Healthcare System using IoT and Building Health Monitor App

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Abstract: *An improvement in technology and miniaturization of sensors, there have been attempts to utilize the new technology in various areas to improve the quality of human life. One main area of research that has seen an adoption of the technology is the healthcare sector. The people in need of healthcare services find it very expensive this is particularly true in developing countries. As a result, this project is an attempt to solve a healthcare problem currently society is facing. The main objective of the project was to design a remote healthcare system. It's comprised of three main parts. The first part being, detection of patient's vitals using sensors, second for sending data to cloud storage and the last part was providing the detected data for remote viewing. Remote viewing of the data enables a doctor or guardian to monitor a patient's health progress away from hospital premises.*

The Internet of Things (IoT) concepts have been widely used to interconnect the available medical resources and offer smart, reliable, and effective healthcare service to the patients. Health monitoring for active and assisted living is one of the paradigms that can use the IoT advantages to improve the patient's lifestyle. In this project, I have presented an IoT architecture customized for healthcare applications. The aim of the project was to come up with a Remote Health Monitoring System that can be made with locally available sensors with a view to making it affordable if it were to be mass produced.

Hence the proposed architecture collects the sensor data through Arduino microcontroller and relays it to the cloud where it is processed and analyzed for remote viewing. Feedback actions based on the analyzed data can be sent back to the doctor or guardian through Email and/or SMS alerts.

Keywords: Internet of Things

I. INTRODUCTION

Health is always a major concern in every growth the human race is advancing in terms of technology. The recent corona virus attack that has ruined the economy of China to an extent is an example how health care has become of major importance. In such areas where the epidemic is spread, it is always a better idea to monitor these patients using remote health monitoring technology. So Internet of Things (IoT) based health monitoring system is the current solution for it. Remote Patient Monitoring arrangement empowers observation of patients outside of customary clinical settings (e.g. at home), which expands access to human services offices at bring down expenses. The core objective of this project is the design and implementation of a smart patient health tracking system that uses Sensors to track patient health and uses internet to inform their loved ones in case of any issues. The objective of developing monitoring systems is to reduce health care costs. Once the health issue has been increased to a critical stage and the life of the person is endangered, then they take medical assistance, which can cause an unnecessary waste of their earnings. This also comes into account especially when certain epidemic is spread in an area where the reach of doctors is impossible.

In current days the cause of unhealthy human lifestyle is based on many factors such as irregular food habits, no nutrition diet, environmental pollutions, lack of proper exercise, indefinite work, restlessness, and increases stress levels which leads to greater disaster in human health. In many countries, mostly up to 40% of children, middle-aged people and working women are affected by an unhealthy lifestyle. Due to the busy schedule in our day-to-day lives, we rarely have time to concentrate on our health thereby resulting in various health hazards. Also, it would be difficult for a doctor to monitor the patient continuously. In order to keep track of their health status and to get advice from the doctor is also a bit difficult for an individual patient. Existing Health care applications systems such as health management

systems, patient monitoring systems that are inadequate in providing sufficient information or services to patients is not up to the mark.

At present authors suggested a framework E-Health care monitoring system (EHMS). It is basically an application model design with various machine learning models. Here IoT wearable sensor collects data from the patient. The collected data from numerous health wearable devices are processed to

E-Health care monitoring system. Later EHMS applies machine learning approaches on raw data to analyze the health condition of the patient for better decision making and diagnosis. Disorder analyze report, doctor appointment will acknowledge to the patient, doctor, and caretakers.

Social insurance may be the majority critical concern from claiming numerous nations in the universe. Enhancing the existing of patients particularly in the weaker parts of the particular social order which incorporate those elderly, physically also rationally handicapped and additionally the chronically sick patients may be the main consideration will make progressed. On existing system, the information is recorded in the manifestation from claiming paperwork or looking into general stockpiling server.

For being connected to the health care system through IoT, doctors can improve the diagnosis accuracy as they are getting all the necessary patient data at hand. In a word, we can say that it allows monitoring patient continuously and remotely.

By using this system, we can get approximate result based on patient health. Moreover, it will be less error, collect data in less time and more accuracy than any human performances.

Through IoT, doctors and relatives can do their individual job without any hesitation as they can monitor the patient's health condition from anywhere. Moreover, it will send alerts whenever a particular health parameter goes beyond the ideal limit. Furthermore, by receiving SMS alert doctors and relatives can take necessary action. Lastly, we can say that it saves lives in case of emergency.

Most of the people at their old age, like to stay at home with their dear ones rather than visiting or passing time in hospitals. But hue to hectic lifestyle of people, who are suffering from many diseases at their early age and the older people become very weak. Additionally, this project will be beneficial to ICU patient.

By accessing patient's health data in real time information helps to make decision for the doctor on how the treatment is going on and what should do next. Over all, this project will enable the physicians to utilize the results from data collection and analyze that data in real time.

This project total cost will be less expensive than any other machines which are used in the hospitals. Moreover, it is compact, lightweight and easy to use.

Health care is all about the patient so the need of the patient always comes first but it is a matter of fact that most of the patient feel uncomfortable to go to hospital or visit doctor's chamber. In this way, this system creates a communication between patient and doctor by providing the data.

The aim of this project is to develop an E-Healthcare System using IoT and building an App that will allow patients to monitor their health status in real-time, communicate with doctors remotely, and receive treatment remotely. The system will be able to track the patient's vital signs, such as blood pressure, heart rate, and temperature, using various IoT sensors, and store the data in a cloud database. This data will be analyzed and processed by the system, and if any abnormality is detected, the system will alert the healthcare professionals immediately. To build an app which is useful for the people to keep check on their regular basic health and to lead an healthy life. By making an app we store the regular data to the person to keep the track on their health and using IOT and machine learning we give the appropriate results of our regular health. Now a day it is very difficult to go to hospitals and being standing in a long queue after covid situation. So here we built an app which is very useful for the people to keep track on their regular health. We are using IOT with and building an Health Monitor App to get the perfect results and we store this information on the firebase database and we give this data to the app.

II. LITERATURE REVIEW

Now-a-days increasing of technologies health experts is taking the great advantage of these electronic gadgets [4]. IoT (Internet of things) devices are highly used in medical sector. In this paper, the project is about health monitoring system. Especially, for Cardiac patient, High Blood pressure patient, hypertension problem, diabetic patient etc. In rural

area because there are less number of doctors compared than urban area. In rural area, medical equipment is not available except government hospital. So, the number of patients is higher than government hospital. Also, the equipment is expired in many cases. So, if any emergency call needed, this hardware device will immediately send the report to the doctors or internal doctors. Doctors will do their rest of works by their reports.

Many chronic illnesses, hypertension has become a common major disease that remains the route cause for cardiac/stroke mortality. But in present time, no remote HRV (Heart Rate Variability) analysis systems for hypertension patient available to help the doctors to track down the progression of the patient's condition or critical events in rural area [5]. IoT is nothing but an advanced concept of ICT (Information Communication Technology). [2] Raspberry pi component is more costlier than Arduino component device. Technologies are broadly expanded in web based or on-line system [6]. Now- a - days collecting real time is vital. When the critical condition, patients are discharging from the hospital, he or she needs to check up in regular basis. That is why IoT based heath monitoring system is best option for rural area.

The Internet of Things digitizes physical assets – sensors, devices, machines, gateways and the network. It connects people to things and things to things in real time. A typical IoT network can grow rapidly, resulting in an experimental increase in the variety, velocity and the overall volume of data. This data opens opportunity for significant value creation and revenue generation. But the real challenge for IoT environments is how to analyze the large volume of information from all sources and take action in real time.

The complexity of IoT combined with the high expectations created by the Internet, Mobile, and 24x7 IT environments has made the need for new analytics

approaches and technologies more urgent. Achieving desired business objectives requires the ability to act in real-time to take advantage of opportunities and address problems quickly. In the pre-IoT era, an issue in a typical supply chain scenario could be addressed in 2-3 day cycles for satisfactory results. But in IoT, time to action is in minutes, seconds, or microseconds – 30 minutes to provision electric service, 30 seconds to act on information from devices, 5 milliseconds to address a security breach. This explosion of data and the high expectations in the IoT environment means the value of data will slip away quickly.

The importance of time-to-action for IoT applications can be seen in a wide array of applications and use cases. Broadly speaking, these applications can be grouped into three categories:

- Operations and fulfillment are a convenient place to prove out efficiency gains.
- Customer-focused sales and marketing applications have the potential to increase customer satisfaction and long-term growth.
- Innovation in new products and services can drive new revenue and business value.

There are also specific use cases within these applications:
• Predictive Maintenance
• Demand/Supply Optimization
• Predictive 1 to 1 Marketing
• Outage Management Addressing the critical time-to-action requirement for these use cases and applications in IoT demands an advanced analytics solution that
Unifies historical, real-time streaming, predictive, and prescriptive analytics.
And provides faster analytics and smarter actions.

III. PROPOSED SYSTEM

In the existing system, we use active network technology to network various sensors to a single PMS. Patients' various critical parameters are continuously monitored via single PMS and reported to the Doctors or Nurses in attendance for timely response in case of critical situations. The sensors are attached to the body of the patients without causing any discomfort to them. In this PMS we monitor the important physical parameters like body temperature, ECG, heart beat rate and blood pressure using the sensors which are readily available. Thus, the analog values that are sensed by the different sensors are then given to a microcontroller attached to it. The microcontroller processes these analog signal values of health parameters separately and converts it to digital values using ADC converter.

In case of a critical situation which requires the immediate attention of the doctors or nurses for any of the patients, the custom software will instruct the Central PMS to enable the GSM modem to send an SMS with the patient ID. A voice call is also made to the doctors and the staff of the hospital. The SMS also consists of a status of the patient's physical condition. With the help of the patient ID, the doctor can easily identify and attend to the patient situation.

The main objective is to design a Patient Monitoring System with two-way communication i.e. not only the patient's data will be sent to the doctor through Application a, but also the doctor can send required suggestions to the patient or guardians through SMS or Call or Emails. The system which we prefer to develop would not only help in monitoring the health of the patient when he is in bed but also when he is out of bed. The main idea of the system is to transmit the information through the App to continuous monitoring of the patient over internet. Such a system would continually detect the important body parameters are Temperature sensor, Pulse sensor, ECG Sensor, Body Movement Sensor and humidity sensor. This project is very useful since the doctor can monitor patient health parameters just by visiting App or URL. And nowadays many IOT apps are also being developed. So now the doctor or family members can monitor or track the patient health through the Android application and would compare it against predetermined range set and if these values cross the specific limit, it would immediately alert the doctor. In this system microcontroller is used to transmit the data. It is connected to IoT which provides information to doctor or caretaker. The data of the patient's health is stored in the Firebase Database. The doctor can easily access the patient's health anytime from anywhere. In case of Emergency it would automatically alert the doctor and relative of the patient via call. In such case the patient will get rapid medical help and also would save time and energy of the relatives, who cannot be near the patient all the time.

The microcontroller or the Arduino board connects to the Wi-Fi network using a Wi-Fi module. This project will not work without a working Wi-Fi network. You can create a Wi-Fi zone using a Wi-Fi module or you can even create a Wi-Fi zone using Hotspot on your smart phone. The Arduino UNO board continuously reads input from these 5 senses. Then it sends this data to the cloud by sending this data to a particular App. Then this action of sending data to IP is repeated after a particular interval of time.
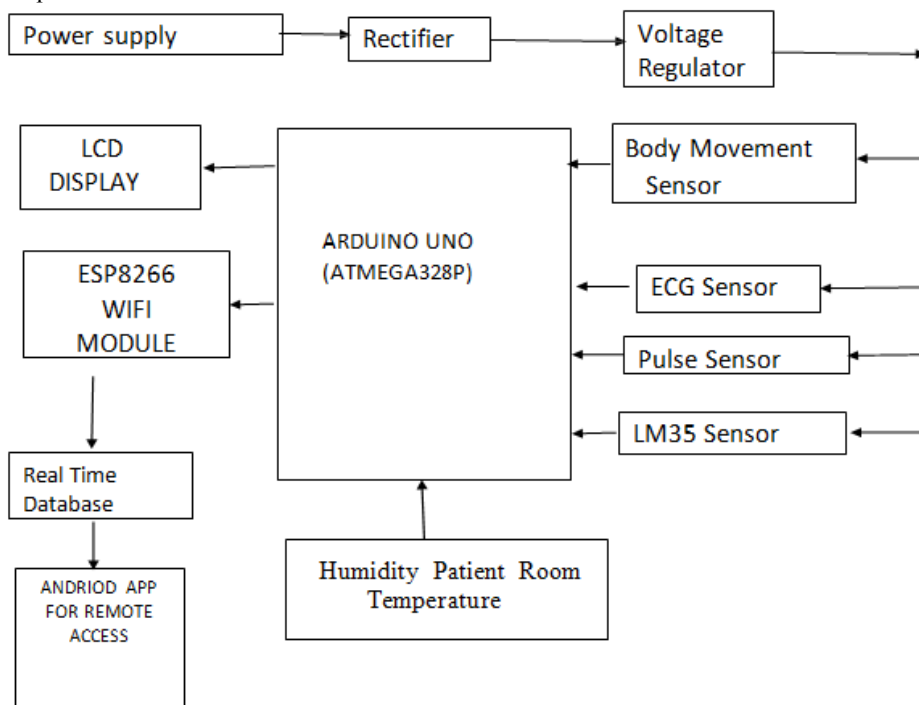

Figure 1 Block diagram of Health monitoring system

Figure 1 is the block diagram of Health monitoring system as the power supply is an essential component of the Health Monitoring System. It provides the necessary power to the system to operate. The power supply can be a battery or a

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power adapter. The battery is preferred as it is portable and can be easily carried by the patient. Sensors: Sensors are the most critical components of the Health Monitoring System. They are used to monitor vital health parameters of the patient, such as heart rate, blood pressure, body temperature, and blood sugar level.

There are different types of sensors available in the market, such as ECG sensors, Blood pressure sensors, temperature sensors, and glucose sensors. The sensors are connected to the Arduino board, which receives the data from the sensors and sends it to the Wi-Fi module. Arduino: Arduino is an open-source electronics platform based on easy- to-use hardware and software. It is used in the Health Monitoring System to process the data received from the sensors and send it to the Wi-Fi module. Arduino is connected to the sensors through analog or digital pins, and it receives the data from the sensors. The Arduino board has an onboard microcontroller that processes the data and sends it to the Wi-Fi module.

IV. RESULTS AND DISSCUSION

The prototype of E Health care System IOT is successfully developed. This system operates fine in regard of patient and doctor. Various Sensors ,LCD, Esp8266 Wi-fi Module are connected to Arduino. Arduino reads the data and Wifi module Sends the data to firebase database through Wi-fi module we can see the sensor readings.
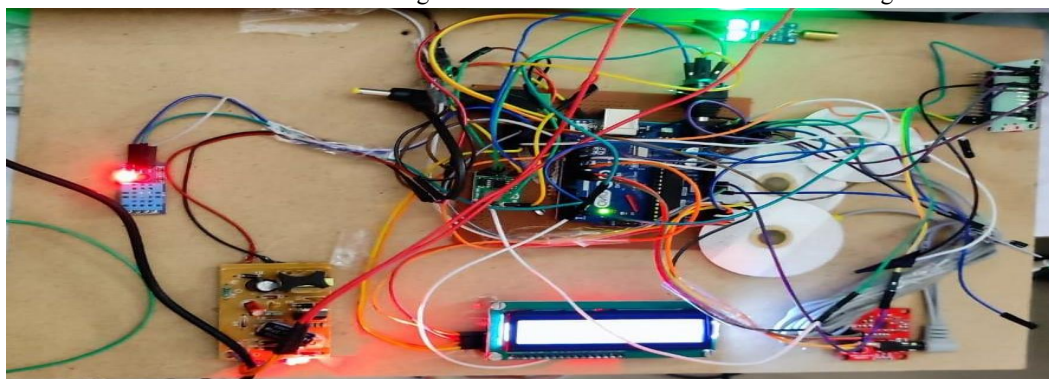

Figure 2 Experimental Set up For E healthcare System

In the above figure 2, it is shown complete device setup which includes Arduino micro controller board with power supply attached to it. Arduino is connected with all the sensors which includes from right bottom Fall detection sensor (Body Movement sensor), Humidity sensor, ECG sensor, Pulse sensor, Temperature sensor. Arduino also connected with esp8266 WIFI module which will be used in case any of sensor data Readings, modules are connected which are used to send sensor data.

The pulse sensor is fixed to the patient's hand. This contains an IR sensor in Pulse Sensor. Every pumping we get pulse from that sensor. This sensor output is given to the Arduino via firebase and through app we can see the sensor reading Procedure for connecting the Sensors From the figure 3 The pulse sensor is fixed to the patient's hand. This contains an IR sensor in Pulse

Sensor. Every pumping we get pulse from that sensor. This sensor output is given to the Arduino via firebase and through app we can see the sensor readings.
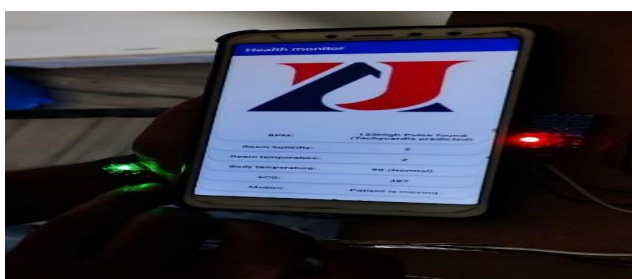

Figure 3 Pulse Measurement sensor

In figure4, NTC type thermistor is used as a temperature sensor. temperature sensor output varies based on the temperature; this output is also given to Arduino.
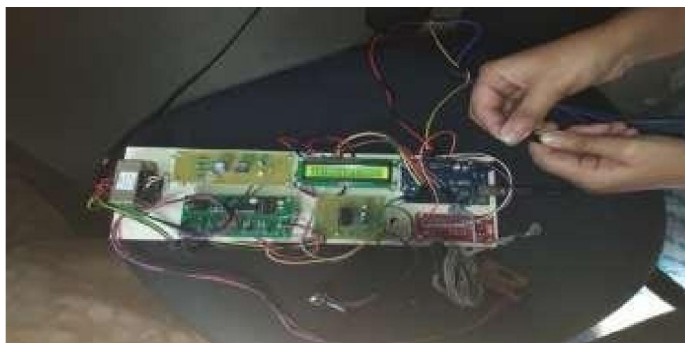

Figure 4: Temperature Measurement sensor

Figure 5, EEG sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op-amp to help obtain a clear signal from the PR and QT Intervals easily and connected to Arduino. The EEG sensor is used with electrodes with error rate indicating the status as active or inactive
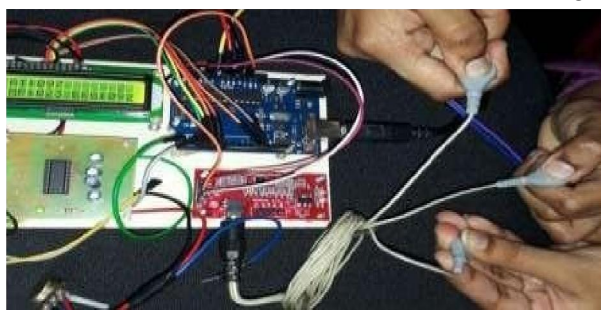

Figure 5: EEG measurement sensor

Data display in the mobile application unit

The day to day vital parameters such as heart beat, body temperature, EEG signals can be displayed in the mobile phone and the same can be send to the doctor during emergency situations.
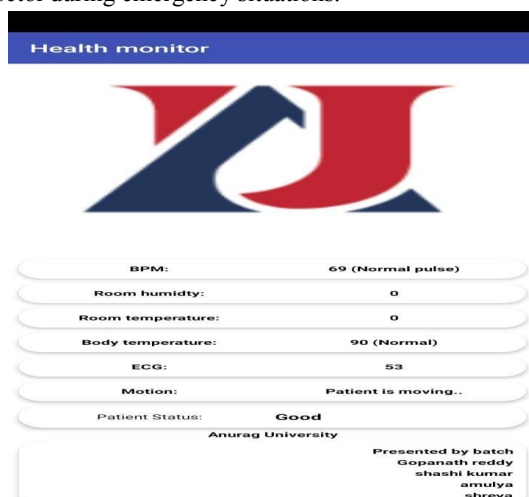

Figure 6: Sensor Readings Displayed in app

From the app we get all the information about the BPM, Room Humidity, Room Temperature, Body Temperature, ECG Values, Motion of the patient and Patient status

Table 1: Patient Sensor Reading

S.NO	SENOR READINGS	VALUES
1	ROOM TEMPERATURE	0
2	ROOM HUMIDITY	0
3	BODY TEMPERATURE	90
4	PULSE SENSOR	69
5	ECG SENSOR	53

V. CONCLUSION

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. 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. Internet of Things rules the whole world in various fields, mainly in health care sectors. 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. The doctor can view the sent data by logging the specific APP. Hence continuous patient monitoring system is designed.

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