EMBEDDED BASED DESIGN AND IMPLEMENTATION OF HEALTHCARE SYSTEM USING IOT

Parthiban.M[1], E.Kanniga[2], M.Sundararajan[3]

[1]PG-Scholar Technology of Digital Communication and Networking

[2] Professor, Department of Electronics and Telecommunication Engineering

[3] Professor,Deanof Electronics Sciences and Research

[1,2,3]Bharath University, Chennai, Tamil Nadu (India)

ABSTRACT

Internet of Things (IoT) is the emerging paradigm, which contains huge amount of smart object and smart devices connected to the internet for communicating with each other. IoT devices are used in many fields which make the users' day to day life more comfortable. These smart devices are used to collect temperature, blood pressure, sugar level etc., which are used to evaluate the health condition of the patient. Communicating the collected information to the doctor, making accurate decision on the data collected and notifying the patient is the challenging task in the IoT. In this paper, the architecture of the Patient Health Monitoring System (PHMS) using IoT devices is proposed to collect the required parameters and evaluate the data obtained from the IoT devices. PHMS also notifies the patient with possible precautionary measures to be practised by them. This system suggests the patient with medical care and next step to be followed in case of critical situation. The PHMS system is evaluated for certain parameters and the decisions made on the data obtained from the source are assumed to evaluate the system. The simulated results experiments the correctness and effectiveness of the proposed system. This system is efficient with low power consumption capability, easy setup, high performance and time to time response.

Keywords: GPS, GSM, IOT, LCD, Microcontroller, Sensors

I. INTRODUCTION

Recent works in communication technologies have inspired the development of telemedicine to a large extent. Telemedicine benefits not only the customers who are able to receive health care more efficiently; it also benefits the doctors who can streamline their efforts to assist more patients.

The advances in information and communication technologies enable technically, the continuous monitoring of health related parameters with wireless sensor, wherever the user happens to be. They provide valuable real time information enabling the physicians to monitor and analyze a patient's current and previous state of health. Now days there are several efforts towards the development of system that carry out remote monitoring of patients.

Although many wireless standards can be used, there are important considerations such as range, throughput, security, ease of implementation and cost. The patient monitoring involves handling of sensitive data. These data should be transmitted securely without any intrusion.

The web-database is a system where the web server will store the data in table format where the digital data are filled in column and then it is plotted against the time to get the parameters. For GUI, Android is used, since its open source and very cheaply available in market which fulfils the criteria of low cost system. Also now days, Android is available to each and every person, including Doctors, since they have started using the Smartphone. In present paper, we report on development of patient monitoring system an android platform which is an open source, to display three parameters such as Heart Beat, Temperature and humidity. With this module, the doctors who are not present in hospital at time of emergency, they can also operate looking at the different parameters on his or her smart phone or laptop.

1.1. Internet of Things

Internet of things is defined as Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts. It can be considered the Future of Internet, where every object is connected to other objects. Every object is given a unique identity in the network. This allows remote access of devices through the network, anytime and at any location.

IoT enabled objects communicate with each other, access information over the Internet, and interact with users creating smart , pervasive and always connected environments. IoT also enables machine to machine (M2M) communication which allows machines being controlled by the Internet and by other machines. This can revolutionize the way technology is used, as machine takes control of machines overcoming the constraints that people face while communicating with digital systems. Machines can monitor sensors all over the world to generate vast quantity of valuable information that would take a human years to achieve.

IoT makes the concept of pervasive computing and ubiquitous computing a reality by allowing objects of our everyday life like cars, roadways, pacemakers, pill shaped cameras in our digestive tracks, billboards that adjust to passersby, refrigerators and even cattle’s equipped with sensors to communicate with humans and assisting them in every step The application of IoT in health-care system is highlighted in the following section.

1.2. IoT in Health-care

IoT enabled remote health monitoring system has huge advantages over traditional health monitoring system. Health sensing components have become very compact and portable, allowing patients to wear them round the clock for monitoring. If these monitoring devices are equipped with unique identifiers like RFID, then those devices can be uniquely identified over the Internet. It acts as an information retriever, retrieving information from the physical world to the digital world . An IoT enabled health monitoring device connected to a patient can be considered as a virtual patient in the digital world. The virtual patient has the exact physiological conditions as the real patient.

A doctor can monitor a patient only a few times a day but critical health issues can occur at any moment. So 24/7 monitoring of health data is necessary. As IoT enabled patients can be accessed over the Internet and by other machines, the health condition of a patient can be monitored uninterruptedly, allowing critical illness to be detected at the right time so that proper actions can be taken. Also, IoT can help to collect health records. Generating statistical information related to health condition, can be performed by machines. It is faster and voluminous and error free collection of data that is possible manual methods could never achieve. Generating statistics, surveillance, risk mapping of diseases can be done using remote health data.

II. LITERATURE SURVEY

Karandeep Malhi et al to develop Zigbee smart noninvasive wearable physiological parameters monitoring device has been developed and reported in this paper. The system can be used to monitor physiological parameters, such as temperature and heart rate, of a human subject. The system consists of an electronic device which is worn on the wrist and finger, by an at risk person. Using several sensors to measure different vital signs, the person is wirelessly monitored within his own home. An impact sensor has been used to detect falls. The device detects if a person is medically distressed and sends an alarm to a receiver unit that is connected to a computer. This sets off an alarm, allowing help to be provided to the user.

B. Sirisha et al describes a solution for enhancing the reliability, flexibility by improving the performance and power management of the real-time multi-patient monitoring system (MPMS). In the current proposed system the patient health is continuously monitored by the MPMS and the acquired data is transmitted to a centralized ARM server using Wireless Sensor Networks. A Zigbee node is connected to every patient monitor system which will send the patient's vital information .Upon system boot up, the mobile patient monitor system will continuously monitor the patients vital parameters like Heart Beat, body temperature etc and will periodically send those parameters to a centralized server using Zigbee node configured as co-coordinator. If a particular patient’s health parameter falls below the threshold value, a buzzer alert is triggered by the ARM server. Along with a buzzer an automated SMS is posted to the pre-configured Doctors mobile number using a standard GSM module interfaced to the ARM server.

Gagana P et al was explains a novel idea when a person falls and is not able to get assistance within an hour, casualties arising from the fall can result in fatalities as early as 6 months later. It would seem then that a choice between safety and independence must be made. Fortunately, as health care technology advances, simple devices can be made to detect or even predict falls in the elderly, which could easily save lives without too much intrusion on their independence. Much research has been done on the topic of fall detection and fall prediction. Some have attempted to detect falls using a variety of sensors such as cameras, accelerometers, microphones, or a combination of the same. This paper is aimed at reporting which existing methods have been found effective and the combination of which will assist in the progression towards a safe, unobtrusive monitoring system for independent living.

Maradugu Anil Kumar et al was proposed a novel idea for continuous monitoring patient's health conditions. The health care scheme is focus on the measurement and monitoring various biological parameters of patient's body like heart rate, oxygen saturation level in blood and temperature using a web server and android application, where doctor can continuously monitor the patient's condition on his smart phone using an Android application. And also the patient history will be stored on the web server and doctor can access the information whenever needed from anywhere and need not physically present.

P. Karthick *et al* portrays a prototype model for the real time patient monitoring system. The proposed is used to measure the physical parameters like body temperature, heartbeat, ECG, blood sugar, and oxygen level monitoring with the help of biosensors. Conventionally there are number of techniques available for the ICU patient's health monitoring system with wired communication technology. In the novel system the patient health is continuously monitored and the acquired data is transmitted to an ARM server using zigbee wireless sensor networks. Embedded processor supports for analyzing the input from the patient and the results of all the parameters are stored in the database. If any abnormality felt by the patient automatic alarm sound will arrive and the message will send to the doctor mobile automatically by using GSM module. The implementation of the system is achieved by the advanced processor and simulation results are obtained by Keil c software

III. PROPOSED SYSTEM MODEL

3.1. Problem Identification

The medical world today faces two basic problems when it comes to patient monitoring. Firstly, the needs of health care's provider's presence near the bedside of the patient and secondly, the patient is restricted to bed and wired to large machines.

3.2. Existing System

There are some shortcomings present in existing system. The patient is monitored in ICU and the data transferred to the PC is wired. Such systems become difficult where the distance between System and PC is more. The available systems are huge in size. Regular monitoring of patient is not possible once he/she is discharged from hospitals. These systems cannot be used at individual level. The other problem with these systems is that it is not capable of transmitting data continuously also range limitations of different wireless technologies used in the systems. So to overcome these limitations of systems we proposed a new system. Our system is able to transmit the parameters of patient continuously and over long distance in wireless medium. 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, this can really provide quick service and be beneficial in saving a lot of lives.

3.3. Proposed System

The architecture of PHMS contains three phases; they are collection phase, transmission phase, utilization phase. Body Area Network (BAN) is constructed to collect the required data from the patient. The parameters used to diagnose the disease may vary from one disease to another. Therefore each parameter is sensed by separate IoT devices which are connected to the patient. All the devices connected in the body of the patient are known as BAN in the data collection phase. Blood pressure module, heart rate monitor, temperature etc. are the basic devices used to collect the blood pressure, heart rate and temperature of the patient. The data collected in the collection phase is communicated to the doctor to evaluate the parameter for diagnosis.

The proposed system is designed for monitor the patient is in any place. The system would constantly monitor important physical parameters like temperature, heartbeat, pressure and would compare it against a predetermined value set and if these values cross a particular limit it would automatically alert the alarm. This system provides a continuous health monitoring service. Block diagram of the Proposed Systems the data processed are transmitted by IoT. Finally the received data is sent to the PC. The graphical user interface programs on the PC are coded using keil C software, Using IoT modem message is transmitted to the doctor web server when the measured temperature exceeds the allowable value or if the heart beat measured is abnormal.

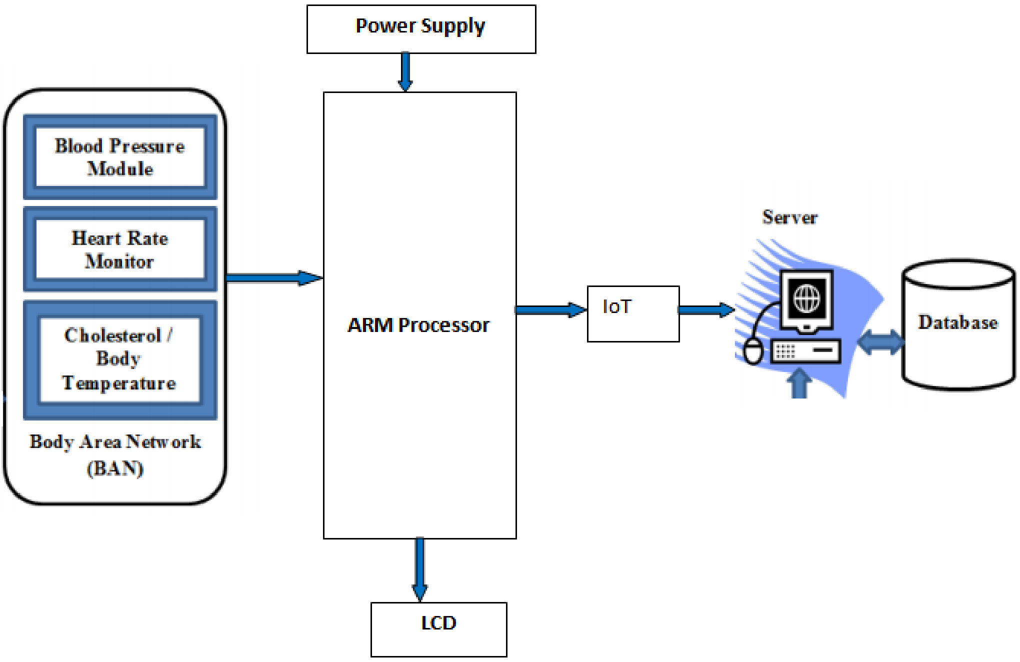

Fig. 1: Proposed System Block Diagram

IV. Implementation Methodology

4.1. Hardware Description

4.1.1. ARM Processor

ARM stands for Acorn RISC machine is a family of instruction set architectures for computer processors based on a reduced instruction set computing (RISC) architecture. And in simple word ARM is "Processor Architecture". Many of newbie and students have misunderstanding that ARM is microcontroller or processor, but actually ARM is Architecture which is used in many processors and microcontrollers

4.1.2. 16X2 Liquid Crystal Display (LCD)

Liquid crystal display is very important device in embedded system. Now days it is very common for screen industry to use LCD replacing Cathode Ray Tubes (CRT). Pixels are used for most flexible ones.

4.1.3. IoT Modem

IoT has evolved from the convergence of wireless technologies, microelectromechanical systems (MEMS) and the Internet. The concept may also be referred to as the Internet of Everything. The internet of things (IoT) is the internetworking of physical devices, vehicles, buildings and other items— embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. A thing, in the Internet of Things, can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low -- or any other natural or manmade object that can be assigned an IP address and provided with the ability to transfer data over a network.

4.1.4. Temperature Sensor (DS18S20)

DS18S20 is 1-wire digital thermometer which gives measurement of 9-bit Celsius temperature and incorporates alert capacity with client programmable trigger focuses. It contains central processor with only one data line for establishing communication. Operates at the temperature range of -100C to +850C.

4.1.5. Heart beat Sensor

The basic heartbeat sensor consists of a light emitting diode and a detector like a light detecting resistor or a photodiode. The heart beat pulses causes a variation in the flow of blood to different regions of the body. When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beat rate.

4.1.6. Pressure Sensor

In instruments like digital blood pressure monitors and ventilators, pressure sensors are needed to optimize them according to patient's health and his requirements.

4.1.7. MAX232

Max232 is a dual driver/receiver which converts TTL level to RS232 level. These receivers usually as the threshold of 1.3v and can accept +/- 30v of supply. When Max-232 IC receives the TTL level it converts it in to voltage levels i.e. logic0 changes to voltages between +3 and +15v and logic1 changes to voltages between -3 and - 15v.

4.1.8. Piezo Electric Buzzer

Buzzer is an electronic device used to produce sound. In the project the buzzer is used to alert the caretaker during extreme condition. This sound indicates that the patient health is in risk.

V. SOFTWARE IMPLEMENTATION

5.1. KEIL C

The µVision IDE from KEIL combines project management, make facilities source code editing, program debugging, and complete simulation in powerful environment. The µVision development platform is easy to use and helping you quickly creates embedded programs that work. The Keil C development tools for the ARM processor family support every level of developer from the professional applications engineer to the student just learning about embedded software development. The industry-standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, and Single-board Computers support all ARM processor compatible derivatives and help you get your projects completed on schedule. With the Keil tools, we can generate embedded applications for virtually every ARM derivative. The Keil Software ARM development tools are designed for the professional software developer; any level of programmer can use them to get the most output of the ARM processor architecture. Keil C µ Vision 4 help provides the various simulation output.

Proteus (***PRO****cessor for* ***TE****xt* ***E****asy to* ***U****se)* Proteus incorporates many functions derived from several other languages: C, BASIC, Assembly, Clipper/dBase; it is especially versatile in dealing with strings, having hundreds of dedicated functions; this makes it one of the richest languages for text manipulation. Proteus owes its name to a Greek god of the sea (Proteus), who took care of Neptune's crowd and gave responses; he was renowned for being able to transform himself, assuming different shapes. Transforming data from one form to another is the main usage of this language.

5.2. Algorithm

Step 1: Start the program

Step 2 : Enter the mode of operation.

Step 3 : Evaluate mode of operation with switch case

Step 4 : Heart Beat Measured

Step 5 : Temperature Measured

Step 6 : BP Monitored

Step 7 : Data base saved successfully

Step 8 : Intimation to Doctor

5.3. Simulation Results

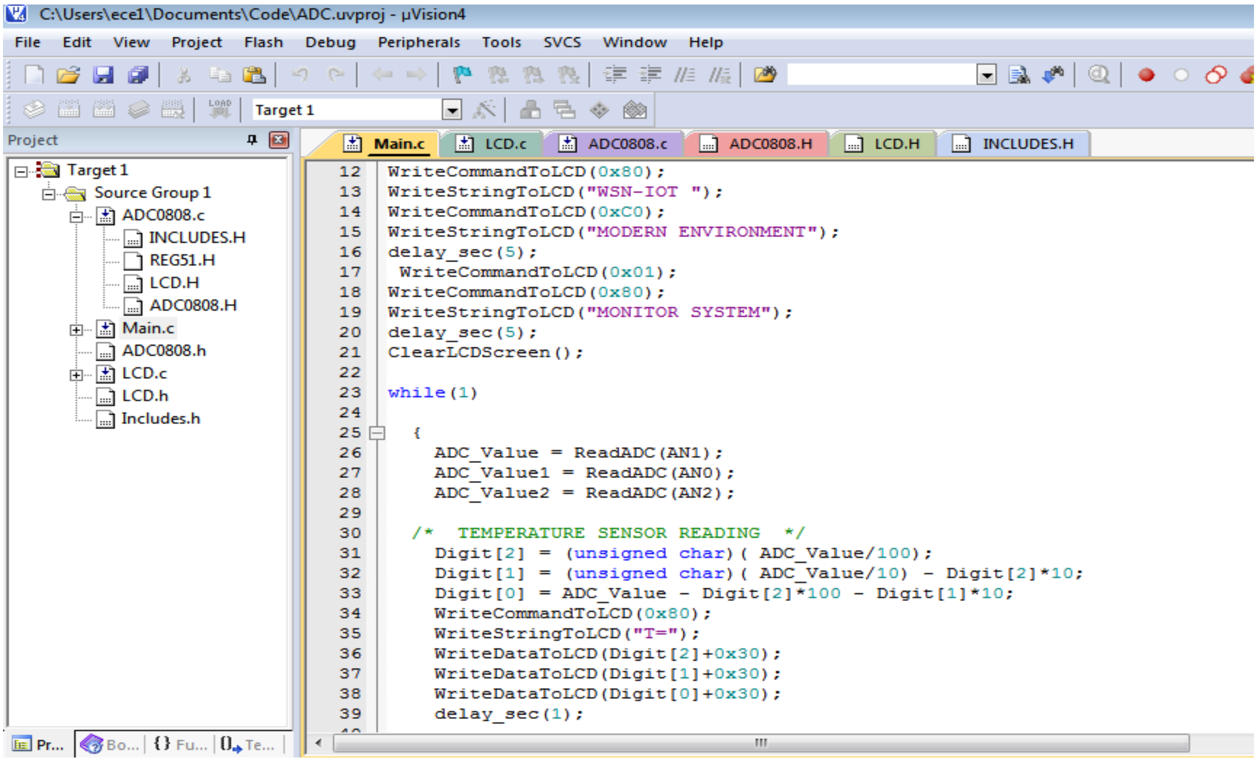

Fig. 2: Keil Program for proposed system

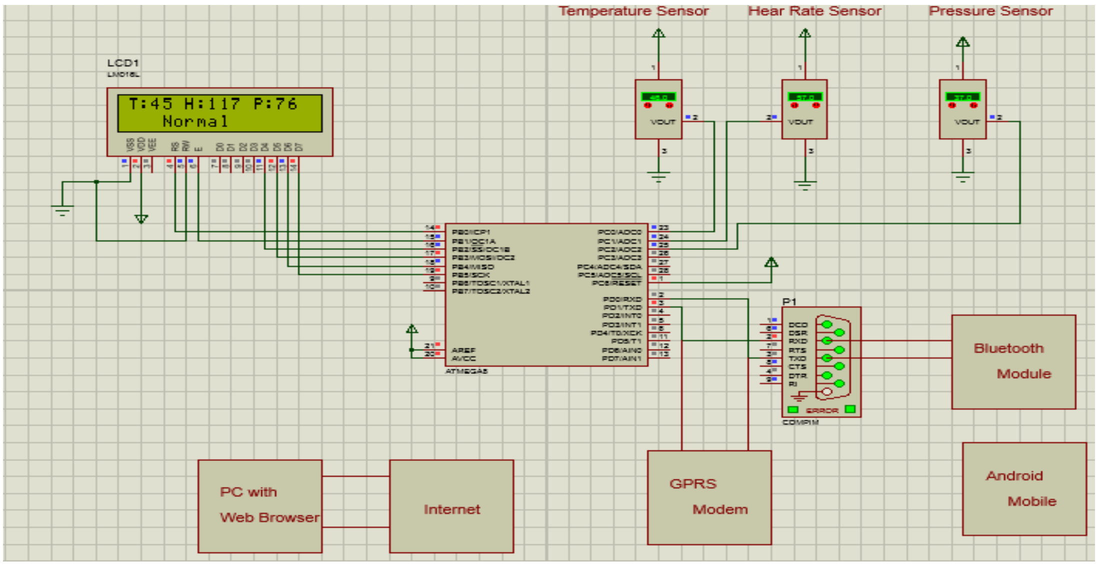

Fig. 3: Simulation results for proposed system

VI. Result Analysis

The devices sense the data from the patient's body and send them to the local system through the wireless sensor devices. Mobile application is designed for the benefit of doctors and patients. The health status of the patient is updated in the application for every 60 seconds after the update in the server. The data collected from the IoT devices to the system is huge and the information only for last three days can be viewed in mobile application.

ISBN: 978-93-86171-35-1

All parameters for the last three days can be viewed through the mobile application anywhere any time. To evaluate the PHMS, sample data is collected to monitor the patient health. Sample data on blood pressure, temperature and pulse rate are collected from ten patients are given in Table.1, Table.2 and Table.3.

Table 1: Blood Pressure Data for Ten Patients

Patient ID	Age	Gender	Day 1		Day 2		Day 3	
			Min/Max (mmHg)	Status	Min/Max (mmHg)	Status	Min/Max (mmHg)	Status
P1	16	Male	80/120	Normal	82/120	Normal	85/110	Normal
P2	19	Female	80/125	Normal	90/110	Normal	80/120	Normal
P3	21	Male	85/135	Normal	85/150	Abnormal	90/150	Abnormal
P4	23	Male	80/135	Abnormal	75/135	Abnormal	70/130	Abnormal
P5	26	Female	85/125	Normal	80/123	Abnormal	75/140	Abnormal
P6	45	Female	85133	Normal	90/130	Normal	85/130	Normal
P7	60	Female	70/133	Abnormal	92/128	Normal	90/128	Normal
P8	19	Male	80/145	Abnormal	70/130	Abnormal	75/135	Abnormal
P9	25	Male	78/135	Abnormal	90/130	Normal	85/130	Normal
P10	40	Male	85/135	Normal	90125	Normal	80/150	Abnormal

Table 2: Temperature Data for Ten Patients

Patient ID	Day 1		Day 2		Day 3	
	Current Temperature	Status	Current Temperature	Status	Current Temperature	Status
P1	96.5°F	Normal	93.3°F	Normal	94.7°F	Normal
P2	94.3°F	Normal	98.6°F	Normal	98.1°F	Normal
P3	99.3°F	Abnormal	101.4°F	Abnormal	106.2°F	Abnormal
P4	102.6°F	Abnormal	97.2°F	Normal	98°F	Normal
P5	101.2°F	Abnormal	102.6°F	Abnormal	105.3°F	Abnormal
P6	112.8°F	Abnormal	97.5°F	Normal	101.1°F	Abnormal
P7	92.6°F	Normal	100.2°F	Abnormal	105.1°F	Abnormal
P8	108.1°F	Abnormal	94.3°F	Normal	95.3°F	Normal
P9	95.4°F	Normal	114.2°F	Abnormal	96.2°F	Normal
P10	96.8°F	Normal	107.3°F	Abnormal	100°F	Abnormal

Table 3: Heartbeat Rate Data for Ten Patients

Patient ID	Day 1		Day 2		Day 3	
	Pulse rate (bpm)	Status	Pulse rate (bpm)	Status	Pulse rate (bpm)	Status
P1	102	Abnormal	107	Abnormal	109	Abnormal
P2	90	Normal	75	Normal	89	Normal
P3	105	Abnormal	109	Abnormal	104	Abnormal
P4	108	Abnormal	72	Normal	82	Normal
P5	94	Normal	104	Abnormal	107	Abnormal
P6	103	Abnormal	74	Normal	104	Abnormal
P7	98	Normal	100	Normal	78	Normal
P8	106	Abnormal	83	Normal	83	Normal
P9	91	Normal	106	Abnormal	86	Normal
P10	87	Normal	107	Abnormal	102	Abnormal

VII. CONCLUSION

This current designed system provides low complexity, low power consumptions and highly portable for health care monitoring of patient's and it can eliminates the need of utilization of expensive facilities. The doctor can easily access the patient's information at anywhere with the help of android web server. In future, we can develop a big data base of all the patients of any hospital and the these health parameters can be monitored continuously, and also the information is uploaded to the hospital server. These servers keep the information of the patients in the data base, and doctors can have the access of patient's history, when any further consultancy happens with the doctor.

REFERENCES

[1] Schnepper, Mathias Haefke, and Hartmut Ewald "A Zigbee-Based Wearable Physiological Parameters Monitoring System" IEEE sensors journal, vol. 12, no. 3, march 2012

[2] b. sirisha, t.sraddha, k. vijayanand "Real-time multi-patient monitoring system using arm and wireless sensor network" International Journal of Communication Network Security, ISSN: 2231 – 1882, Volume-2, Issue-2, 2013

[3] Gagana P, Vani K, "Fall Detection Methods for the Safe and independent living of Elderly People and Patients " International Journal of Advanced Research in Computer and Communication Engineering, Vol. 4, Issue 3, March 2015.

[4] Maradugu Anil Kumar, Y.Ravi Sekhar, "Android Based Health Care Monitoring System", IEEE sponsored 2nd International Conference on Innovations in Information Embedded and Communication Systems ICIIECS'15.

[5] P.Karthick, C.Suresh Kumar, P.Arun prasad, S.Pushparaj, M.Jagadeeshraja N.Suthanthira Vanitha “Embedded Based Real-time Patient Monitoring System”, International Journal of VLSI and Embedded Systems-IJVES

[6] Purnima, Neetu Rout, Rahul Tiwary ,Renuka Bhandari “ Zigbee and GSM based Patient Health Monitoring System ”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 1, January 2014.

[7] Manisha Shelar, Jaykaran Singh, Mukesh Tiwari “Wireless Patient Health Monitoring System”, International Journal of Computer Applications (0975 – 8887) Volume 62– No.6, January 2013.

[8] Reza S. Dilmaghani, Hossein Bobarshad, M Ghavami, Sabrieh Choobkar, and Charles Wolfe “Wireless Sensor Networks for Monitoring Physiological Signals of Multiple Patients” IEEE transactions on biomedical circuits and systems, vol. 5, no. 4, august 2011

[9] Yadav Satyendra Satyanarayan, Yadav Raghvendra Satyanarayan, Deep H. Desai “Intelligent Wireless Emergency Alert System for Patient Monitoring using AT89S52 Microcontroller” International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 2, Issue 4, April 2013

[10] shyr-kuen chen, tsair kao, chia-tai chan, chih-ning huang, chih-yen chiang, chin-yu lai, tse-hua tung, and pichung wang “A reliable transmission protocol for zigbee-based wireless patient monitoring” IEEE transactions on information technology in biomedicine, vol. 16, no. 1, January 2012