IOT based Remote Monitoring of Patient's Body Temperature and Pulse Rate

Anshika Banerjee
Computer Engineering
Saraswati COE,
Kharghar, Navi Mumbai

Sneha Pawar
Computer Engineering
Saraswati COE,
Kharghar, Navi Mumbai

Dhanraj Walunj
Assistant Professor
Saraswati COE,
Kharghar, Navi Mumbai

ABSTRACT
In recent years, the world is facing a frequent problem that the number of patients is increasing and the number of diseases are also increasing hence, the problem of home-care for patients is very important. In recently, wireless sensor networks are used to structure home-care system in many researches. Wireless sensor networks application for physiological signals communication transmission has many technologies.

Most monitoring systems that are in use in today's world works in offline mode but it is of greatened that a system must be designed so that patient can be monitored remotely in real time. The system consists of sensors which measures pulse and body temperature of a patient which is controlled by the microcontroller. Both the readings are displayed in LCD monitor. Wireless system is used to transmit the measured data to a remote location. The pulse sensor counts thepulse for specific interval of time and estimates Beats per Minute while the temperature sensor measures the temperature and both the data are sent to the microcontroller for transmission to receiving end. Finally, the data are displayed in the LCD at the receiving end. The optical pulse sensor counts the pulse per minute and temperature sensor measures the temperature from the body and both the measured data are sent to a receiving end utilizing wireless technology where the data is displayed in a cell phone for further processing and patient care.The system is developed for home use by patients that are not in a critical condition but need to be constant or periodically monitored by clinician or family. In any critical condition the SMS is send to the doctor or any family member. So that we can easily save many lives by providing them quick service. The system promises to cost effective, ease of implementation, automatic and continuous monitoring of patient.

Keywords
Micro controllers, off-line mode, body temperature, pulse, remote monitoring, sensors, LCD monitor.

1. INTRODUCTION
Many individuals and organizations may, for distinct reasons, wish to use electronic surveillance techniques at some time or another. The use of wireless technology is enhanced to meet the need of remote control and monitoring. Remote patient monitoring(rpm)is a technology that enables us to monitor patient outside of clinic or hospital without having to visit a patient. It may increase access to health services and facilities while decreasing cost. Remote patient monitoring saves time of both patient and doctor, hence increasing efficiency and reliability of health services [1]. Pulse and body temperature are the major signs that are routinely measured by physicians after the arrival of a patient. Pulse refers to how many times a heart contract sand relaxes in a unit of time (usually per minute). Pulse varies for different age groups. Normally it is difficult to keep track on abnormalities in pulse count for patient self manually. The average pulse 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 37 degree Celsius or 98.6 Fahrenheit [3]. Patients are not well versed with manual treatment which doctors normally use for tracking the count of pulse. 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 patients [2].Like Pulse, normal body temperature also varies from person to person and changes throughout the day. The body temperature is lowest in the early morning and highest in the early evening [2]. The normal body temperature is about 37 C or 98.6o F. However, it can be as low as 36.1 o C (97oF)in the early morning and as high as 37.2o C (99o F) and still be considered normal. Thus, the normal range for body temperature is 97 to 100 degrees Fahrenheit or 36.1 to 37.8 degrees Celsius [3]. Temperature can be measured by using several types of sensors. These sensors come in different forms such as thermocouples, the rmistors, resistance temperature detectors (RTD), and integrated circuit (IC) sensors. The temperature sensor produces analog output voltage which is proportional to the temperature. The temperature sensor requires analog to digital (A/D) converter so that the analog output voltage can be converted to digital form [5]. The output of the temperature sensor is connected to the Port a of PIC16F72 microcontroller. The microcontroller processes this data and displays it in LCD as well as sends it to the receiving end for displaying at the remote place. This system describes the design of a very low-cost remote patient monitoring system which measures Pulse and body temperature of a patient and sends the data to a remote end where the data will be displayed and physician or doctor will be able to examine him/her. This device will be much needed during emergency period or for saving time of both patient and doctor. The first procedure of the system that we use the biosensor to measure Pulse and blood pressure from human body, the measured signal sends to the end device and then sends to the router, which is responsible for transmit the measured signal between end device and coordinator [5]. When the measured signals send to the PC via theRS-232 serial port communication interface, the PC can analyze and store signal. We can send the signal to remote PC or PDA from the internet. In particular, when measured signals over the standard value, the personal computer will send GSM short message to absent manager's mobile phone [2]. A wireless heartbeat and temperature monitoring system has been proposed before using Arduino Uno. With the advancement of technology, both quality of security[10]and health in human life is increasing day by day. This paper

presents the design of a very low cost remote patient monitoring system which will measure heart rate and body temperature of an individual and the measured data will be sent to a remote end where the data will be displayed on a monitoring system. This device will help both the patient and doctor during emergency period by saving both time and cost of patient and physician. Monitoring and control is the core of the real- time monitoring system for patient physical states, and it can dispose, display, save, query and analyze the data from each patient. To know the physical states of inpatient, the physical parameters need to be monitored real time. With the increase in the number senior citizens and chronic diseases, the number of elderly patients who need constant assistance has increased. One key point of all critical care for elderly patient is the continuous monitoring of their vital signs. The results prove that the mobility, usability and performance of our proposed system have impacts on the user's attitude, and there is a significant positive relation between the user's attitude and the intent to use our proposed system. This proposed system is expected to monitor the electrical activity of heart of the patient under critical care more conveniently and accurately for diagnosing which can be interfaced with Wi-Fi module to bring it under network system widely for the doctor to monitor the patient's condition sitting in his own office without being physically present near to the patient's bed. Wireless networked embedded device includes signal conditioning circuitry, sensors and a PIC controller with a wireless Transceiver module(CC2500). To measure or monitor human movements or 3 activities, a graphical LCD display is selected for its low price, small size, capability of continuous measurement, and ease of integration. IEEE 802.15.4 is selected as the wireless transmission standard because of its short-range, low-cost, and low power characteristics. This system can not only realize accurate measurement of indicators, but also save the patients travel between home and the hospital.

2. RELATED WORKS

Patients all gives a conceptual design of a wearable physiological monitoring system based on wireless sensor network to monitor physiological parameters like ECG, EMG, EEG, SaO2, body temperature, blood pressure, respiratory rate GSR and movement of the wearer. The acquired signals are pre-processed at each node at the sensor level and transmitted to the wearable data acquisition hardware (sink node) for further processing. It is then transmitted wireless to the remote monitoring station. Choice all describes the development of a wearable sensor platform to monitor several physiological correlates of mental stress. The adjustments in both system design and sensor selection to balance information content and wear ability is detailed. Using experimental signals collected from the wearable sensor, a selected number of physiological features that show good correlation with mental stress is described. All also describes the architecture of a wearable ECG monitor that is patient location independent and provides continuous monitoring. The signals from the sensors are transmitted using Bluetooth to the smart phone in its area, which can in turn be send to the destination via internet [11]. Proposes a power and area efficient electrocardiogram (ECG) acquisition and signal processing application sensor node for wireless body area networks (WBAN). This sensor node can accurately record and detect the QRS peaks of ECG waveform with high-frequency noise suppression. The proposed system is implemented in 0.18-mm complementary metal–oxide–semiconductor technology with two chips: analog front end integrated circuit (IC) and digital application specific integrated circuit (ASIC). Therefore, this ECG sensor node is convenient for long-term monitoring of cardiovascular condition of patients, and is very suitable for on-body WBAN applications. Otto, in their paper describe a prototype system for continual health monitoring at home. The system consists of a modest wireless body area network (WBAN) and a home health server. The sensors of the WBAN monitor user's Pulse, mobile and locomotive activity and upload the information with time-stamp to the home server at regular intervals of time. The home server may integrate this information into the local database for the user's inspection or it may forward the information further to a medical-server [1] . Bachmann ET all describes the idea of low-power wireless sensor nodes for biomedical applications that can operate autonomously or on very small batteries. Component-level power optimization for the radio and digital signal processing is described in the paper along with a short comparison between radio power consumption and on-node processing. Abdala ET all several solutions for improving the reliability and the power management of real time of real-time multi-patient monitoring systems. A reliable wireless Personal Area Network based on digital signal processing has been developed using sleep strategy and other techniques like dynamic voltage and frequency scaling to achieve low power management and assisted power control [10]. Results show that this approach has been successful in outperforming the single WPANs in terms of efficiency and reliability give a novel wireless data collection system for health monitoring of patients based on PIC controller and wireless sensors. The exclusive characteristics of this system such as low power, low cost, and high flexibility make them ideal for this application [9].

In previous days, especially in medical field wireless sensors85 are not available these are with wires and their power consumption is more therefore they are getting costlier. Every time the doctors or nurse should have to keep the record of patient's parameters manually. Therefore, there is no allowance to patients to move freely [4]. these things are very tedious. Many studies and projects have focused on novel ubiquitous healthcare systems utilizing WSN technology to simplify methods of monitoring and treating patients [5]. A case in point is the Mob health project, which developed a system for ambulant patient monitoring over public wireless networks based on a body area network (BAN). Another example is the Ubiquitous Monitoring Environment for Wearable and Implantable Sensors project at Imperial College London, which aims to provide a continuous and unobtrusive monitoring system for patients to capture transient, but life-threatening events [3].

2.1 Existing Methodologies

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 .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. To overcome these limitations a device, use to keep track on pulse count of patient should be easy to use, portable, light weighted, small size so that it gives freedom of mobility for patient. The devices which can be carried everywhere to keep track on patient's health. This device that is a pulse sensor would help them to keep track on pulse 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.

2.2 ARDUINO

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices.

The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog input/output (I/O) pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++.
The first Arduino was introduced in 2005, aiming to provide a low cost, uncomplicated way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. The hardware design specifications are openly available, allowing the Arduino boards to be produced by anyone. Ad fruit Industries estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced, and in 2013 that 700,000 official boards were in users' hands in last years' the use of Arduino increases exponentially due to its readability and easiness. But the point to think is whether the use of Arduino is in favor of engineers or not. First, we will look upon the advantages of Arduino and later we will discuss the disadvantages. Yes, there might be some disadvantages of Mighty Arduino as well. Let's start with advantages.

Advantages

Ready to Use: The biggest advantage of Arduino is its ready to use structure. As Arduino comes in a complete package form which includes the 5V regulator, a burner, an oscillator, a micro-controller, serial communication interfaces, LED and headers for the connections. You don't have to think about programmer connections for programming or any other interface. Just plug it into USB port of your computer and that's it. Your revolutionary idea is going to change the world after just few words of coding.

Examples of codes: Another big advantage of Arduino is its library of examples present inside the software of Arduino. I'll explain this advantage using an example of voltage measurement. For example, if you want to measure voltage using ATmega8 micro-controller and want to display the output on computer screen then you must go through the entire process. The process will start from learning the ADC's of micro-controller for measurement, went through the learning of serial communication for display and will end at USB - Serial converters. DC voltage measurement using Atmel AVR micro-controller.On the other hand, if you want to measure the voltage using Arduino.

Easy to use: In my opinion, if you started your journey of micro-controllers with Arduino then it will be very difficult for you to make the complex intelligent circuitries in future. The easy to use hardware/software of Arduino unable a person to learn the basics of many things likes Serial communication, ADC, I2C etc.

Fig. 1: Microcontroller Vs Arduino Uno

3. PROPOSED SYSTEM

System would constantly monitor important body parameters like temperature, pulse and would compare it against a predetermined value set and if these values cross a 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 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 pulse 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 pulse, 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.

characteristics of reported phishing website at phishtank.com corpus is studied and based on that attributes are decided and training data for machine learning algorithm is prepared [5]. Using training data machine learning algorithm generates set of rules based on which decision is to be made. Prediction module gets two inputs rules generated by machine learning algorithm and attribute found from requested URL. Prediction module finally predict URL falls under which category (Phishing, Legitimate, and Doubtful).

3.1 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 Pulse Monitoring as one of the Parameters. Below it is explained as to How Pulse is monitored: -

1) The pulse rate of the patient is constantly monitored.
2) The normal range of Pulse is 60 to 135.
3) 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: -

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

3.2 Design details

The proposed heartbeat and temperature monitoring device is intended to have the following features:

1) The system utilizes an optical mechanism to measure the modulations generated by
2) Electrical or physical variations in the heart movements.
3) Wired communication is eradicated.
4) Real time monitoring of the patient is possible.
5) The doctor does not need to visit the patient to monitor him/her.
6) Time is saved for both patients and doctor.
7) Helpful in emergency period.
8) Routine checking of the patient can be done easily.
9) Useful for remote areas.
10) Once installed, the maintenance cost is very low.
11) Easy to use (Even illiterate people can operate it).
12) Increases access to health care while decreasing the health care delivery costs.
13) The device utilizes a GSM module to send the data in the form of SMS to a mobile
14) device for better portability of the system.
15) The device has a functionality of showing both the time and date of the measured data.

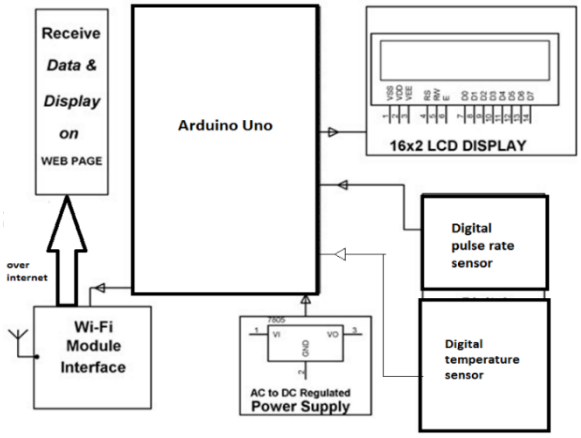

Fig. 2: Block diagram showing heartbeat and temperature measuring and transmitting system

3.3 System algorithms

For temperature:
1. Start
2. Set the baud value for initializing serial communication
3. Include appropriate libraries DHTLIBVERSION
4. Detect the output pin of DHT11. Print ok if detected
else print checksum error
5. Read data from the sensor
int chk=DHT.read11(DHT11PIN); i
6. Display the output on the serial monitor
Serial. Print(chk);
7. If value of chk is less than or equal to 37 then print normal
else give alert message
8. Stop
For pulse rate:
1. Start
2. Set the baud value for serial communication
3. Include appropriate Arduino libraries
4. Set the LCD connection
lcd.begin(16,2);
5. Detect the output pin of the sensor
if detected the print ok
else print checksum error
6. Read data from the sensor
7. if value of data lies in the normal range of BPM 60 to 110
print BPM normal
else give alert message

4. CONCLUSION

Improving the quality of life for the patient's is becoming an essential task for society today. Technical aids are required allowing people to live independently and safely in their private home if they wish. In this study, we have developed a wireless home care system that can wirelessly monitor vital data of the elderly at home and notify caregivers and family members in real time in case of abnormality. However, the only precondition the system can work well is that the system must be installed in personal computer connecting with INTERNET. Otherwise, the patient just uses this system as a standalone system. The digital gap still exists between young generation and older generation in our society. In addition,

that, the system is also costly and it is quite difficult for the elderly to afford to buy it without hesitation. Based on this reason, the proposed home care system is more suitable to be used in community-based care model. The research and design of embedded monitoring instrument overcome the shortcoming of traditional diagnosis system. The instrument has simple structure stable and reliable operation, high Accuracy, low power consumption, good portability full featured function, and extensive application occasion. The system can monitor and record the physical states and moment parameters real time, and the provide auxiliary means for the correct diagnosis of doctor. With intelligent transceiver module, the sign of acute disease for patient can be found early, and then the patient can be helped in time, the sudden death of patient can be avoided. The system is important to be applied to patient care.

5. FUTURE SCOPE

Because of resource limitations in both time and money, this work is based on patient's management, secure access of users and hierarchy of information and integration of all users into the health care delivery process. This project can also be implemented and analyzed using big data concepts. The analysis of the patient's record can be done using Hadoop framework and other similar structures. Analysis will help to conclude something about the patient'swell-being.According to availability of sensors or development in biomedical trend more parameter can be sense and monitor which will drastically improve the efficiency of the wireless monitoring system in biomedical field. Warning for abnormalities of health condition can be displayed. Sound can be added to the device so that the device makes a sound each time a pulse is received and alarm is started for abnormal health condition. The output can be sent to mobile phones by using GSM module or Bluetooth module for further analysis.

6. REFERENCES

[1]. Microcontroller Based Wireless Temperature And Heart Beat Read-Out. Authors: Nishasingh, Sr. Asst. Prof. Ravi Mishra (ME II Year VLSI Design, Department Of EC,SSCET, Gunwani, Bhilai Nagar (C.G), India) (Sr. Asst. Prof. Department Of EEE, SSCET,Gunwani, Bhilai Nagar (C.G), India).

[2] A wireless heartbeat and temperature monitoring system for remote patients C. K. Das1,M. W.Alam2 and M. I. Hoque3Department of Electrical and Electronic Engineering,Chittagong University of Engineering and Technology (CUET),Chittagong- 4349, Bangladesh

[3] A Heartbeat and Temperature Measuring System for Remote Health Monitoring usingWireless Body Area Network Mohammad Wajih Alam1*, Tanin Sultana2 and Mohammad Sami Alam3 Department of Biomedical Engineering, School of Electrical Engineering,University of Ulsan, Ulsan, South Korea, Department of Electrical and Electronic Engineering, Chittagong University of Engineering and Technology, Chittagong,Bangladesh Department of Electronics and Communication Engineering, Lovely Professional University, Punjab, India.

[4] International Journal of Computer Applications (0975 8887) Volume 62 No.6, January2013 Wireless Patient Health Monitoring System. Manisha Shelar, Jaykaran Singh Mukesh Tiwari,R.G.P.V. University Department of EXTC S.S.S.I.S.T Sehore34.

[5] International Journal of Engineering Research and Technology (IJERT) ISSN: 2278-0181Vol. 1 Issue 6, August 2012 Remote Wireless Health Care Monitoring System Using ZIGBEE P.Murali Krishna (M.Tech) Jnt University, Anantapur Andhra Pradesh, India.

[6] O. Lauer, G. Neubauer, M. Roosli, M. Riederer, P. Frei, E. Mohler, J.Frohlich, Measurement setup and protocol for characterizing and testing radio frequency personal exposure meters Bio electromagnetics DOI: 10.1002/bem.20687,July2011.

[7] Dr. Neil Townsend, Medical Electronics in Michaelmas Term 2001, pp. 1-6.

[8] Biswadip Ghosh (2010). Improving the Quality of Healthcare Research Data Sets Health Information Systems: Concepts, Methodologies,Tools, and Applications(pp.18261841).

[9] Warsuzarina Mat Jubadi, Siti Faridatul Aisyah Mohd ahak,Heartbeat Monitoring Alertvia SMS, 978-1-4244-4683-4/09/25 dollar.00 2009 IEEE.

[10] 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 Neuro Engineering and Rehabilitation 2005.

[11] Dave Grundgeiger, Programming Visual Basic.Net, First Edition 2002, OReilly Publication, ISBN: 0-596-00093-6, 464 Pages.