JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A CLOUD BASED HEALTH MONITORING SYSTEM USING ARDUINO

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Abstract: **Health has prime importance in our day-to-day life. Sound health is necessary to do the daily work properly. Monitoring your beloved ones becomes a difficult task in the modern day life. Keeping track of the health status of the patient at home is a difficult task. Especially old age patients should be periodically monitored and their loved ones need to be informed about their health status from time to time while at work. An innovative system that automated this task with ease. System puts forward a smart patient health monitoring system that uses Sensors to track patient health and uses internet to inform their loved ones in case of any issues. This project aims at developing a system which gives body temperature, blood pressure and heart rate and SPO2 using DHT11, BP sensor and pulse Oximeter respectively. These sensors are interfaced with Micro Controller Arduino ATMEGA328. This Micro Controller Arduino ATMEGA328 is provided with a programming written in embedded c language. The data is sent to the server through wireless data transmission. This wireless data transmission is done by Node MCU (ESP8266) module. Data is transmitted on IOT platform i.e. Ubi Dots which generates the graphs of Temperature, Blood Pressure and Heart Beat over a period of time. Data visualization is done on ubidots, so that record of data can be stored over period of time. This data is stored on web server, so that it can be seen to user who logged into the website using his username and its corresponding password**

Index Terms **– Temperature sensor, Heart rate sensor, BP sensor, Arduino Micro controller, Internet of things etc.,**

1. INTRODUCTION

Health is the fundamental capability humans require to perceive, feel, and act effectively, as it represents a primary element in the development of the individual. That is why it is necessary to provide adequate ways to manage healthcare by monitoring and medical assistance. Increased life expectancy of the elderly and technological evolution led to innovative and effective solutions for in-home monitoring and treatment of patients. This introduces the use of telemedicine and home monitoring using Internet of Things (IoT).A solution for a sustainable and adaptable patient oriented infrastructure development is presented with the help of Arduino UNO R3.Thus this hopes to achieve a solution that is cheap and economically stable. This proposes architecture for the system, which is developed using the above mentioned devices. The main applications of IoT can be in healthcare, which increase the availability, quality of care and reduces costs. This system will help in real time monitoring of the patient but will be cost. Advancement in information and communication technologies has led to the emergence of Internet of Things. In the contempory health care environment, the usage of IoT technologies brings convenience of physicians and patients, since they are applied to various medical areas (such as real-time monitoring, patient information management, and health care management). The body sensor network (BSN) International Journal of Engineering and Manufacturing Science. technology is one of the core technologies of IoT elaborating in health care system, where a patient can be incident. Thus we can make use of arduino for developing cheap systems in healthcare using IoT. In our system we are measuring patient's parameters like Blood Pressure, temperature, and heart rate sensors. The persons. The doctors, patient or his caretakers are sensors values are collected and the data information is given to arduino and then it is transferred to server. The data stored in a database and can be displayed in a website that can be accessed only by authorized given authorization to view the status of the patient. With the rapid growing need for timely medical services, the traditional method of treatment at the health care falls short in success with respect to emergency cases. A method predicts the risks prior need of the hour. IoT for healthcare offers to be a vital solution for such a serious issue. Of many chronic illnesses, Hypertension has become common yet a serious disease that remains as the root cause for major Cardiac mortality and Stroke mortality.

In 2015Coronary Artery Disease (CAD) affected 110 million people and resulted in 8.9 million deaths. It makes up 15.9% of all deaths making it the most common cause of death globally. The risk of death from CAD for a given age has decreased between 1980 and 2010, especially in developed countries. The number of cases of CAD for a given age has also decreased between 1990 and 2010. In the United States in 2010 about 20% of those over 65 had CAD, while it was present in 7% of those 45 to 64, and 1.3% of those 18 to 45.Ischemic heart disease(IHD) is one of the major cause of deaths worldwide. As per WHO's report the death toll is 6.96 % in Bangladesh due to ischemic heart

diseases (IHD), which ranks it first as the cause of death. There should be extensive efforts at various levels to reduce the mortality and morbidity out of IHDs. In literature there is enough evidence to show that the risk of IHD increases with the risk factors a person has. Preventive medicine is gaining importance and popularity globally. For some diseases, prevention is better than cure. IHD episodes can be primordially, primarily and secondarily prevented. A strategy to prevent development of risk factors or control of risk factors will modify the risk of IHD. Having episode of IHD has long lasting effects on the individual from having repeated episodes of chest pain to having limited quality of life due to heart failure and even death. It is the need of the hour to make maximum number of people aware for health and make them to walk up to a doctor for preventive health checks

The organizational framework of this study divides the research work in the different sections. The Literature review is presented in section 2. Further, in section 3 shown Concept of Motivation, in section 4 shown the Proposed System, in section 5 shown the Implementation work. Experimental Results work is shown in 6. Conclusion and future work are presented by last sections 7.

2. LITERATURE REVIEW

Modern health care system introduces new technologies like wearable devices or cloud of things. It provides flexibility in terms of recording patients monitored data and send it remotely via IOT. For this connection, there is need of secure data transmission .To transmit the data with privacy is the Moto of this paper. The proposed system introduces security of health care and cloud of things .System works in two major parts viz. storage stage and data retrieving stage. In storage stage, data is stored, updated for future use. In data retrieving stage, retrieve data from cloud. The cloud server can share with authenticated user as per request. A patient with wearable devices continually updates his record every 5 or 10 min. In emergency mode, it updates for every 1min.The wearied device will send results to phone using Bluetooth connection or NFC technology. This can able to give to cloud server using GSM and 3G.

At cloud server, each patient is defines with unique address. So data at cloud can authenticate the right patient and provide the required request.[1]

Tele monitoring system via WBAN is evolving for the need for home based mobile health and personalized medicine. WBAN can able to collect the data acquired from sensor and record the output. This output results sent to controller wirelessly to health monitoring system. In this paper, Zigbee is used to in WBAN technology due to its guaranteed delay requirement for health telemonitoring system. Zigbee used in the communication.[2]

Afef Mdhaffar, Tarak Chaari, Kaouthar Larbi, Mohamed Jmaiel and Bernd Freisleben has explained low power WAN network to perform analysis of monitored data in health caring system. They have established WAN network for communication upto the range of 33m2 at around 12 m altitude. Also they have demonstrated that power consumed by LoRaWAN network is ten times less than the GPRS/3G/4G.The IOT architecture has been given for step wise working for understanding of IOT .The main purpose of LoRaWAN is the energy consumption. The power consumption in idle mode for LoRaWAN is 2.8mA while in GPRS is 20mA.Hardware cost in LoRaWAN is 10doller while in GPRS is 50 dollar. Maximum data rate in LoRaWAN is 50kbps (uplink), 50 kbps downlink while in GPRS is 86.5 kbps(uplink ,14kbps(downlink).These results gives the overall efficiency of LoRaWAN in the demonstration of IOT for health monitoring system. [5]

Mohammad M. Masud, Mohamed Adel Serhani, and Alramzana Nujum Navaz had given the measurement of ECG signals at various intervals and at different situations. They have considered energy aware, limited computing resources and lose network continuity challenges .For these challenges; mathematical model has been developed to execute each task sequentially. There are three approaches designed to work out the process .One is mobile based monitoring approach, data mining and third is machine learning approach [6]

Ayush Bansal , Sunil Kumar, Anurag Bajpai, Vijay N. Tiwari, Mithun Nayak, Shankar Venkatesan, Rangavittal Narayanan focuses on development of a system which is capable of detecting critical cardiac events. Using an advanced remote monitoring system to detect symptoms which lead to fatal cardiac events [7].

Hamid Al-Hamadi and Ing-Ray Chen gives trust based health IOT protocol that considers risk classification, reliability trust, and loss of health probability as design dimensions for decision making. Comparative analysis of trust based protocol and baseline protocols te check feasibility.[8]

Muthuraman Thangaraj Pichaiah Punitha Ponmalar Subramanian Anuradha .”Digital hospital” term is introduced for hospital management. It enables automatic electronic medical records in standard. Also discusses with the implemented real world scenario of smart autonomous hospital management with IOT.[9]

3. MOTIVATION

In the rural areas as of my survey there is a lack of proper health treatment of the people. And they don’t find proper quality of treatment. So many people get the treatment after the disease or fever gets too critical. As of considering the cost of treatment as well many of the rural people cannot afford for it. So, to make the first step of treatment process easier this project is planned. As this project is designed to give a prime parameter to diagnose the disease.

In developing countries there is lack of resources and management to reach out the problems of individuals. A common man cannot afford the expensive and daily checkup for his health. For this purpose, various systems which give easy and assured caring unit has been developed. This system reduces time with safely handled equipment. This contribution towards the society will be very worthy. Because people can detect the abnormal practice of the body before getting into any serious disease. The person who is worried more about any other loved person can take care and keep the track of his health by sitting in any corner of the world with the help of IOT.

4. PROPOSED SYSTEM

Our system continuously monitoring patient’s vital signs and sense abnormalities. The monitored data is delivered to medical staff. Upon encountering abnormalities, the system alerts the medical staff about the abnormal parameter. Thus, reduces the need for manual monitoring done by the medical staff.

Our proposed system uses Arduino with esp8266 to send data from sensors to cloud platform that is ubidots. Arduino has been programed with esp8266 module which includes the API key provided by on the things peak site. Any number users can see the medical record recorded on the ubidots using the thing speak access key.

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5. IMPLEMENTATION

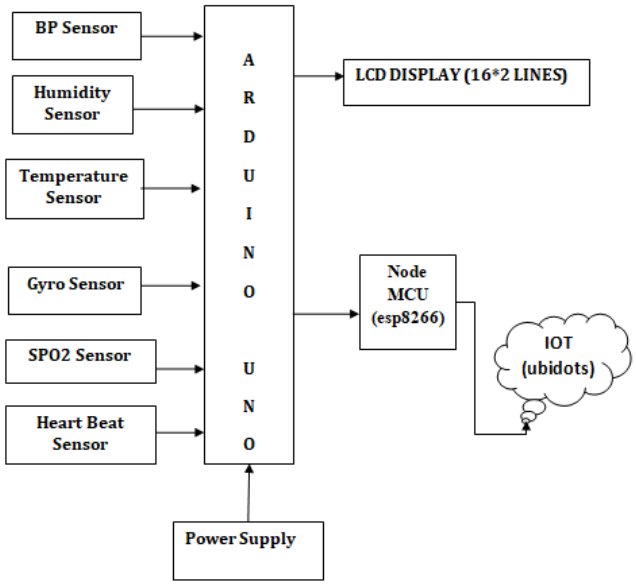

Fig.1 Proposed Block diagram

Fig 1 shows the proposed system .The health monitoring sensors are used to collect health related data i.e. for data acquisition. Communication can be done by controller for sending data on internet wirelessly. Data processing has been done at server. All data collected and aggregated at server point. To get health related information in understandable format it can be shown on web page i.e. data management.

Our proposed system uses Arduino with esp8266 to send data from sensors to cloud platform that is Ubi.com. The design a Health Monitoring System with two-way communication i.e. not only the patient's data will be sent to the doctor through SMS and email on emergencies, but also the doctor can send required suggestions to the patient or guardians through SMS or Call or Emails.

1. WORKING SYSTEM

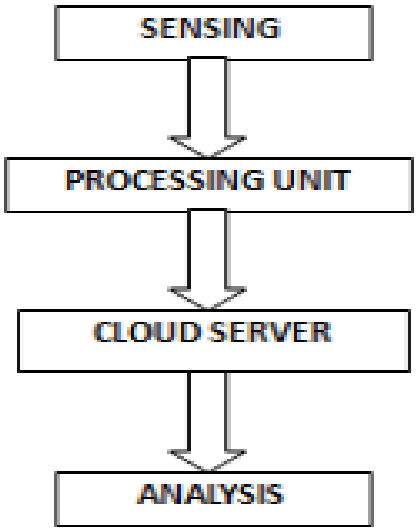

Fig.2 working flow of system

The health monitoring sensors are used to collect health related data i.e. for data acquisition. Communication can be done by controller for sending data on internet wirelessly. Data processing has been done at server. All data collected and aggregated at server point. To get health related information in understandable format it can be shown on web page i.e. data management.

Fig 2 shows the working flow of system. The results collected from sensor are analyzed i.e. if abnormal behavior has been detected , then emergency plan activated to inform the Doctor about patient's health .So it reduces critical conditions in Hospital.

2. HARDWARE REQUIREMENTS

A. Arduino

The Arduino Uno shown in fig.3 is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed byArduino.cc.The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. Simulation is done on Arduino IDE software. The ATmega 16U2 provides serial data to the main processor and has a built-in USB peripheral. Arduino Uno power cable Standard A-BUSB cable. It has 14 digital I/O pins.

Fig.3 Arduino Microcontroller

B. Node MCU

The NodeMCU (ESP8266) shown in Figure 4 is a microcontroller with an inbuilt Wi-Fi module. The total pins on this device are 30 out of which 17 are GPIO (General

Purpose Input/ Output) pins which are connected to various sensors to receive data from the sensors and send output data to the connected devices. The NodeMCU has 128KB of RAM and 4MB flash memory storage to store programs and data. The code is dumped into the NodeMCU through USB and is stored in it.

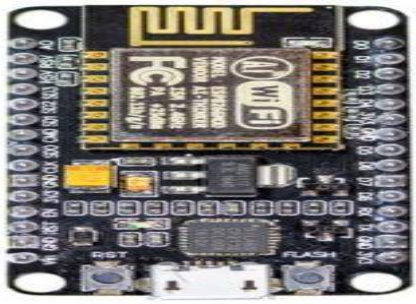

Fig.4 Node MCU (esp8266)

C. TEMPRATURE AND HUMIDITY SENSOR

DHT11 Temperature and Humidity Sensor shown in figure 5 it include a temperature and stickiness sensor complex with an adjusted computerized flag yield Temperature sensor are mainly used to measure the body temperature of the maternal. It can measure temperature more accurately than a using a thermistor. It is common for a woman's body temperature to change during pregnancy. During pregnancy the woman's body generates additional heat due to Increased metabolism, Elevated levels of hormones such as progesterone, Increased workload on the woman's body a result of extra weight as the pregnancy progresses as well as the processing and fetal nutrients and waste products. Simultaneously the woman has increased peripheral circulation which leads to dissipation of heat from the body.It covers the range from -55ºC to +150ºC..

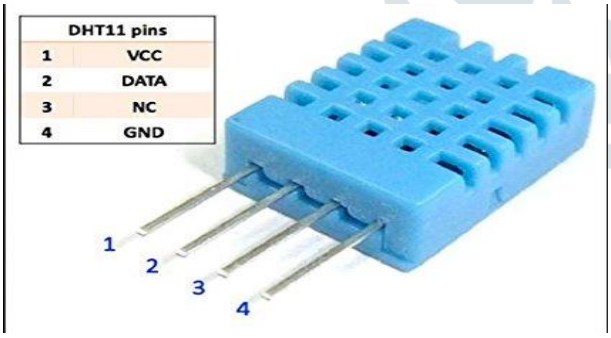

Fig.5 Temperature and Humidity Sensor

D. Pulse Oximeter

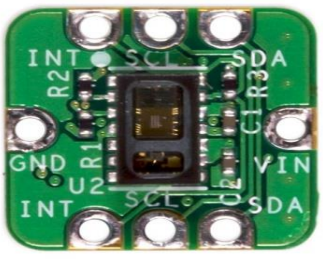

Fig.6 Pulse Oximeter

Figure 6 shows pulse oximeter . The heart rate measure kit can be used to monitor heart rate of maternal. The result can be displayed on a screen via the serial port. It is designed to give digital output of heart beat when a finger is placed on it. Operating voltage is +5V regulated and the operating current 100mA. The entire system is a high sensitivity, low power consumption and portable.

E. Accelerometer(Gyro) Sensor

One of the foremost common mechanical phenomenon detectors is that the measuring instrument sensor. Accelerometers are available that can measure acceleration in one, two or three orthogonal axis. The movements of the fetus is mainly due to the vascular state of the placental insufficiency in the uterus. These movements is known as "kicking". From the fourth month onwards the baby will start kicking but it will not observed by the mother. By measuring the fetal movement, the clinicians will be able to predict the condition and development of the fetal. Fetal movement is monitored by ultrasound scan but this is expensive. so accelerometer sensor is used. The ADXL335 is a small, thin and low power sensor, it have 3-axis with signal conditioned voltage outputs. It will measure the acceleration with a minimum full-scale range of ±3 g. Accelerometer sensor have three voltage output pins namely XOUT, YOUT, and ZOUT. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL335 is available in a small, low profile, 16-lead, plastic lead frame chip scale package. The sensor shown in fig 7.

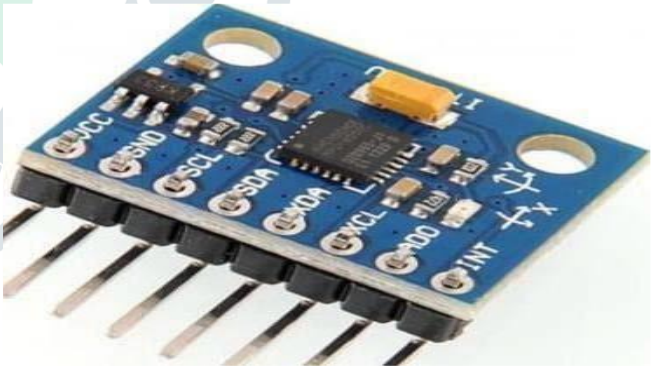

Fig.7: Gyro Sensor

F.LCD Display

LCD stands for liquid crystal display, which is used to show the status of an application, displaying values, debugging a program, etc.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. This LCD has two registers, namely, Command and Data. Shown in fig 8.

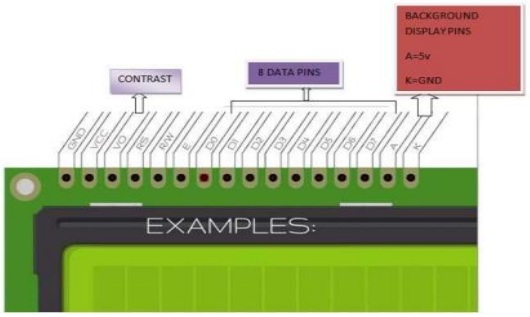

Fig.8 16x2 LCD Display

F. BP Test Kit

The Figure 9 shows a BP test kit. It is made to wrap around the upper arm or wrist then press the start button it displays the systolic and diastolic blood pressure readings and also the pulse rate. It has three pins 5v, Ground and a Tx pin using which the device can be connected to a microcontroller. Readings are taken by wrapping the pressure cuff around the upper arm and pressing the "START" button. An air pump inflates the cuff which compresses the upper arm until blood flow is cut off. Then the cuff's air pressure is slowly released. When the air pressure gets low enough, blood flow resumes but is pulsed with each heartbeat. That sound is detected by a microphone and the pressure threshold of that pulsing is called the "systolic" pressure. As the cuff air pressure continues to get lower, blood flow eventually stops pulsing and becomes continuous. The pulsing sound goes away and that second threshold is called the "diastolic" pressure

Fig.9: BP Test Kit

3. SOFTWARE REQUIREMENTS:

- *ARDUINO IDE*

Arduino IDE Arduino IDE is open source software that makes to write the code in easy manner and helps to upload it into the Arduino board and the uploaded code contains the program that describes the working of the process. The main advantage is the software can be used in any Arduino board. The Arduino can control and interact with a wide variety of sensors like temperature, accelerometer and heart beat sensor.

- *UBI DOTS*

Internet of Things (IoT) describes an emerging trend where a large number of embedded devices (things) are connected to the Internet. These connected devices communicate with people and other things and often provide sensor data to cloud storage and cloud computing resources where the data is processed and analyzed to gain important insights. Cheap cloud computing power and increased device connectivity is enabling this trend. IoT solutions are built for many vertical applications such as environmental monitoring and control, health monitoring, vehicle fleet monitoring, industrial monitoring and control, and home automation. The basics components of any Internet of Things application powered by Ubidots are: Devices, Variables, Synthetic Variables Engine, Dashboards, and Events. Within this article we will address each of these concepts as they relate to Ubidots IoT Development and Deployment Platform and how you can better organize your Ubidots Apps to best connect with the users.

6. EXPERIMENTAL RESULTS

The hardware setup is designed and the parameters such as the temperature, Humidity, Gyro and heartbeat, SPO2 and BP are measured using different sensors. The accelerometer sensor is placed along with the three axis for the measurement of the kick count of the fetus. The parameters are measured and transferred to the mobile phone through IoT and the results obtained from the different sensors are discussed in this chapter.

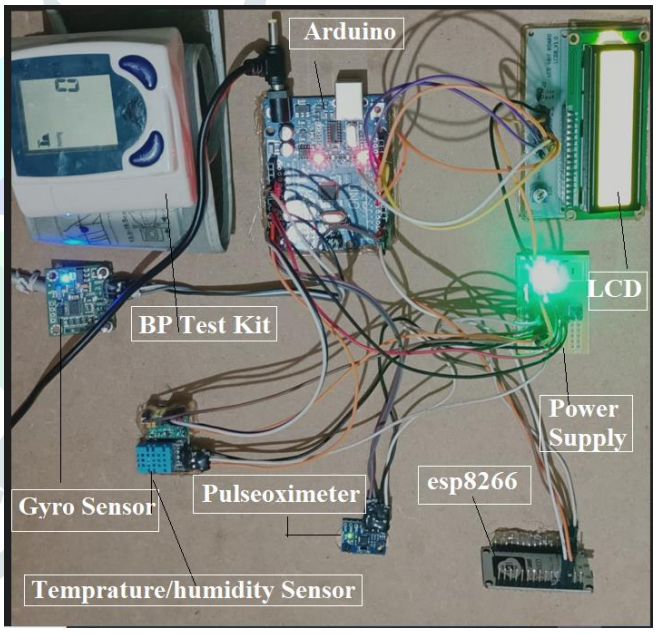

Fig .10 Experimental Hardware setup

The above Figure 10 shows the hardware setup of IoT based Health Care Monitoring System for Rural Pregnant Women. In that Accelerometer (Gyro) sensor, three axis X,Y,Z in the shows the tilt of the fetus when the sensor is placed in the mother abdominal wall. Accelerometer sensor is designed wireless and the fetal movement is measured. By using RF modules transmitter and receiver the output from the accelerometer sensor is transmitted to the Node MCU controller. LCD Display shows the displayed output of accelerometer sensor with the measured values of the three axis. The values in the accelerometer sensor vary according to the movement of the fetus.

It is designed to give digital output of heart beat of the maternal when a finger is placed on it. The temperature

of the maternal can also be measured by placing a finger on it. The blood pressure of the maternal is measured by placing the cuff over the arm.

LCD Display shows the Displayed Output for the measured parameters obtained from different sensors. This hardware setup displays the output for the parameters measured such as the BP, fall status, temperature, Humidity, SPO2 heart beat and along with the three axis in the accelerometer sensor using IoT based healthcare monitoring system.

The measured and monitored parameters of patient like temperature, humidity, BP ,Pulse and motion and data sending to IoT are shown in figures Figure 11 to Figure 16 respectively.

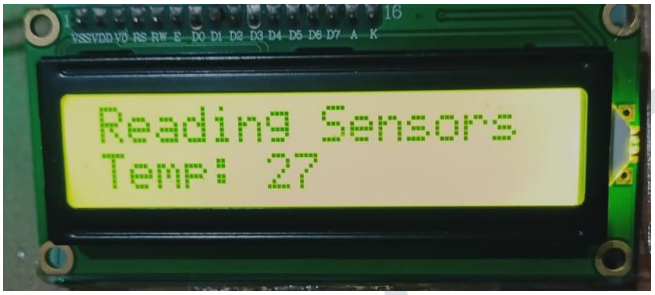

Fig.11: LCD shows that Body Temperature sensor Reading Value

Fig.12: LCD shows that fall status detected when Gyro sensor activated

Fig.13: LCD shows that SPO2 value of Patient

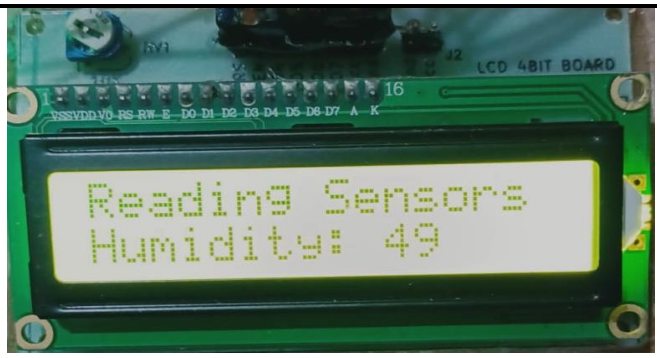

Fig.14: LCD shows that Humidity value

Fig.15: LCD shows that Pulse value of Patient

Fig.16: LCD shows that read the data from sensors and send it to IoT

The below figure 17 and 18 depicts the output of the different sensor of the patient and notification received from ubidots

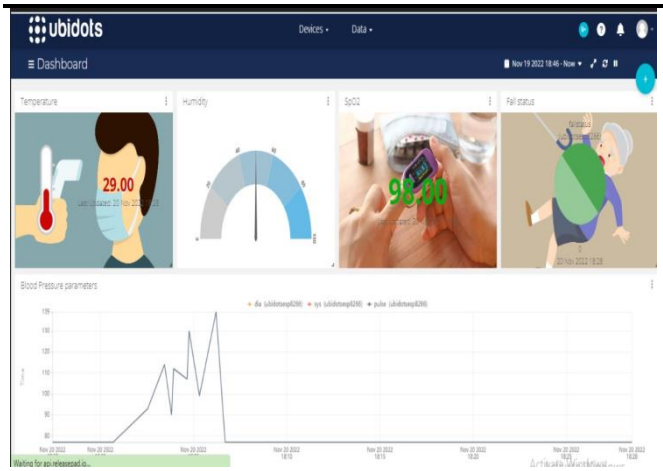

Fig.17: Shows that different health monitoring conditions of patient in ubidots.

Manually different sensor connected to ardiuno, its connected to IoT which gives values of regrading patient analysis. It shares the values both in graphical representation and values also in termite web links, it shows at above figure 17.

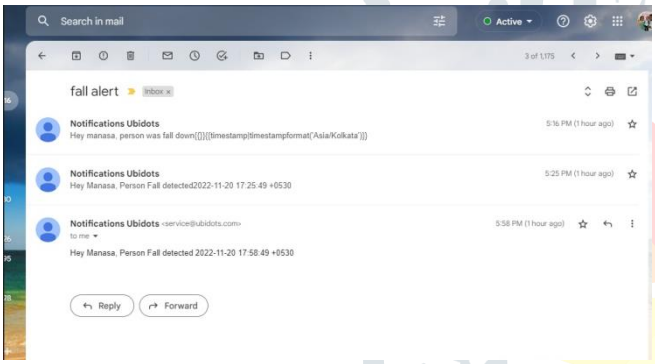

Fig.18 Shows that received alert notifications to mail from ubidots

7. CONCLUSION AND FUTURESCOPE

Now a days we have an increased risk of health conditions. In general IoT based health care platform which connects with smart sensors attach with human body for health monitoring for daily checkup. In this paper we discussed about IoT based patient health monitoring system. The importance of observing medical patient, continuous remote monitoring is necessary. Our project work is giving the opportunity to monitor patient continuously by using the web along with live monitor service. This system which helps to detect heart rate, blood pressure, temperature and Humidity of person using heart beat sensing ,blood pressure sensing, temperature sensing even if person is at home. This system also helps for hospital monitoring system, all patient monitored by single person in server room. This system which helps to measure body temperature, heartbeat, pulses of person. so we can save. With online recoding of medical parameters, the workload of the case providers and the nursing staff is reduced. The clinical information database contains all data regarding the patients in electronic form. If this technology will developed then we can detect heart blockage, bradycardia, tachycardia and paralysis ,syncope ,hypertension, hypertensive nethropathy ,hypertensive retinopathy, fever through this technology by our project.

Future Work

In our proposed system we monitor the patient different and Also we will monitor the whole ward room or patient room from far places by Wi-Fi module. Therefore, person fall detection feature will be added which would be beneficial to older people. But in the future we will upgrade both hardware and software part. In software segment we will upgrade the Website as well as the Apps. We will build a user friendly feature in the website which will show the patient name, date and time description in the ECG segment automatically. Similarly, Apps will be upgraded and uploaded in the Play store. Therefore, people will get the opportunity to download the Apps from Google Play Store and install it in their Mobile phone.

ACKNOWLEDGEMENT

The author would like to thank to department of Electronics and Communication for providing various test components and Professor & HOD Dr. M. Hemalatha for guiding about project. I have reviewed the concept very nicely and the above described project has brought me great knowledge regarding IOT and interfacing part of the hardware components.

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