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IOT based Multi Sensor Integrated Health Monitoring System for Cardiac Patients

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ABSTRACT

Today, internet is considered as an important aspect in the daily life. Lifestyle of the people has been changed a lot. Many applications are there to make the life easier. Nowadays, there are lot of health issues are being faced by the people. There are more and more people who need continuous health monitoring. It is not that much easy to monitor the patient continuously. Internet of Things (IOT) is used for such monitoring and it allows the process of monitoring remotely.

Health Monitoring System is an advanced technology which is used to monitor the patients with health issues. Internet of Things (IOT) which plays a vital role in health monitoring system. IOT is a platform which allows doctor or caretaker to access data of the patient by using an application.

The patient is monitored by measuring pulse rate, blood oxygen level, temperature and ECG of the patient from the sensor. The data is uploaded to the cloud which allows access of that parameters at any time and at any place and also sends the alert message to the registered mobile number if the parameters exceed the certain limit i.e., when patient's health is abnormal.

Keywords: Health Monitoring System, Internet of Things (IOT), Medical devices, NodeMCU, Sensors, GSM, Platform implementation, Cloud computing.

1.INTRODUCTION

Hospitals always need better management. The database of all patients should be handy enough. But also, there should be data prevention. Besides the patient data should be kept private in case. Healthcare is the most important concern of many countries in the world. Improving the lives of patients especially in the weaker parts of the society which include the elderly, physically and mentally disabled as well as the chronically ill patients is the major factor to be improved.

Previously it is impossible to monitor the patient by doctor in remote areas during critical conditions. So this method which continuously monitors the patient condition and automatically sends the data to server is introduced, so the doctor can access the data continuously and caretaker is intimated when patient is in critical condition. In previous methods, monitoring of patient can be done only by using different instruments for different parameters. But here, to monitor required conditions of patient by assembling different instruments in a single module.

Nowadays IOT is the widely used technology. The growth of internet is tremendous and has been further extended to connecting things through internet. All devices are connected to one another with various smart technologies to create worldwide ubiquitous network called Internet of Things (IOT). It records the data of each sensor and uploads the data into the server. The data can be accessible on many devices using internet with secured login and password. Patients need to be monitored constantly, 24 hours a day which is very difficult to do either at hospitals or at home.

2.LITERATURE SURVEY

Ahn et al. [1] implemented a system for measuring the physiological signals in sitting position such as ECG and BCG by using a smart

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chair that senses the non-constrained bio-signals and can be monitored using a monitoring system such as the one they had developed providing a classic example of the application of iot in healthcare.

Almotiri et al. [2] proposed a system of m-health that uses mobile devices to collect real-time data from patients in and store it on network servers connected to internet enabling access only to a certain specific clients. This data can be used for the medical diagnosis of patients and is achieved by using a number of wearable devices and body sensor network.

Barger et al. [3] made a smart house facility using a sensor network to monitor and track the movements of the patient in hoke and a prototype of the same is also being tested. The primary objective of their work is to check if their system is capable to outsmart the behavioural patterns and have discussed about the same in their work.

Chiuchisan et al. [4] proposed a framework to prevent the threats to patient in smart ICUs. The proposed system intimates the patient's relatives and doctors about any inconsistency in their health status or their body movements and also about the atmosphere of the room so that the necessary precautionary measures can be taken.

Dwivedi et al. [5] developed a framework in order to secure the clinical information that has to be transmitted over the internet for Electronic Patient Record (EPR) systems in which they propose a multi-layered healthcare information system framework which is a combination of Public Key Infrastructure, Smartcard and Biometrics technologies.

Gupta et al. [6] proposed a model which measures and records ECG and other vital health parameters of the patient using Raspberry Pi and can be of a great use for the hospitals and patients as well as their family members.

Gupta et al. [7] present an approach using Intel Galeleo development board that collects the various data and uploads it to the database from where it can be used by the doctors and also reduce the pain born by the patients to visit hospital each and every time to check their health parameters.

Lopes et al. [8] proposed a framework based on IoT for the disabled people so as to study and find the IoT technologies in healthcare segment that can benefit them and their community. They took two use cases to study the latest IoT technologies and its application that can be used mainly for the disabled people.

Nagavelli and Rao [9] proposed a novel method to predict the severity of the sickness from the patient's medical record using mining based statistical approach which they said as degree of disease probability threshold. And in order to meet their goal they have revamped an0 algorithm that is mostly needed to derive the hyperlink weight of the websites.

Sahoo et al. [10] studied the healthcare management system and about the large amount of patient data that is generated from various reports. They further analysed the health parameters to predict the future health conditions of the patient or the said subject. They use a cloud based big data analytic platform to achieve the same using the means of probability.

Tyagi et al. [11] explored the role of IoT in healthcare and studied its technical aspects to make it reality and identify the opportunities for which they propose a cloud based conceptual framework in which the patients' medical data and information can be securely transferred, with the permission of patient and their family by building a network among patient, hospital, doctors, Labs etc. The primary reason behind this is to relieve patient from the expensive clinical aid, overcome the shortage of doctors and therefore providing enhanced care and service to patients.

Xu et al. [12] presented a data model to record and use the IoT data. They designed and developed a resource-based Ubiquitous Data accessing method to collect and publish IoT data globally to so that it can be accessed anywhere, anytime. They also present an emergency medical

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service based on IoT and how to collect and use theIoT data on different platforms.

3.EXISTING SYSTEM

The GSM Based Intelligent Wireless Mobile Patient Monitoring Systemis an embedded system where a microcontroller is used to control all of its operation by a set of programs which are built on it. The main objective of this project is to monitor one's Heart Rate and Body Temperature from any corner of the world. By using GSM module, measured value of heart rate and temperature to doctor's mobile phone via SMS who lives so far away from the patient. Thus, doctor can monitor his patient remotely.

SMS based Patient health Monitoring using GSM modem -The primary function of this system is to monitor the 3 health parameters of a patient. We have monitored temperature, Humidity and Heart Beat of the Patient and the Data collected by these sensors are sent to the Microcontroller. The Microcontroller then transmits the data to the user in the form of SMS. Here we are using the GSM modem in order to transmit the information.

Patient health monitoring system using GSM-The main objective is to design a Patient Monitoring System to diagnose the health condition of the patients.Giving care and health assistance is must to the bed ridden patients at critical stages in ICU. In hospitals where a large number of patients whose physical conditions have to be monitored frequently, the need for fast responding alert mechanism is inevitable. Proper implementation of such systems can provide timely warnings to the medical staffs and doctors.The use of sensors detects the conditions of the patient and the data is collected and transferred using a microcontroller.

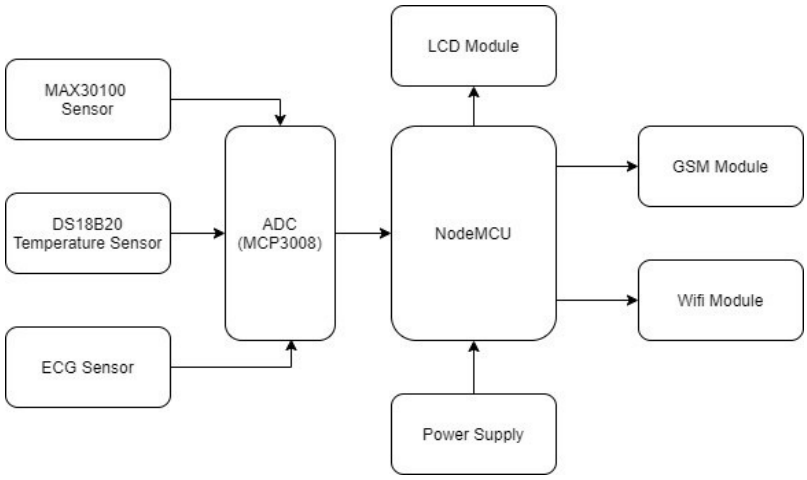

Figure 1 Block Diagram of IoT based Multi Sensor integrated Health Monitoring System for Cardiac Patients

4.PROPOSED METHODOLOGY

OBJECTIVES

- To provide a much helpful health monitoring system to the patients in remote areas where there is no easy connect between doctor and patient.
- To intimate caretaker or doctor about the patient's health by measuring some major parameters like pulse rate, blood oxygen level, temperature and ECG of the patient.
- To alert caretaker or doctor when the patient's health is abnormal using GSM technology.

BLOCK DIAGRAM

Health Monitoring System is an advanced technology which is used to monitor the patients with health issues. It is a device which has been inbuilt with multiple sensors which is used to

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measure the parameters which are needed from the patient and the data is uploaded in the cloud which allows doctor as well as caretaker to access the dataof the patient from anywhere at any time when it isneeded.

Internet of Things (IOT) which plays a vital role in health monitoring system. IOT is a platform which allows doctor or caretaker to access data of the patient by using an application. Access of data leads doctor to prescribe or to guide the patient remotely which will be helpful to maintain the patient's health.

The patient is monitored by measuring pulse rate, blood oxygen level, temperature and ECG of the patient from the sensor and the measured values are digitized and then sends it to the microcontroller or microprocessor.

The data is uploaded to the cloud which allows access of that parameters at any time and at any place and also sends the alert message to the registered mobile number if the parameters exceed the certain limit i.e., when patient's health is abnormal.

CIRCUIT DIAGRAM

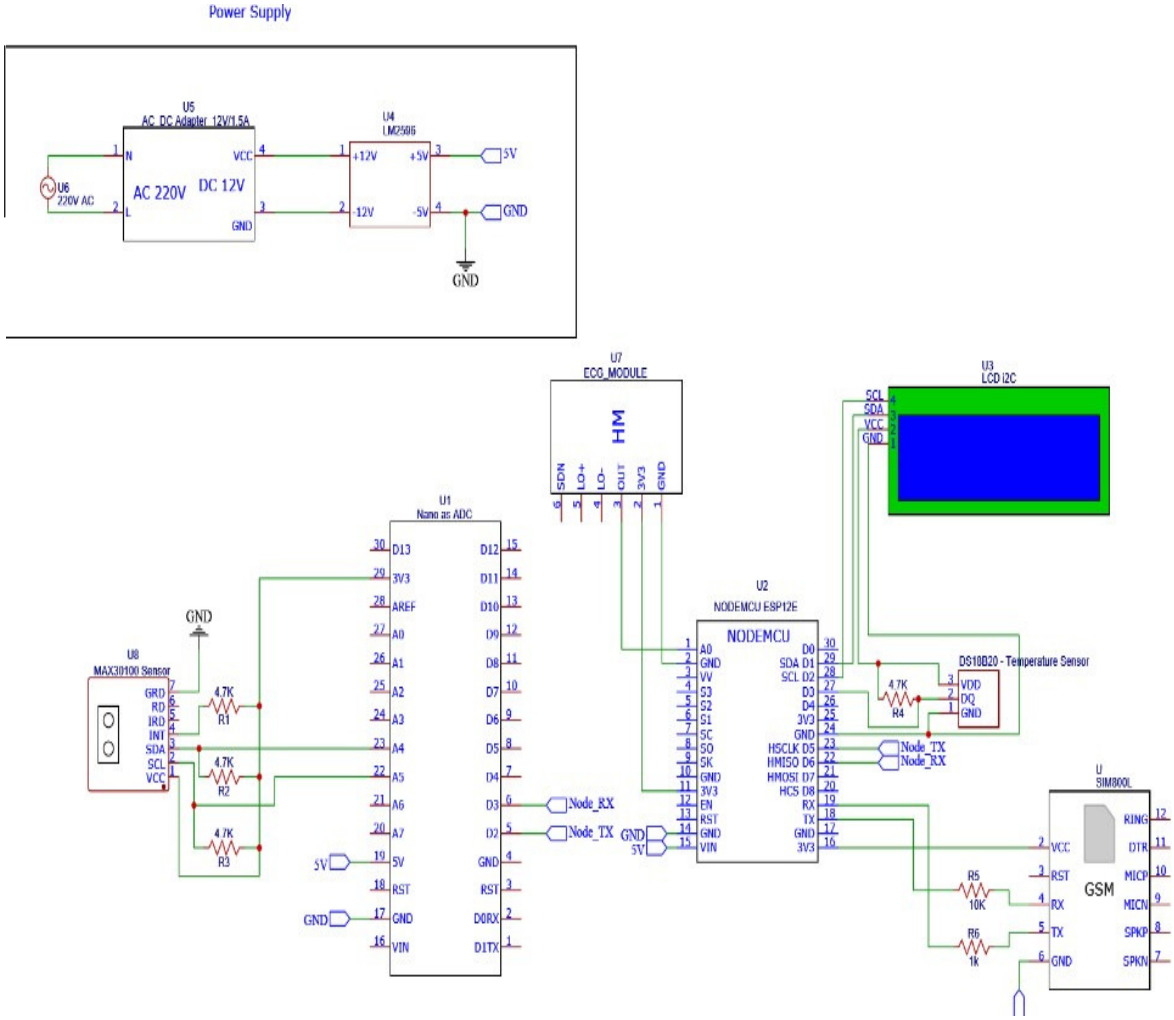

Figure 2 Circuit Diagram of IOT based Multi Sensor integrated Health Monitoring System for Cardiac Patients

DESCRIPTION

- MAX30100 is connected to ADC to convert the analog output from sensor into

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digital value and then it is given to NodeMCU which is control unit of the whole system.

- As same MAX30100, analog values from DS18B20 Temperature sensor and ECG sensor are also digitized and then they are given to microcontroller.
- After processing the values, control unit sends it to the cloud using IOT.
- Whenever the data is needed, IOT platform helps to get the information at any time.
- NodeMCU is connected to LCD to display the health parameters of the patient.
- If the parameters exceed the limit, control unit invokes the GSM to send alert message to the particulars.

WORKING PRINCIPLE

This system uses multiple sensors which are integrated as a single unit to measure pulse rate, blood oxygen level, temperature and ECG of the patient to monitor their health. ADC converts measured analog parameters into the digitized output and sends the value to the microcontroller. Node MCU which is the control unit of the system gets the digitized output from ADC as input. It sends the data to Liquid Crystal Display (LCD), then LCD displays the parameters which are obtained from the patient.

Data uploading and accessing are done by the IOT platform. The data obtained from the sensors is uploaded to the cloud which means data is stored and it can be accessible by doctor or caretaker of the patient. It gives the way to maintain the patient's health with proper guidance. An account is created for a patient to store the parameters which are obtained from the patient using sensors. It can be accessed from anywhere at any time through the internet.

Besides this system alerts the doctor or caretaker of the patient through GSM (Global System for Mobile Communication) technology when the patient's health is abnormal. So that necessary steps can be taken immediately to save the patient.

5. HARDWARE DESCRIPTION

The following hardware components are required for the implementation of this system,

- NodeMCU
- MAX30100 Sensor
- Temperature Sensor (DS18B20)
- ECG Sensor
- ADC (MCP3008)
- Liquid Crystal Display (LCD)
- i2c LCD Module (PCF8574)
- GSM Module (SIM800L)
- 12V/1.5A Adapter
- LM2596 Buck Converter

NodeMCU

Figure 2 NodeMCU

NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added.

ESP8266 NodeMcu is a popular and widely used development board based on the ESP-12E WiFi Module that combines elements of easy programming with Arduino IDE (C\C++) and WiFi capability. Through the build-in programmer and CH340G USB-to-Serial chip, flashing the ESP8266 and serial output on a PC, development and prototyping projects are done with ease. Just like Arduino boards, the ESP8266 NodeMcu has GPIO pins, voltage regulator, ADC, Micro-USB port (for flashing and serial output) – all on one board. On top of that the ESP8266 NodeMcu has a full WiFi that takes care of the WiFi communication to a server or client.

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MAX30100 SENSOR (PULSE OXIMETER SPO2 AND HEART-RATE SENSOR MODULE)

Figure 3 MAX30100 Sensor

The MAX30100 is an integrated pulse oximetry and heart-rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. The MAX30100 operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times.

TEMPERATURE SENSOR (DS18B20)

Figure 4 DS18B20 Temperature Sensor

The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with non-volatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line (parasite power), eliminating the need for an external power supply. Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area. Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems.

ECG SENSOR

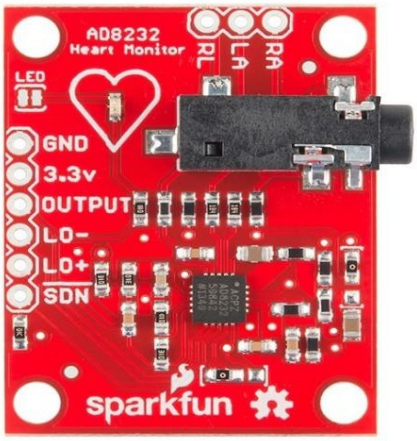

Figure 5 ECG Sensor

The **AD8232** is an integrated signal conditioning block for **ECG** and other biopotential measurement applications. The ECG sensor attached to the patient measures electrical activities of heart over a period of time. The sensor outputs are converted to digital signal. The data acquisition is carried out using microcontroller and is transmitted through IoT module

ADC (MCP3008)

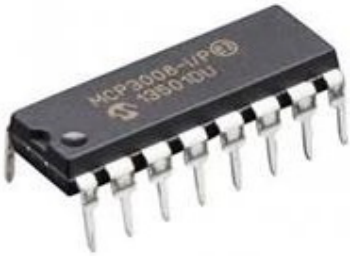

Figure 6 ADC(MCP3008)

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The MCP3008 is an 8-Channel 10- bit ADC IC, so it can measure 8 different analog voltage with a resolution of 10-bit. It measures the value of analog voltage from 0-1023 and sends the value to a microcontroller or microprocessor through SPI communication.

Liquid Crystal Display (LCD)

Figure 7 LCD

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels. LCDs were a big leap in terms of the technology they replaced, which include light-emitting diode (LED) and gas-plasma displays. LCDs allowed displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it. Where an LED emits light, the liquid crystals in an LCD produce an image using a backlight.

I2C LCD MODULE (PCF8574)

Figure 8 i2c LCD Module (PCF8574)

PCF8574 is an I2C based I/O expander IC that provides 8-bit I/O expansion for microcontrollers with I2C interface. Using just two lines of the I2C Interface i.e., the SDA (Serial Data) and SCL (Serial Clock), it is possible to configure 8 bidirectional I/O Pins.

GSM MODULE (SIM800L)

Global System for Mobile communication (GSM) is digital cellular system used for mobile devices.

Figure 9 GSM Module (SIM800L)

SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls. Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range connectivity. After connecting power module boots up, searches for cellular network and login automatically. On board LED displays connection state. GSM (Global System for Mobile Communication) sends an SMS to the doctor's mobile in alarming condition.

12V/1.5A ADAPTER

Figure 10 12V/1.5A Adapter

A **12V** DC device needs a **12V** DC **adapter**. Amperage is the amount of power the device uses. The **adapter** has to be able to supply the amount of Amps the device draws. The higher amperage (amp) **power supply** will not

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have to **work** as hard to handle a smaller load, andwill run cooler and more stable.

LM2596 BUCK CONVERTER

Figure 11 LM2596 Buck Converter

The **LM2596** is a commonly used popular step-down switching regulator IC. The adjustable version can take in input voltage from 4.5V to 40V and convert it to variable voltage sourcing upto of 3A of continues current. Because of its high current capability is commonly used in power modules to power/control heavy loads.

6.CONCLUSION

In this model the continuous monitoring of patient can be achieved by collecting the physiological information from various sensors, processing them using PIC microcontroller, transmitting the data through GSM and IoT module and storing the results in the internet, so the data can be accessed anywhere and there is no problem even the patient forgot any report while consulting a physician. Doctor can access the details by typing the particular id given to the patient. If the values exceed the reference value it alerts the caretaker of the patient.

REFERENCES

1. G. Lopez, V. Custodio, and J. I. Moreno,LOBIN: E-textile and wireless-sensor-network-based platform for healthcare monitoring in future hospital environments,IEEE Transactions on Information Technology in Biomedicine, 2010.
2. Lanata, E.P. Scilingo, E. Nardini, G. Loriga, R. Paradiso, and D. De-Rossi, Comparative evaluation of susceptibility to motion artifact in different wearable systems for monitoring respiratory rate,IEEE Transactions on Information Technology in Biomedicine, 2010.
3. S.M. Riazulislam, Daehankwak, M.H.K.M.H., Kwak, K.S.: The Internet of Things for Health Care: A Comprehensive Survey. In: IEEE Access (2015).
4. Yeh, L.Y., Chiang, P.Y., Tsai, Y.L., Huang, J.L.: Cloud-based fine-grained health information access control framework for lightweight IOT devices with dynamic auditing and attribute revocation. IEEE Transactions Cloud Computing, (2015) IoT-Based Health Monitoring System for Active and Assisted Living 19.
5. G. Yang, L. Xie, M. Mantysalo, X. Zhou, Z. Pang, L. D. Xu, et al., A Health-IoT Platform Based on the Integration of Intelligent Packaging, IEEE Transactions on Industrial Informatics Unobtrusive Bio-Sensor and intelligent Medicine Box, vol. 10, no. 4, 2014.
6. B. G. Ahn, Y. H. Noh, and D. U. Jeong, Smart chair based on multi heart rate detection system. In 2015 IEEE SENSORS, pages 1–4, Nov 2015.
7. P. K. Sahoo, S. K. Mohapatra, and S. L. Wu.Analysing healthcare big data with prediction for future health condition. IEEE Access, 4:9786–9799, 2016. ISSN 2169-3536.
8. M. Brian Blake, An Internet of Things for Healthcare, IEEE Internet Computing, pp.4-6,2015.
9. Long Hu, MeikangQiu, Jeungeun Song, M.Shamim Hossain and Ahmed Ghoneim, Software Defined Healthcare Networks, IEEE Wireless Communications, Vol. 22 No. 6, pp. 67-75, December 2015.
10. Boyi Xu, Li Da Xu, Hongming Cai, Cheng Xie, Jingyuan Hu, and Fenglin Bu, Ubiquitous Data Accessing Method in IoT-Based Information System for Emergency Medical Services, IEEE Transactions on Industrial Informatics, Vol. 10, No. 2, May 2014.
11. B. Thaduangta et al., Smart Healthcare: Basic Health Check-up and Monitoring System for Elderly,in 2016 International Computer

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Science and Engineering Conference (ICSEC),2016.

12. H. N. Costin, I. Chiuchisan and O. Geman. Adopting the internet of things technologies in health care systems. In 2014 International Conference and Exposition on Electrical and Power Engineering (EPE), pages 532– 535, Oct 2014.
13. S. Tyagi, A. Agarwal, and P. Maheshwari. A conceptual framework for IOT-based healthcare system using cloud computing. In 2016 6th International Conference - Cloud System and Big Data Engineering (Confluence), pages 503–507, Jan 2016.
14. C. Kim, A. Soong, M. Tseng, and X. Zhixian, Global wireless machineto- machine standardization,IEEE Internet Computing, vol. 15, no. 2, pp. 64–69, Mar.–Apr. 2011.
15. Goutam Motika, AbinashPrusty, Wireless FetalHeartbeat Monitoring System Using ZigBee & IEEE 802.15.4 Standard, 2011 Second International Conference on Emerging Applications Information Technology.
16. Ovidiu Apostu, Bogdan Hagiu, Sever Paşca, Wireless ECG Monitoring and Alarm System Using ZigBee, The International Symposium on ADVANCED TOPIC INELECTRICAL ENGINEERING2068-7966/ATEE 2011.
17. Real time wireless health monitoring application using mobile devices, International Journal of Computer Networks & Communications (IJCNC) Vol.7, No.3, May 2015, Amna Abdullah, Asma Ismael, Aisha Rashid, Ali Abou-ElNour, and Mohammed,Tarique.
18. M.Prakash, CJ Kavitha Priya, An Analysis of Types of Protocol Implemented in Internet of Things Based on Packet Loss Ratio, Proceedings of International Journal of Information and Communication Technology for Competitive Strategies, ISBN: 978-1-4503-3962-9, DOI: https://doi.org/10.1145/2905055.2905085, 4th– 5th Mar 2016.
19. Dr.A.Sabanayagam, G.Anish Girija, DESIGN AND MODELING OF MOBILE HEALTH MONITORING SYSTEM, International Journal of Innovations in Scientific and Engineering Research (IJISER),vol4,no 2,pp.63-65,2017.
20. I. Chiuchisan, M. Dimian, and U. Street, INTERNET OF THINGS FOR E-HEALTH: AN APPROACH TO MEDICAL APPLICATIONS, in Computational Intelligence for Multimedia Understanding (IWCIM), 2015 International Workshop on, 2015.

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