Health Care Monitoring System using IoT

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ABSTRACT

In the health care sector, IoT plays a significant function. The people in the hospital who are seeking medical care are non-ambulatory, so if there is a method for fore casting illness it will be helpful for them. In Healthcare system latest trends of IoT is used. IoT software helps patients to reduce health-related threats and hospital expenses by gathering patient information and processing data using cloud services to exchange data sources. This system offers a cloud-based solution to a diagnostic framework for automatic cardiac disease that utilizes sensors to monitor specific patient parameters such as heart beat rate, oxygen level in blood and temperature, etc. Here, this proposed work helps to predict cardiac attack by collecting sensor data and submitting the data to the doctor via cloud. Using this plan will save both specialist and patient time and easily make recommendations about follow up medical care and to receive it at any-time and anywhere they need it. Through gathering data, the patient may receive appropriate and secure medical attention through tracking the current state of the patient collected by cloud using IoT devices.

Key Words: IoT, sensor, Microcontroller, Arduino Nano, SpO_2, GPS

I INTRODUCTION

This is one of the Latest ideas related to Medical applications. One more benefit of using IoT is that, this data can be seen using a desktop computer, laptop, using an Android smart phone or Tablet. The user just needs a working Internet connection to view this data. There are various cloud service providers which can be used to view this data over Internet. Amazon Web Services (AWS), Google Cloud Platform (GCP) are few famous and easy to use service providers among these. IoT is rapidly revolutionizing the healthcare industry. Keeping track of the health status of your patient at home is difficult task because of the busy schedules and our daily life work. Especially old age patients should be periodically monitored. So we propose an innovative system that automated this task with ease. Our device puts forward a smart patient health tracking system using Web server so that the patient health parameters like heart rate and blood oxygen level along with body temperature can be monitored. IoT patient monitoring has three sensors. First one is a temperature sensor, second is pulse sensor and we also get oxygen level values using sensors. The proposed work is very use full 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 health monitoring system, it needs a Wi-Fi connection. The micro-controller or the Arduino board connects to the Wi-Fi network using a Wi-Fi module. The Arduino Nano board continuously reads input from these 3 sensors. Then it sends this data to the cloud by sending this data to a particular URL/IP address. In this work, pulse oximeter sensor is used to measure the blood oxygen level (SpO_2). The Temperature sensor to measure the temperature of the body. The system then transmits this data over the internet using WiFi transmission by connecting to internet connection. The data is transmitted and received over Google Firebase platform to display data of patient remotely.

The main objective is to design a Remote Patient Health Monitoring System to diagnose the health condition of the patients. Giving care and health assistance to the bedridden patients at critical stages with advanced medical facilities have become one of the major problems in the modern hectic world. In hospitals where many patients whose physical conditions must be monitored frequently as a part of a diagnostic procedure, the need for a cost-effective and fast responding alert mechanism is inevitable. Proper implementation of such systems can provide timely warnings to the medical staffs and doctors and their service can be activated in case of medical emergencies. Present-day systems use sensors that are hardwired to a PC next to the bed. The use of sensors detects the conditions of the patient and the data is collected and transferred using a microcontroller. Doctors and nurses need to visit the patient frequently to examine his/her current condition. In addition to this, use of multiple microcontrollers based intelligent system provides high-level applicability in hospitals where many patients must be frequently monitored. For this, here we use the idea of network technology with wireless applicability, providing each patient a unique ID by which the doctor can easily identify the patient and his/her status of health parameters. Using the proposed system, data can be sent wirelessly to the Patient Monitoring System, allowing continuous monitoring of the patient. Contributing accuracy in measurements and providing security in proper alert mechanism give this system a higher level of customer satisfaction and low-cost implementation in hospitals. Thus, the patient can engage in his daily activities in a comfortable atmosphere where distractions of hardwired sensors are not present. Physiological monitoring hardware can be easily implemented using simple interfaces of the sensors with a Microcontroller and can effectively be used for healthcare monitoring. This will allow development of such low-cost devices based on natural human-computer interfaces. The system we proposed here is efficient in monitoring the different physical parameters of many number bedridden patients and then in alerting the concerned medical authorities if these parameters bounce above its predefined critical values. Thus, remote monitoring and control refer to a field of industrial automation that is entering a new era with the development of wireless.

II Problem Statement

Heart disease is one of the leading causes of death in the world. The cases of death from heart diseases have increased by 34% in the recent times. Most of the times the patient is unable to reach the hospital on time. Even if the patient reaches the hospital on time absence of doctor or medical expert team on the given point of time makes the effort to save a life to go in vain. Considering the present scenario, the medical staff has risk of getting infected just for monitoring purpose. Remote health monitoring can provide useful physiological information in the home. This monitoring is useful for elderly or chronically ill patients who would like to avoid a long hospital stay. Wireless sensors are used to collect and transmit signals of interest and a processor is programmed to receive and automatically analyze the sensor signals. In proposed work, appropriate sensors are chosen according to what would like to detect and design algorithms to realize detection. Examples are the detection of body temperature, monitoring cardiac signals. To solve this issue, we here design a IoT based health monitor system that allows monitoring of multiple patients over the internet. The system monitors patient temperature and hear rate using pulse sensor along with blood oxygen level. This entire system is run by microcontroller based circuitry.

III LITERATURE SURVEY

[1] Presents the design and implementation of IoT based health monitoring system which incorporates temperature and pulse rate sensors. This is mainly based on monitoring the health of the patient body and whenever the patient’s health is critical or abnormal an alert will be sent to doctor, so that doctor can diagnose the problem immediately which helps to save patient's life. Purpose is to inform doctor about the patient’s health condition during abnormal conditions, so that doctor can take the best step possible. This paper provided us a brief insight on how a system can be build using IoT and sensor data.

[2] Provides the details of usage of Internet of Things (IoT) and thereby keeping IoT as the foundation. Several sensors are used to extract data of various health parameters of patient, which is then stored in the cloud database. Then the data is further presented in the website for viewing purpose. The data will be investigated by the doctor through SMS which is very convenient for the doctor. When there is an emergency condition, the system provides the list of doctors based on their geographical location, which is solely provided by the Global Positioning System (GPS) module. The nearest doctor will be located by comparing the distance of each doctor from the patient. This gave us an idea how the system can be developed by incorporating the sensors and making use of the IoT to communicate the data to the database

[3] Mainly gives information regarding the cloud computing. Cloud computing is effectively used as it is very convenient, In cloud computing we come across service models (Infrastructure as a Service, Platform as a Service, Software as a Service) and deployment models such as public cloud, Private cloud, Hybrid cloud. Using Cloud Computing there's several advantages like scalability, global reach, so this increases the accessibility of data where it would be helpful in remote areas where medical facilities are not available, where sensor data will be sent to microcontroller that will be reserved in the cloud database in real time, so that it could be accessed at anytime. When it comes to data choosing, a database is very critical, so cloud computing provide us the option of choosing various types of databases for various needs. By this paper we got an insight, why cloud computing is very much important to our system for the accessibility and scalability of data.

[4] Speaks about how GPS is important and useful during emergency and flexibility of a website to present data. GPS helps in finding the location of the patient during emergency so that immediate action could be taken to protect the patient. Also, by using the website we could look upon the availability of doctors. Website also provides the information about the past data, So that a doctor or patient can use the website to view tables of different types of data. By this it is understood that why a website is a better way to present the data which would be convenient to everyone.

[5] Author tells how IoT has evolved over the years and how it is helping in machine to machine communication. Earlier the Internet were characterized by the WWW, the network only had the linked HTML documents that resided on top of the Internet architecture. This network of static HTML pages eventually evolved in to what is called as the Web 2.0, where two way communications became common, which helped in bringing up the dynamic pages where it enabled user participation, collaboration and interaction. Web 2.0 technologies include internet community commonly refereed as social networking services, dynamic websites, blogs, and many more. Technologies have become the essential part for every global business and as well as modern social interaction. As we use IoT in everyday life, where systems can be provided with identifying, sensing, networking and processing capabilities that will allow the communication between machine to machine and other services over the internet to accomplish the objective.

Health-related issues have been regarded as one of the main problems which directly impact quality of life of a person and development of the nation. Avoidance of health care monitoring negatively results in many aspects. Among the extensive applications enabled by the Internet of Things (IoT), digital health care is a mainly essential one. Internet of Things (IoT) provides a new life to the healthcare field. One of the better ways is where the doctors are able to certainly and quickly use the relevant patient information through the help of internet of things to take suitable actions. Making use of embedded wearable sensors, the system monitors the health parameters dynamically. This analyzed data is stored on cloud for scalability and flexibility purpose. Results of the analysis are then automatically sent to the doctor when a critical condition occurs [6]

[7] Speaks about IoT has helped sensor smarter, so that they could communicate with each other. IoT helps in reducing the human intervention and useful in decision making. Applications of IoT are very

extensive, one of the major applications of IoT is digital health care, IoT provides a new life to the health care field. Heart beat sensor monitors the heart beat sampling rate and then transmits discrete values over Wi-Fi module. Thingspeak has been used as the remote cloud server for secure data storage and access. The data which is stored in the database can use for further analysis. By this it is understood how heart rate can be measured and further how to communicate from sensor to the database.

The amount of data in every system is growing very fast and generated from many different sources like sensors, social media, motorsport, airline industry or scientific data are in different formats. The challenge nowadays is how we use the data to infer meaningful insights from such huge volume of data and along with that challenge is how to manage and store the data in a particular place .The size of the databases used in organizations/enterprises has been eventually growing at high rates. Structured data is termed as the relatively well-organized information, which can be further reserved into Relational Database Management System (RDBMS). As RDBMS are efficient, simple and straight forward for writing queries. In comparison to structured data, unstructured data can be considered as information, which does not have a pre-defined data format, cannot be organized, or cannot be stored well into relational tables. Majorly the fastest growing type of data, e.g. image, sensors data, web chats, social networking messaging data, video, documents, log files, and email data. This provided us the understanding on which type of database has to be selected to incorporate to our system [8]

In the current situation, we come across various problems in health sector which can be solved with different ideas. Existing patient monitoring system, even in multispecialty hospitals are following traditional methods of maintaining records of patients in the form of hardcopies i.e., files, records, reports etc., which has lot of disadvantages and also this is not eco-friendly. In hospitals they also do various scanning, blood tests, X-rays and so on. But they provide reports of these in the form of hardcopies. What if the case, where they could upload data to a specific account, such that the doctor can easily checkout that and effectively provide medications to the patient. Currently available heart rate monitor watches or gloves are only used in gyms for fitness observations which are not actually connected to cloud for providing any graphs/reports, though it is not needed in that case. As health is the main point of concern, past and present record is much needed to diagnose correctly for present health condition. And in case the patient cannot describe the problem in detail, those records will do the job. In this research work attempts are made for implementation of patient monitoring system which consists of sensors connected to microcontroller, intended to acquire vitals from patient body. The accumulated data is synced to the Firebase database account of a particular patient. The uploaded data is utilized for generating reports in daily or weekly basis so that the report is very helpful for the doctor to diagnose fairly and quickly [9]

Nowadays, the development of e-health concept is offering various aspects. In this paper, novel website architecture is described. Designed for an e-health platform based on sensors, this website offers the ergonomic and multi-functions opportunity for an ambient intelligent hospital. It enables the management of patients' records, real time patient's state monitoring based on remote sensing of biometric signals as well as indoor geo-localization for either in or out patient and professionals. Using architecture based on combined approach, this website presents a part of a big e-health project development [10]

IV Methodology

Design a health care monitoring system which has heartbeat detection system, temperature detection system, and SPO_2 detection system. A doctor or health specialist can use the system to monitor remotely of all vital health parameters of the patient or person of interest. The heart beat rate detector, temperature, SPO_2 modules comprise of a WiFi module, wireless transmitter and microcontroller. The data collected was transmitted wirelessly to a receiver module. Pulse sensor or the heart beat rate sensor is used to check the cardiac arrest of the patient which are designed circuit for cardiac signal detection and microcontroller. The detected signal was extracted by microcontroller and transferred to cloud. A simple cloud server where hosted with a database for all the vital data to be accessed remotely.

Since the main intention of the work is to come up with a solution to monitor the condition of the patient using different parameters like temperature, blood pressure and heart beat over internet using a user friend User Interface (UI). Here we are designing a Patient 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. And patient or guardian can able to track patient's location at any point in time through Google Maps which would enable to send medical services in case of an emergency for non-bed ridden patients. This is achieved by combining the use of hardware and software together.

Hardware components convert physical parameter like temperature and blood pressure using sensors into electrical signals and later to binary signal. Also serves as a platform to integrate all sensors and give appropriate electrical power required for the hardware to operate. Software on the other side helps convert the digital signals from hardware to readable data and send this data to server by connecting to the internet. The embedded software deals with the hardware whereas the UI software deals with data storage and front end presentation. Sensors such as temperature sensors, heartbeat sensors, blood pressure sensors used as wearable device. These devices or rather sensors are connected to a microcontroller and transmit this data to a central server over internet and is stored in server database. The data so stored is fetched and presented using a web app that can be monitored on any device such as a smart phone or desktop. The device at patient side has a panic button which can be used by the patient at the time of severe chest pain, anxiety, uneasy in breathing. When this button is pressed the GPS sensor will send the geographical locations the emergency case patient to the doctor and ambulance. The interface will also display the availability of doctor and serves as a point of input from the doctor on their willingness to take the case based on the location of the patient.

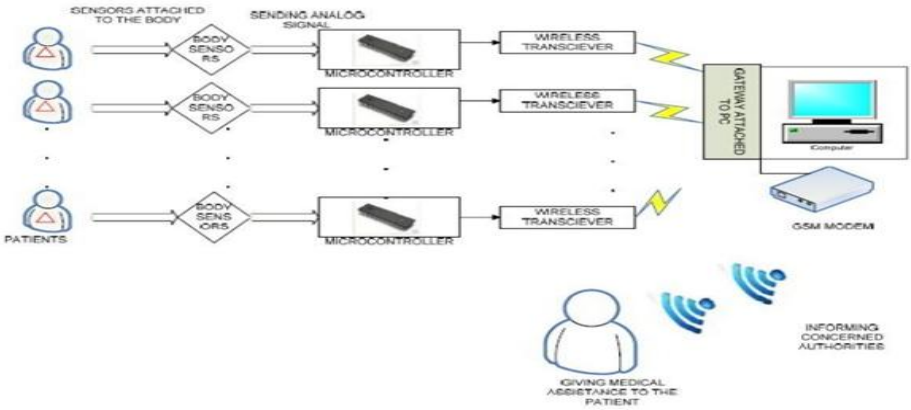

Fig 1: Block Diagram of the system

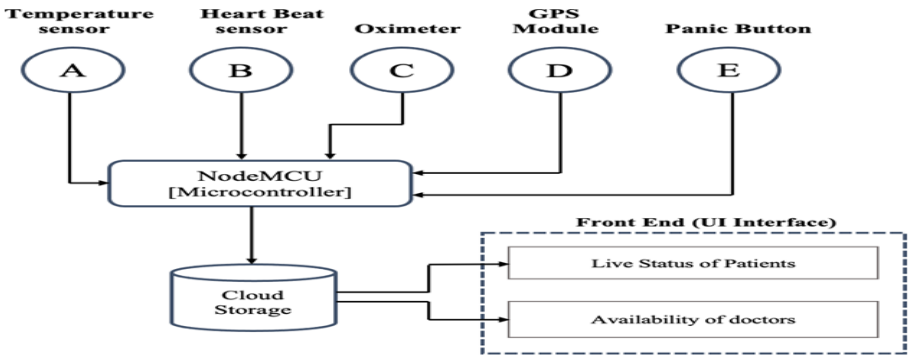

Fig 2: Archictural flow of the system

When the patient monitors his/her health using various types of sensors, the data from the sensors gets transferred to nodeMCU (WiFi module). Now the data present in the WiFi module will transfer the sensed data in real time to firebase (database). The sensed data will now be stored in the firebase real time database. The front end (UI Interface) is a place where details about the patient data will be present. So patient could login to their account using the UI interface to get the details about their monitor levels. In order to get these details in the UI interface, Real time database transfer the data to the UI interface. The other major advantage of the UI interface is, patient's get the details about the availability of doctors. Doctors even have the ability to monitor the details of their patient's health in real time. So this is how the whole system of health care monitoring system using IoT works and it is very convenient and easy to use.

V Results and Discussions

The user interface (UI) is the point at which human users interact with a computer, website or application. The goal of effective UI is to make the user's experience easy and intuitive, requiring minimum effort on the user's part to receive maximum desired outcome. The web application developed using HTML5, CSS3, Bootstrap5 and for the interactivity purpose, we have JavaScript as a scripting language. The web application is the place where the patients can get their details and availability of doctors. The home page of the web application looks as shown in Fig 3

Fig 3: User Interface Portal

Fig 4 is the doctor sign-up and account registration page where doctors has to provide email-id, set their password, name, doctor id, experience and specialization.

Fig 4: Doctor Sign-up and Account Registration Page

Fig 5 is the patient registration page, where patient has to first sign-up by providing their email-id, set their password, name, device number, age and ailment.

Fig 5: Patient Sign-up and Account Registration Page

Personal physiological data from the patient is collected that simulates heartbeat, temperature, oxygen level of the body and at emergency situation the location of the patient is tracked. The readings are collected in a simple cloud database and can be viewed remotely by a doctor or Healthcare giver. The data can also be used in research on medical issues affecting the elderly or chronically ill.

From the experimental setup, various sensors data were collected from nodes through wireless medium. On the cloud it will be stored like an unstructured dataset. Patient database is created for security with username and password. So Authorized person can access the cloud to monitor sensor data in cloud to view in data log, analog log, digital input and digital output. With the wide use of internet, this work is concentrated to execute the internet technology to establish a system which would communicate through internet for better health. Hence the present work is done to design an Internet of Things based smart patient health tracking system using an Arduino microcontroller. In this, pulse rate sensor is used to detect the heart beat and temperature sensor to read the temperature and sends the data to the cloud using internet. This information is also sent to the LCD display, so patient can easily know their health status. During critical situations to alert the doctor, the warning message is sent to the doctor's phone and at the same time buzzer turns to alert the care taker. The doctor can view the sent data by logging the specific website or IP address. Hence continuous patient monitoring system is designed. The system introduced smart healthcare to monitor the basic important signs of patients like heart rate, body temperature, and, the level of blood oxygen in the body. Authentic medical staff can view and track the data in real-time even though the patients perform the tests outside of the hospital. The system can also benefit nurses and doctors in situations of epidemics or crises as raw medical data can be analyzed in a short time. The developed prototype is very simple to design and use. The system is very useful in the case of infectious disease like a corona virus (COVID-19) treatment. The developed system will improve the current healthcare system that may protect lots of lives from death.

Fig 6 is the page of the web application where details of the patient will be available in real time when the patient monitors his/her temperature, heart rate and blood oxygen level. Also if there's any emergency in the patient's health, doctors can get the details of the timestamp and location of the patient

Fig 6: Monitored data of a patient

VI CONCLUSION

An efficient health care monitoring system is developed to monitor the up to date status of the patient irrespective of the presence of the doctor. The system collects information like temperature, blood oxygen rate and pulse rate of the patient and updates the same to the doctor. The system is evaluated experimentally and collected the sample data to verify the status of patients. The doctor can monitor the progress of patients health now and then to advise them about their health. In this paper healthcare monitoring system for cardiac patients is proposed which monitors body parameters of heart patient like Heart rate, Temperature and SPO_2. It helps caregivers and hospital staff to monitor and store patient's body parameters continuously. On any abnormality, it gives alert to caregivers. Using Internet, data can be made available for remote use and only to authorized users like remote specialist doctors for special advice. Thus designing parameters like availability, security, correctness and efficiency are achieved successfully. The use of this system can be extended to care and monitor elderly people staying all alone at their homes and also for baby care. Also the UI is designed for a user friendly experience. The future scope of work will explore the possibility of using the huge amount of data of patient condition at various time stored in the data bases to analyze parameters draw useful insights about the data. The proposed system of patient health monitoring can be highly used in emergency situations as it can be daily monitored, recorded and stored as a database. In future the IoT device can be combined with the cloud computing so that the database can be shared in all the hospitals for the intensive care and treatment. The transparency of this system helps patients to trust it. When threshold value is reached, the alarm system that consists of buzzer and LED alerts the doctors and he can act more quickly. The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedure. Hence the proposed work provides the opportunity for the doctors to monitor the health of the patients even outside the hospital or apart from the duty hours using IoT and the health of the patients is monitored remotely. It is cost effective and provides timely response to improve the patient's health and it avoids the patients to have long stays in hospital. It also helps them to move freely and walk happily with help of sensors. These are the measurable benefits which avoid the patients from regular visits to hospitals which are extremely painful for chronically ill,

elderly and bedridden patients in home. Hence in total by using the proposed work we can solve many of the healthcare problems which the society is facing and improve the quality of better human life.

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