IoT Patient Health Monitoring System Using ESP8266 Wi-Fi Module

Aishwarya Vakhariya*, Snehal Pawar,Urmila Bandgar, Prof. A.N. Shaha
Department of Electronics and Telecommunication, Government College of Engineering, Karad, Maharashtra, India
****Corresponding Author***
Email Id: aishwaryavakhariya31@gmail.com

ABSTRACT

Nowadays Health-Care environment has developed science and knowledge based on Wireless-Sensing node technology oriented. Patients are facing a problematic situation of unforeseen demise due to the specific reason of heart problems and attack which is because of non existence of good medical maintenance to patients at the needed time. This is for specially monitoring the old age patients and informing doctors and loved ones. So, we are proposing an innovative project to dodge such sudden death rates by using Patient Health Monitoring that uses sensor technology and uses internet to communicate to the loved ones in case of problems. This system uses temperature and heartbeat sensor for tracking patient's health. Both the sensors are connected to the Arduino-uno. To track the patient health micro-controller is in turn interfaced to an LCD display and WI-FI connection to send the data to the web-server (wireless sensing node).In case of any abrupt changes in patient heart-rate or body temperature alert is sent about the patient using IoT. This system also shows patients temperature and heartbeat tracked live data with timestamps over the internetwork. Thus, Patient health monitoring system based on IoT uses internet to effectively monitor patient health and helps the user monitoring their loved ones from work and saves life.

Keywords: *Wireless sensing node technology, Patient health monitoring, IoT, Arduinouno.*

INTRODUCTION

The increased use of mobile technologies and smart devices in the area of health has caused great impact on 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. Likewise, countless ordinary users are being served from the advantages of the M-Health (Mobile Health) applications and E-Health (health care supported by ICT) to improve, help and assist their health. According to the constitutions of World Health Organization (WHO)the highest attainable standard of health is a fundamental right for an individual. As we are truly inspired by this, we attempt to propose an innovative system that puts forward a smart patient health tracking system that uses sensors to track patient vital parameters and uses internet to update the doctors so that they can help in case of any issues at the earliest preventing death rates. Health monitoring using IoT is a technology to enable monitoring of patients outside of conventional clinical settings (e.g. in the home), which may increase access care right to the home. In addition, patients and their family members feel comfort knowing that they are being monitored to care and decrease healthcare delivery costs. This can significantly improve an individual's quality of life. It allows patients to maintain independence, prevent complications, and minimize personal costs. This system facilitates these goals by delivering and will be supported if a problem arises.

IoT based patient health monitoring system is a generic term given to any medical equipment

that has internet capability and can measure one or more health data of a patient who is connected to the device such as heartbeat, body temperature, blood pressure, ECG, steps etc. The equipment can record, transmit and alert if there is any change in the patient's health**.** By this definition, it includes devices such as smart-watches, fitness trackers, smart-phones to expensive hospital equipment which can connect to internet. IoT based health monitoring system is used where the patient and heath expert(s) are at different locations. For ex., a patient can stay at home and continue his/her routine life and a doctor can monitor patient's heath. Based on the received data the heath expert can prescribe a best treatment or take an immediate action in case of an emergency.

LITERATURE SURVEY

In[1], author has presented "An IoT Based Health care monitoring system". Constant observation is required in hospitals where the patients are under medical care for a longer period of time. Although the patient is not in a critical situation, the doctors still need confirmation on their health parameters. Now a day, the expenses for hospitalization are high and expensive. So the health policies in various countries have shifted its focus from providing reactive, acute care to provide care outside the hospital. Hence author designs and build the sensing data that conditions system to display accurate body parameters of the patients.

In [2], Model allows the doctors to monitor patient health from anywhere. The proposed system helps people to consult the specialist all over the world. The system uses IoT and wireless sensor technology for efficient health monitoring. The data from sensors is taken every 30seconds. The data is stored and can be visualized on the web server. The system is implemented in such a way that if the sensor data exceeds the threshold values, a message is sent to the doctor. The main advantage is in case of emergency the intervention time between doctor and patient is reduced. The objective is achieved by proposing a low-cost system for saving human lives so that human lives will be comfortable. The limitations are the doctor's availability and the proposed model doesn't include the blood pressure monitoring system.

In [3], paper represents the patient's physiological signals are acquired by the various sensors attached on the patient body, and are then transmitted to the remote base-station and also PC/Laptop/Smart phone for storing and analyzing. The main microcontroller used in this work is the Raspberry Pi 3 Model B. The GSM module and Zigbee modules have also been interfaced with the microcontroller through wire interconnections and programmed and finally fixed at the patient hospital bed. The fingerprint sensor is interfaced with the microcontroller so as to grant access only to the concerned doctor/nurse and not some other physician at the hospital. Raspberry-Pi is used as a sensor node as it has better features compared to the other controllers.

In [4], author has designed a health monitoring terminal device, which collects the physiological and position information of the human body through sensors, displays real-time data through the screen, and uploads data through the NB-IoT module. The experimental results show that the device has excellent performance in measuring heartbeat and GPS position. We built our own web application in the cloud server, which is used to permanently store the collected data and provide web services for data query. At the same time, we apply email alerts to human health monitoring. In an emergency, the user's physiological and location information is sent to the doctor/family, and the new email reminder function is used to achieve the same effect as the SMS alarm.

In [5], author has presented "A Literature Survey in ECG Feature Extraction". Patient's health has been observed in this paper. There is a well-organized health monitoring system developed and designed by author. The system enables the doctors to monitor patient's health parameters (temp, heartbeat, ECG, position). The parameters of the patient are measured continuously (temp, heartbeat, ECG) and wirelessly transmitted using ZigBee. It provides a solution for improving the performance and power management of the patient health monitoring system. The presented system is used to continuously observe and analyze the data in microcontroller. If a particular patient's health parameter falls below the particular range, SMS is sent to the doctor's mobile number using a standard GSM module. They have used Zigbee for wireless networking. The doctor can collect a record of a particular patient's data by accessing the database of the patient on the irrespective Personal Computer, Laptop and Mobile which is persistently updated through Zigbee.

In [6], author presented "IoT Based Patient Monitoring System". It is a mobile physiological monitoring system that is capable of continuously monitoring the patient's heart rate using ECG. Using replaceable electrodes ECG sensor can be attached to the patient's chest. Signals produced during muscle contraction is sensed by the system and recorded. The signals collected from the body are converted to an electrical signal. This paper shows the use of smart healthcare system. This new technology is capable of offering a large range of benefits to patients through early detection of abnormal conditions.

In [7], author presented "Health Monitoring Systems using IoT and Raspberry Pi". IoT Raspberry Pi based health care monitoring system has been analyzed by author in this paper. Any unusuality in condition of patient health can be detected and informed to the related person of patient. The elemental component of ECG is Instrumentation Amplifier, which is responsible for taking the differences in the voltage. The exhibited system is efficient and easy to understand. It is a connection between patient and doctor.

In [8], author presented a "Review on-IoT Based smart healthcare system". Here architecture of Smart Health Care Monitoring and IoT is demonstrated by author. New technologies help in minimizing the better quality as well security concept. ECG signals are obtained by electrodes that are placed on the chest. Later wires are connected to ECG sensor (AD8232).The sensor is used in measuring the electrical activity of the heart. Problems and challenges that could be faced in future are presented by this system. Applications of IoT can be improved using new methodologies and technologies. Sensors like Blood pressure, Temperature, Heart rate, ECG are used in IoT along with Raspberry Pi kit and Wi-Fi module.

In [9], author has presented "An Overview on Heart rate Monitoring and Pulse Oximeter System". In this paper a low-cost device is described that measures the heart rate of the patient by placing sensors on the fingers, later the result will be displayed on LCD. The designed system can be used by unprofessional people. The change in heart rate can be displayed by graph using graphical LCD. Over a period of time, maximum and minimum heart rate can be displayed using the designed system. Abnormalities are displayed on LCD indicated by buzzer. In order to send heart rate to PC output should be attached.

In [10], author has presented "Heart rate Measurement from the Finger Using a Low-Cost Microcontroller". IoT has a wide range of application. IoT has been developed for Wireless sensor network (WSN). Using IoT, health monitoring designs are presented. There are some problems that are related to health monitoring and IoT. New technologies help to minimize

better quality as well as security concept. New technologies and methodologies are used. Aurdino board, Wi-Fi modules, temperature, pulse oximeter, blood pressure, heartbeat rate sensors are used in IoT.

In [11], author has presented, "Heart Attack Detection and Heart Rate Monitoring Using IoT". In this paper with the help of observed heart rate through IoT device, heart attack can be detected. Here the method used by author includes Arduino board, Wi-Fi module and pulse sensor. Pulse sensor will start sensing the heart rate readings once the system is set and heart rate of the patient will be displayed on LCD screen. Data can be transmitted over internet with the use of Wi-Fi module. By checking a patient's heart rate it can be determined if the patient is healthy or not based on heart rate displayed on the LCD screen. Limits are set to the system, heart rate of the patient is monitored and immediately alert message will be sent by the system if the heart rate goes below or above threshold value. They have implemented an application that will track and monitor heart rate of patient

In [12] correctly and message will be sent in case of possibilities of heart attack. In [13], author has presented "Heart rate Monitoring System". This paper explains a unique contribution in identifying all components of an IoT healthcare system. A generic model is proposed that can be applied to IoT based healthcare monitor. It is important and no known end-to-end system is found for remote monitoring of health issues. Here concentration is given more on the sensors to observe the various parameters of the patient body. The contribution is done by concentrating on LPWANs (Wide Area Network), by focusing on their unique suitability for use of IoT systems.

In [14], author has proposed "Survey Paper for Health Recommender System". Here various parameters of the human body are detected by the designed health monitoring system. Later this data is made available to doctors via internet. In case of emergency when the person is not in a state of conscious, the alerts will be generated automatically and sent to the doctor. Here records of health parameters can be instantly used.

People pay attention towards prevention and early identification of disease, Author has examined aurdino based health monitoring system. Disability can be detected in the health through sensors through internet and informed to the particular person. The proposed architecture is efficient and easy to understand. It plays as a connection between doctor and patient.

In [15], author has presented "Remote Health care Monitoring System using Arduino Board over Distributed Ubiquitous Environment". Here author concentrates on IoT based Smart Healthcare System. The major objective of this designed system is to transfer the patient's health parameters. This paper proposes the efficient system for observing patient pulse rate and temperature. The system uses pulse sensor to keep track of heart rate the patient. With the use of sensors we can access the various parameters of body. These input data are transmitted to the computer for family and doctor's for reference. Thus in the modern health care system, the usage of IoT technologies have brought many benefits for patients,

In [16], author has presented "Zigbee and GSM Based Patient Health Monitoring System". Here a system is presented with a technique that will upgrade the health monitoring systems inthehospitalsbyprovidingmonitoringcapability.Thesystemiswirelessbased.Asit'sawireless device, the cost of cables is affordable. Unless unusual condition of patient is not captured

there will be persisting observation of important signs of patient over long duration. Critical situation of patient can be overcome.

The major objective of this paper is to design a patient health monitoring system that alerts the staff in the hospitals so that instant care is made available to the patients. With the help of proposed system, staff work can be reduced persistent monitoring capability is provided. In upcoming days work may include a number of sensors in a single system.

IoT IN HEALTHCARESYSTEM [17]

Modern healthcare systems are conducted with the help of various technical aspects such as wearable devices, a cloud of things, and IoT. The health care department can monitor all activities of patients, record patient's data, and send these data remotely with the presence of the Internet of Things.

Secure data transmission is important to maintain this connection. To implement IoT in the healthcare department, this technology is designed properly with high-performing and multiple communication standards. To maintain information-intensive health applications a resource-based data retrieving method is introduced. To control the activities of patients this technology is combined with a smart box, which is treated as a medical system. To increase security in data transmission, Web Real-Time Communication process is implemented properly.

An electronic sphygmomanometer is enabled to maintain communication *via* Bluetooth and other android applications. This technology is involved in the recording of any transmitted data by using mobile devices and other electrical devices. Distributed flow environment for Internet of Things healthcare is involved in real- time application. To maintain patient's information local server and communication process is implemented when a patient is under the observation of any healthcare department.

To analyze electrocardiogram signals an IoT based system with embedded medical platforms is used, this system is conducted by maintaining various heart functions. In a few cases, to increase mobility of patient IoT Portable Medical devices are implemented in the healthcare system. However, use of IoT Portable Medical Devices can increase security threats and negative drawbacks. To predict various kinds of disease, light-weight IoT devices are used with existing databases. Therefore, IoT can implement a cloud-based high-performing fine-grained health information access control framework to collect information about security related issues and cloud reciprocity issues.

To challenge real-world application a proxy-based approach is implemented for IoT devices. For blind people, the Internet of Things can introduce a portable electrical device with mounted ultrasonic range finders. These devices help blind people to detect any obstacle near then, by using Bluetooth headphones. To alert blind people by vibrio tactile feedback, IoT can introduce depth sensor-based den navigation systems, however, this system is consists of a limitation of database connectivity. Implementation of IoT is conducted by maintaining four-protocol layers. Sensors and transmitters are linked with systems in the physical layer. Signal transmission from sensors to the cloudlets is conducted through a network layer. The Middleware layer can store data in the cloud and incense availability of data. Analysis and diagnosis processes are conducted in the application layer.

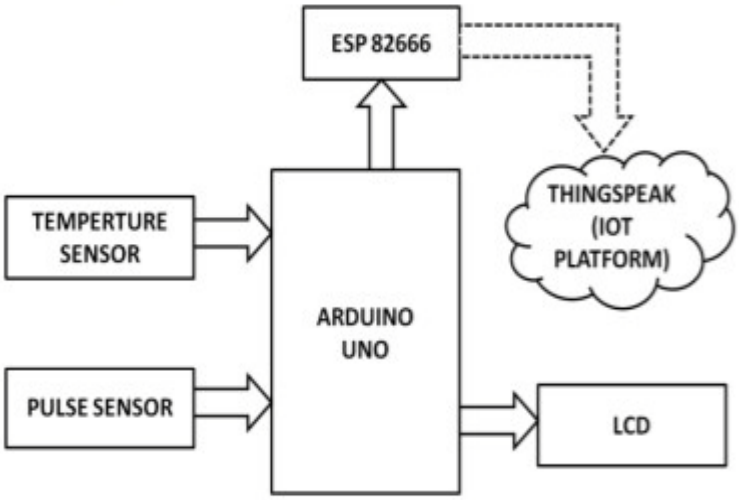

Fig. 1. System of IoT Block Diagram

Figure1depicts that the proposed system of the Internet of Things. To collect health-related data various health monitoring sensors are used, such as, communication and data acquisition are conducted by controllers, who are involved in data transmission via the internet. Server is able to maintain data processing, where all data is collected and aggregated properly. This entire process is shown in the web page to provide an understandable format of health-related information such as data management.

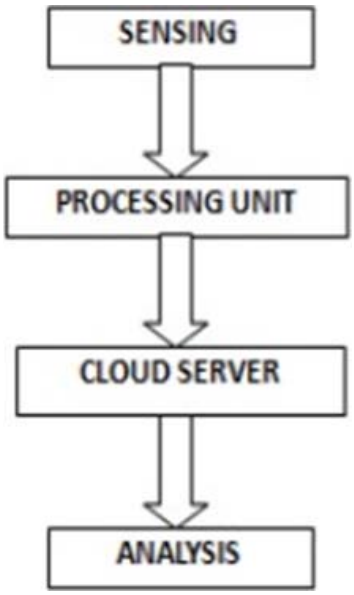

Fig. 2. Work Flow of IoT System

Figure 2 can provide information about workflow of the system. Firstly, sensors can provide results towards the analysis phase via processing units and cloud servers. In the analysis phase, results are analyzed, if any abnormal activity is found, then this system can enable emergency activity and provide information towards doctors about patient health. Subasi et. al. (2018) stated that, critical conditions in hospitals are maintained by this process.

COMPONENT OF IoT

1) **Arduino uno:** this is a microcontroller, which is working with the help of AT Mega 328. Arduino IDE software is involved in the simulation process. The main process can collect serial data with the help of at mega 16U2 and also help to create USB peripherals.
2) **Temperature Sensor:** to measure body temperature of body LM35 sensor is used. This sensor is put in contact with the body to measure body temperature. LM35 calibrated linearly in Celsius. Low self-heating capabilities peasant in LM35, this sensor is conducted without the help of any external calibration.
3) **Pulse Sensor:** to provide an analog output of heartbeat this plus sensor is developed, this sensor provides an analog output when finger is placed in sensor. This sensor is contains LED on top site, which indicates each heartbeat. The output pin of sensor is connected with the controller to provide sensor output. Light modulation by blood flow is the main principle of this sensor.
4) **Wi-Fi Module:** To maintain any controller access in the WI-FI network, the ESP8266 module is implemented. This module is conducted with a self-contained SOC-and high-performing TCP/IP protocol. Along with this 802.11b/g/n protocol is used in this module.
5) **IoT Platform:** In the healthcare system Think speak platform is used to transfer data from any internet- enabled device, which can help developers to capture sensor data easily. This platform can provide information about action and alert, which mainly depends on real-time data. Visual tools are used in this case to unlock the value of data.

CURRENT USE OF IoT IN HEALTH CARE INDUSTRY [18]

There are a number of scopes for IoT in order to make a difference in the lives of patients. The devices can capture as well as monitor related data regarding patient and allows the providers to obtain the insights without bringing the patients visiting. The procedure can assist the patient results as well as preventing the possible communications for the process that involves risk. However, lack of EHR system integration is one of the major issues faced while using IoT in healthcare. Some of the EHR systems allow the patients importing data into the record. However, it remains limited to a few dominant where the EHR players as well as leaves providers unspecific of the processing data that can be helpful for the organization to use the process. The challenges for interoperability in order to keep data in distinctive medical devices depend on the purpose and ordering physician.

IoT helps to grow an interest in leading healthcare device manufacturers, dealers as well as suppliers to invest heavily in the Internet of Things. In result, they get returns in terms of real time promotions as well as efficient inventory management that help to grow sales and reduced operational expenses. The Internet of Things is fragmented as well as the expertise referred to exist across the various parts of the value chain such as communications connectivity provider, hardware OEMs, data storage, analytics and applications (Subasi *et al.*, 2018).

The aim of this paper is to analyze the IoT opportunities for healthcare device manufactures and the limitations within the ecosystem. Nurses and technicians are responsible for inputting patient data into a centralized digital system. Mobile industry have led to standardized qualitative care for patients and a superior healthcare professional that enhanced and garner patient's multitude of needs. Health and fitness app help them to keep track of their daily food intake, thus maintain proper nutrition level of all inhabitants and doesn't led switch them to anorexia nervosa and bulimia nervosa by offering customized solutions.

BENEFITS OF IoT IN HEALTHCARE INDUSTRY

1) **Decreased Operational Cost:** IoT technology in healthcare can decrease operational costs. It has huge potential to reduce costs and improve patient outcomes by offering the best IoT medical devices. A report by Strategy Analytics says that Healthcare IoT may save up to a quarter of business costs. IoT healthcare applications can drive down costs and optimize cost level by providing more robust features.
2) **Better Patient Experience:** The healthcare industry is adopting IoT hospitals for better patient experience. IoT connected healthcare applications offer remote monitoring and make physical spaces smarter and more integrated. The overall efficiency of operations, clinical tasks, and management of essential resources improve the patient's experience.
3) **Reduced Errors:** IoT healthcare applications help physicians practice, prevent, and diagnose medicine more easily. With real-time data and the possibility to analyze past treatments and diagnosis of a patient – Smart healthcare systems using IoT helps to reduce errors. Moreover, constant automated monitoring and enhanced study of the patient's condition leads to proper treatment without the possibility of error.
4) **Improved Outcomes of Treatment:** The data gathered by IoT healthcare devices are highly accurate and enables the doctors to make informed decisions. Patient history can be analyzed and measured swiftly. Data can also be sent to a board of doctors or healthcare professionals on a cloud platform. The AI-driven medical IoT devices support making intelligible decisions or suggestions based on existing data leading to improved outcomes for the treatment.
5) **Improved Disease Management:** IoT healthcare application benefits in eliminating the need for a health care professional by providing ubiquitous monitoring systems that can be used for disease management. Furthermore, readily accessible sensors and gateways analyze data and communicate it wirelessly to medical professionals giving added scope to improved disease management systems.

CONCLUSION

A summary of Health Monitoring system is discussed in this paper. This paper includes various technologies and applications for IoT based Health Monitoring system. It also explains and analyzes various applications, implementation and methods for the process of IoT based Health Monitoring system. Every technology has got their own applications and restrictions. The summary of this paper shows that which technique and applications should be adopted to improve the quality of IoT based Health Monitoring system.

REFERENCES

1) Sneha N.Malokar, Samadhan D. Mali."AIOT. Based Health Care Monitoring System", Int.J. of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 6(1), June2017,pp.4661-4667.
2) S.P. McGrath, I.M. Perreard, M.D. Garland, K.A. Converse, and TA. Mackenzie, "Improving Patient Safety and Clinician Workflow in the General Care Setting With Enhanced Surveillance Monitoring," IEEE J. Biomed. Heal. Informatics, vol. 23, no. 2, 2019, pp.857–866.
3) Bell, P. Rogers, C. Farnell, B. Sparkman and S. C.Smith, "Wireless patient monitoring sytem, "Healthcare Innovation Conference (HIC): IEEE,Seattle,WA,2014.
4) G.P.Guano, D.Alulema, and E.V.Carrera, "A portable electronic system for health monitoring of elderly people," in IEEE Colombian Conference on Communication and Computing, Popayan, Colombia, May. 2015, pp. 1-6.

5) Thirumurugan, S.Surendhar, R.Sathesh Raaj, N.Ezhilmathi, A literature survey in ECG feature extraction, Advances in Natural and Applied Sciences, Vol. 11, Issue 7, 2017, pp 455.
6) Hemalatha Rallapalli, Pavani Bethelli "IOT Based Patient Monitoring System", Int. J. ofComputing,CommunicationsandInstrumentationEngg.(IJCCIE),4(1),2017,pp.115-118.
7) Vivek Pardeshi, Saurabh Sagar, Swapnil Murmurwar, Pankaj Hage "Health Monitoring Systems using IoT and Raspberry Pi", Int. Innovative Mechanisms for Industry Applications (ICIMIA2017), pp.134-137.
8) AshleshaA.Patil,Dr. S.R.Suralkar "Reviewon- IOT Based Smart Healthcare System", Int.J. of Adv. Research in Engineering and Technology (IJARET), 8(3), May-June 2017, pp. 37–42.
9) EsratJahan, Tilottoma Barua, Umme Salma,"An Overview on Heartrate Monitoring and Pulse Oximeter System**",** Int. J. of Latest Research in Science and Technology, 3(5), September-October2014, pp. 148-152.
10) DoganIbrahim, KadriBuruncuk **"**Heartrate Measurement from the Finger using a Low cost Microcontroller**",** Int'l Journal of Computing, Communications & Instrumentation Engg. (IJCCIE), 4(1), 2017, pp.25-29.
11) Nikunj Patel, Princekumar Patel, Nehal Patel "Heart Attack Detection And Heart Rate Monitoring Using IOT", Int. J. of Innovations and Advancement in Computer Science IJIACS , 7(4), April 2018, pp.611-615.
12) Ahmed Abdulkadir Ibrahim, Wang Zhuopeng , "Heart rate monitoring system**",** Int. J. of Engineering Research and Application ,8(1), (Part-III)January2018,pp.77-80.
13) Rakshith Babu H and Prof. Latha. S, "Survey of IOT based Patient Health Monitoring System", Int. e-Journa lFor Technology and Research**,** 1(6), June 2017, pp.1-5.
14) Jwala Lahamge, Priyanka Phatale, Dhananjay Shimpi, Swapnali Walke, Ayesha Butalia, "Survey Paper for Health, International Conference on recent Trends in Engineering, 2016, pp 540.
15) Sowmya G, Sandeep B L, "Remote HealthCare Monitoring System Using Arduino Board over Distributed Ubiquitous Environment", Int. J. of Advanced Research in Computer and Communication Engineering, 5(4), April 2016, pp.816-819.
16) Purnima, Neetu Rout, Rahul Tiwary, Renuka Bhandari, "Zigbee and Gsm Based Patient Health Monitoring System", Int.J. of Adv Research in Electrical, Electronics and Instrumentation Engineering,3(1), January 2014, pp.6664-6669.
17) Soni, Vishal Dinesh Kumar, An IoT Based Patient Health Monitoring System, International Journal on Integrated Education, 2018, 1, pp. 43-48.
18) https://blog.contus.com/IoT-healthcare-applications-benefits/.