Real Time Patient Health Monitoring System Using IOT

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***Abstract*—**The increased use of mobile technologies and smart devices in the area of health has caused great impact in the world. Health experts are increasingly taking advantage of the benefits these technologies bring, thus generating a significant improvement in health care in clinical settings and out of them. The Internet of things is increasingly allowing to integrate devices capable of connecting to the internet and provide information on the state of health of patients and provide information in real time to doctors who assist. It is clear that chronic diseases such as diabetes, heart and pressure among others, are remarkable in the world economic and social level problem. The aim of this article is to develop an embedded system which is capable of monitoring the health and workout routine recommendations to patient's with chronic diseases. In Internet of Things patient's parameters get transmitted through medical devices via a gateway, where it is stored and analysed.

Keywords: *Microcontroller, Internet of Things(IOT), LM35, ECG(AD8232), Analog heartbeat, Load Cell.*

I. INTRODUCTION

Today increasingly growing number of people with chronic diseases, this is due to different risk factors such as dietary habits, physical inactivity, alcohol consumption, among others. According to figures from the World Health Organisation, 4.9 million people die from chronic diseases and million for high blood pressure. It is said that in next 10 years, deaths from chronic diseases will increase by 17%,which means in figures of about 64 million people, [1] Chronic diseases if not carefully monitored and treated early, they can end the patient's life. Patient's often take time to adapt and accept the reality of disease long-term because disability. Reason for this is that these diseases must have constant monitoring by your doctor to discuss the state of it and set the appropriate treatments. For many years the standard way of measuring blood pressure levels and heart in a specialised centre but now the technologies have been advanced in today there are variety of sensors reading vital signs such as blood pressure, heart rate monitor including electrocardiograms,[2] which allow patient's to take their vital signs daily. Although the main objective of these readers is that patients know their vital signs daily, there is reason to be second on the list priorities when taken daily shows, and is to be store the results consistently which shed daily tests so they can be the subject of medical studies. Similarly the readings that do permanently to patient's reports, doctors also recommend you workout routines that allow them to improve the quality of life and overcome such diseases.[3]The internet of things applied to the care and monitoring of patient's is increasingly common in the health sector, seeking to improve the quality life of people. The concept of internet of things is recent and is defined as the integration of all devices that connect to the network, which can be managed from the web and in turn provide information in real time, to allow interaction with people they use it.[4] Internet of Things (IOT)- driven health and wellness monitoring systems enable remote and continuous monitoring of individuals, with applications in chronic conditions such as heart failure, depression, preventive care and wellness.[5] IOT the term itself first mentioned by Kevin Ashton in 1998 and aims at the exchange of information.[6] IOT can be seen from three paradigms, which are internet-oriented middleware, things sensors oriented and knowledge-oriented semantics.[7] The IOT has a number of challenges that are still working. The purpose of hardware layer is to allow the interconnection of physical objects using sensors and related technologies. Another challenge is communication layer, which is tasked billion devices connected to network, which involves improving bandwidth and the electromagnetic spectrum.

II. RELATED WORKS

In real-world applications, more IoT-enabled devices operate on limited power batteries for prolonged time periods. The energy consumption becomes a crucial design consideration to enhance the entire network lifetime.[8] Therefore, controlling data exchange can minimize the energy expenditure and further improve network utilization. The area of health in recent years has been rapidly integrating technology in the monitoring, diagnosis and treatment of patients remotely. Thus achieving to improve the quality of life of patients and greater traceability of information from them. The study showed that the data driven event triggering has great potential to improve energy efficiency and network utilization. A long-term continuous cardiac health monitoring system highly demands more battery power for real-time transmission of electrocardiogram (ECG) signals and increases bandwidth and treatment costs and diagnostic server traffic load.

III. PROPOSED METHOD

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. This smart system 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 project, the architecture of the patient health monitoring system using IoT devices is proposed to collect the required parameters and evaluate the data obtained from the patient with medical care and next step to be followed in case of critical situation. This 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.

In this project, an IoT based patient health monitoring system using Arduino device is proposed to collect the required parameters like temperature, heart beat and ECG (AD8232) sensor and evaluate the data obtained from the IoT devices. Over the last few years, the usage of Arduino increases exponentially due to reliability, easiness, open source programming and low cost. In this paper, we introduce a new way of implementing patient health monitoring system with Arduino Uno. Data generated by the sensors are processed by Arduino microcontroller ATMEGA 328P, ESP8266 provides unsurpassed ability to embed Wi-Fi capabilities within other systems. It offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. The data generated from Arduino is available in the IoT website thingspeak.com with the use of Wi-Fi module. This system 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.

IV. SYSTEM AND OVERVIEW

The block diagram of proposed system is shown in Fig1.1.The sensors Temperature, ECG and Heartbeat are connected to the Arduino board. The values from microcontroller is given to the web server using internet. The parameter values can be viewed by doctors through thingspeak.com. In our project Arduino board is used. The microcontroller is connected with all other hardware units in the module.

A. The Lm35 Temperature Sensor

The LM35 are precision integrated circuit LM35 temperature sensors, whose output voltage is linearly proportional to the temperature in Celsius (Centigrade). The Lm35 sensor thus has an advantage over linear temperature sensors, calibrated in kelvin as the user is not required any external calibration or trimming to provide typical accuracies of -55 to +150 degree Celsius temperature range. The LM35's low output impedance, linear output and precise inherent calibration make interfacing to readout or control circuitry especially easy. As it draws only 60microamperes from its supply, it has very low self-heating, less than 0.1 degree 11Celsius in still air.

B. ECG Sensor

ECG is primarily a tool for examination of cardiac diseases. An ECG sensing device commonly consist of a group of electrodes to detect electrical events of a heart. The ECG is the electrical manifestation of the contractile activity of the heart and can be recorded fairly using with surface electrodes on the limbs or chest. The rhythm of the heart in terms of beats per minute (BPM) may be easily estimated by counting the readily identifiable waves. The amplifier takes the input from three electrodes which are connected to the patient.

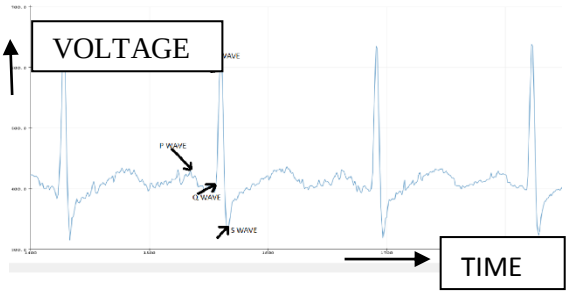

Fig1.1: ECG Waveform in Arduino Software

C. Heartbeat Sensor

Heart beat Sensor is designed to give digital output of heart beat when a finger is placed inside it. This digital output can be connected to Arduino directly to measure the Beats per minute(BPM) rate. It works on the principle of light modulation by blood flow through finger each pulse. IC LM358 is used for this sensor. Its dual low power operational amplifier consists of a super bright as the light must pass through finger and detected at other end. When heart pumps a pulse of blood through blood vessels, finger becomes slightly more opaque so less light reach at the detector. With each heart pulse, the detector signal varies which is converted to electrical pulse[9].

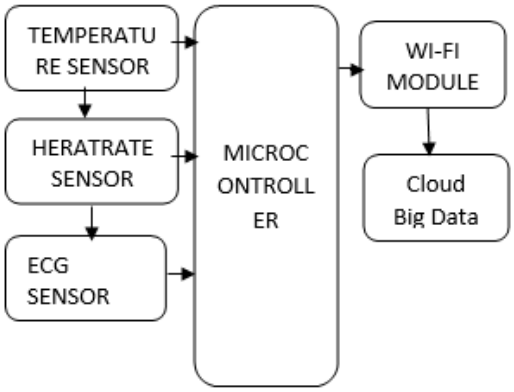

Fig1.2: Block Diagram

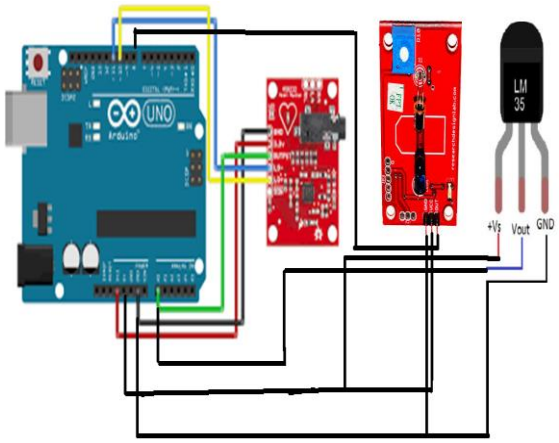

FIG: 1.3 Circuit Diagram

Sensor	Heartrate	Temperature	ECG (AD8232)
Resolution (bits/sample)	10	8	12
Sampling Rate (Hertz) Maximum	2-8	0.001-1	100-1000
Transmission Rate (bits/s)	80	8	12000

Table 1.1 Specifications Of Sensors

V. IMPLEMENTATION DETAILS

A. Arduino IDE

An integrated development environment (IDE) also known as integrates design environment or integrated debugging environment is a software application that provides comprehensive facilities to computer programmer for software development. An IDE normally consist of:

- A source code editor
- A compiler/ or an interpreter
- Build automation tools
- A debugger

Sometimes a version control system and various tools are integrated to simplify the construction of a GUI. Many modern IDEs also have a class browser, an object inspector and a class hierarchy diagram for use with object oriented software development. IDEs are designed to maximise programmer productivity by providing tightly-knit components with similar user interfaces. This should mean that the programmer has to do less mode switching versus using discrete development programs. However, because an IDE is a complicated piece of software by its very nature, this higher productivity only occurs after a lengthy learning process. Typically an IDE is dedicated to a specific programming language, allowing a feature set that most closely matches the programming paradigms of the language.

IDEs typically present a single program in which all development is done. This program typically provides many features for authoring, modifying, compiling, deploying and debugging software. The Arduino Integrated Development Environment or Arduino software contains a text editor for writing a code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to Arduino to upload programs and communicate with them.

B. IOT DATABASE thingspeak.com

ThingSpeak.com is an IOT platform that lets you collect and store sensor data in the cloud and develop IoT applications. The ThingSpeak.com platform provides apps, API keys that lets you analyse and visualize your data in MATLAB and then act on the data. Sensor data can be sent to ThingSpeak.com from Arduino, Raspberry Pi and other hardware. The following are the steps to use thingspeak.com:

Step1: Collect the data in the new channel-Create a channel, collect data and write it to a new channel.

Step2: Analyse your data – analyse and visualize data using MATLAB.

Step3: Act on your data-Set threshold limits on data to send a tweet under certain conditions.

C. WORKING OF THE PROJECT

IOT patient monitoring has three sensors temperature, heartbeat sensor and ECG sensor. This project is very useful since the doctor can monitor patient health parameters just by visiting website or URL. And now a days many IOT apps are also being developed. So now the doctor or family members can monitor or track the patient health through the Android Apps.

To operate IOT based patient health monitoring system, you need a Wi-Fi connection. The microcontroller or the Arduino board connects to the Wi-Fi network using Wi-Fi module. This project will not work without a working Wi-Fi network. You can create a zone using a Wi-Fi module or you can even create a Wi-Fi zone using Hotspot on your smartphone. The Arduino board continuously reads input from these three sensors. Then is sends this data to the cloud by sending this data to a particular URL/IP address. Then this action of sending data to IP is repeated after a particular interval of time.

ADVANTAGES OF THIS PROJECT

1] IOT monitoring proves really helpful when we need to monitor and record and keep track of changes in the health parameters of the patient over the period of time. So with IOT we can have the database of these changes in the health parameters. Doctors can take the reference of these changes

or the history of the patient while suggesting the treatment or the medicines to the patient.

2] Hospital stays are minimised due to remote patient monitoring.

3] Hospital visits for normal routine check ups are minimised.

4] Patient health parameter data is stored over the cloud. So it is more beneficial than maintaining the records on printed papers kept in the files. Or even the digital records which are kept in a particular computer or laptop or memory device like pen-drive. Because there are chances that these devices can get corrupt and data might be lost. Where as in case of IOT, the cloud storage is more reliable and does have a minimal chances of data loss.

VI. RESULTS AND ANALYSIS

The output from the sensor and amplifier circuit was connected with Arduino. The observed output signal was periodic ac signal with amplitude varying from peak to peak according to person. A model sinusoidal signal and the output from sensor were fed to Arduino and the counted pulse rate was successfully sent via Wi-Fi module. The counted signal from the sensor to measure the heartbeat was relatively a weak signal which needed to be amplified and filtered before it was sent to the Arduino. So, the signal was amplified using an operational amplifier. The amplified signal was then filtered to get the desired output of heartbeat which was then sent to the microcontroller for further processing. The microcontroller then sent the received data of both heartbeat and ECG of a patient to a remote end via Wi-Fi module. The output is received on the thingspeak.com website and is displayed. The output consist of data from sensors. It provides the data of heartbeat, temperature and ECG. Also the measured data from sensors vary depending upon their age group. This data from sensors are posted to the web.

VII. CONCLUSION

The system developed patient monitoring system based on Internet of Things, is an alternative that can be used to help patients with chronic diseases. Likewise, with this set of solutions the aim is to improve the quality of life of patients, not just monitoring them, but also to enable direct them to improve their eating habits and workout routines. By using the system the health care professionals can monitor, diagnose and advice their patients all the time. The health parameters data are stored and published online. Hence, the health care professionals can monitor their patients from a remote location at any time.

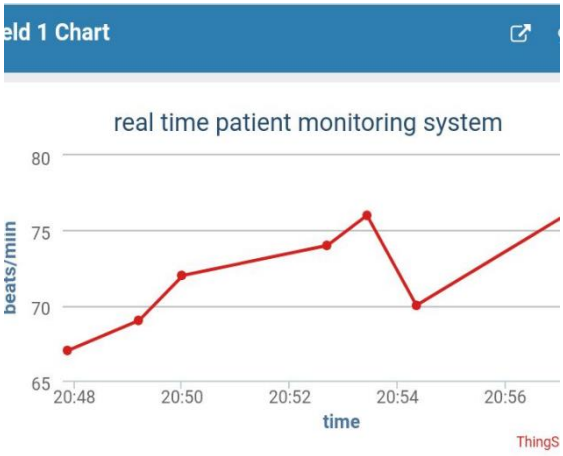

Fig 1.4: Heartrate Plot

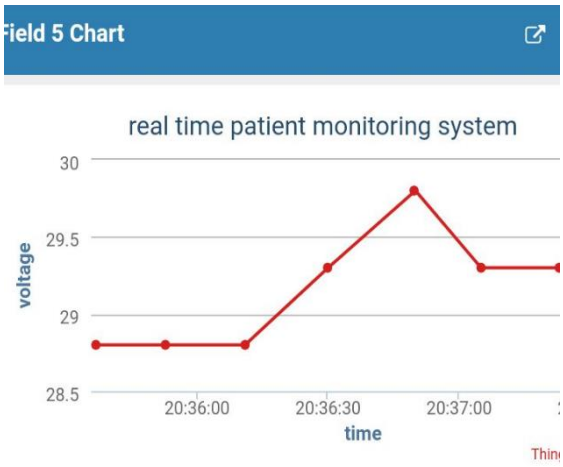

Fig 1.5: Temperature Plot

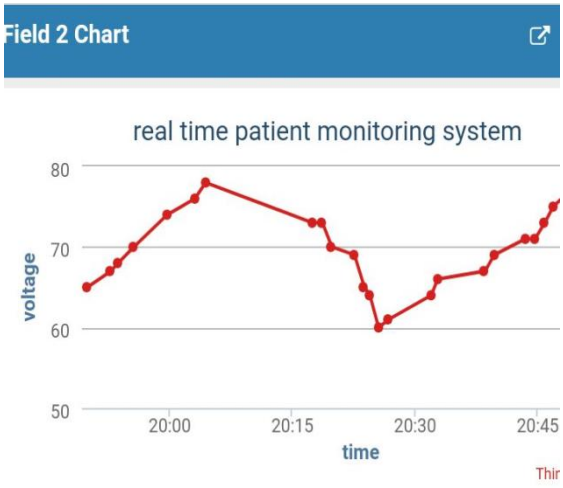

Fig 1.6: ECG Plot

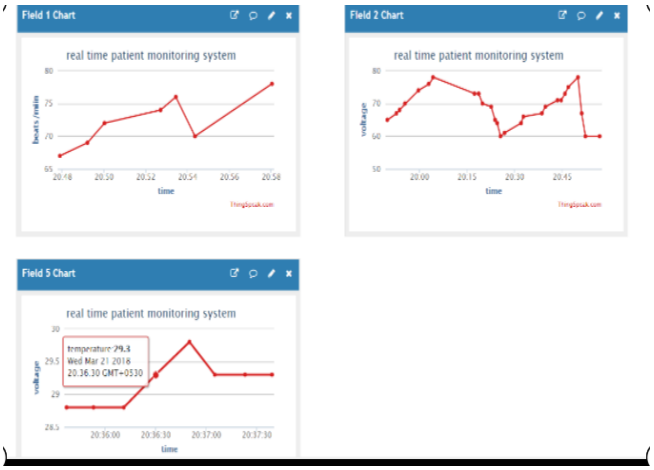

Fig1.7: Sensors Data on Thingspeak.com

VIII. FUTURE DEVELOPMENT

In this project, we designed an IoT system that is going to monitor the health of the patient continuously and uploads the values directly to the cloud with the help of TCP/IP. The physical parameters of sensors are sensed and the values are updated in the cloud periodically. These data can be accessible to the doctors who are at the far and the controlled conditions sent by them are received using the wireless devices which are using the TCP/IP. An indication can also be given by the microcontroller if the values of any 1111parameter changes beyond the threshold values. The future scope of this project is to retrieve the patient's condition from the doctors. The extension of this project will be an automatic defibrillation treatment to the patient with the help of Internet of Things.

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