete the project on schedule.



7. References

1. O. Lauer, G. Neubauer, M. Röösli, M. Riederer, P. Frei, E. Mohler, J. Fröhlich, "Measurement setup and protocol for characterizing and testing radio frequency personal exposure meters" *Bioelectromagnetics* DOI: 10.1002/bem.20687, July 2011.
2. Dr. Neil Townsend, "Medical Electronics" in *Michaelmas Term 2001*, pp. 1-6
3. Emil Jovanov, Aleksandar Milenkovic, Chris Otto and Piet C de Groen, "A wireless body area network of intelligent motion sensors for computer assisted physical rehabilitation", *Journal of NeuroEngineering and Rehabilitation* 2005
4. P. Binkley, "Predicting the Potential of Wearable Technology," *IEEE Engineering in Medicine and Biology Magazine*, Vol. 22, No.3, May/June 2003, pp. 23-24
5. Dave Grundgeiger, *Programming Visual Basic .Net*, First Edition 2002, O'Reilly Publication, ISBN: 0-596-00093-6, 464 Pages
6. Warsuzarina Mat Jubadi, Siti Faridatul Aisyah Mohd ahak" *Heartbeat Monitoring Alert via SMS*", 978-1-4244-4683-4/09/\$25.00 ©2009 IEEE
7. Sándor Miklós Szilágyi, László Szilágyi, Attila Frigy, Levente Gorog and Zoltán Benyó "Spatial Heart Simulation and Adaptive Wave Propagation" (2008). *Encyclopedia of Healthcare Information Systems* (pp. 1253-1260).
8. Biswadip Ghosh (2010). "Improving the Quality of Healthcare Research Data Sets" *Health Information Systems: Concepts, Methodologies, Tools, and Applications* (pp. 1826-1841).