Telehealth- In IoT Environment

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***Abstract*--Internet of Things (IoT) is the emerging paradigm, which contains huge amount of smart object and smart devices connected to the internet for communicating with each other. IoT devices are used in many fields which make the users' daily routines more comfortable. These smart devices are used to collect temperature, heart rate, etc., which are used to evaluate the health condition of the patient. Communicating the collected information to the doctor, making accurate decision on the data collected and notifying the patient is the challenging task in the IoT. The architecture of the Telehealth System using IoT devices is proposed to collect the required parameters and evaluate the data obtained from the IoT devices. The system also notifies the patient with the parameters that are being monitored. This system suggests the patient with medical care and next step to be followed in case of critical situation. The system is evaluated for certain parameters and the decisions made on the data obtained from the source are assumed to evaluate the system.**

***Keywords*--IoT, Telehealth, Patient Monitoring, Raspberry Pi, Heartbeat sensor, Temperature sensor, Cloud**

I. INTRODUCTION

The Internet of Things (IoT) is referred to as a network of physical objects which includes embedded technology for communication, senses or interacts with the internal states or the external environment . IoT is short for Internet of Things. The Internet of Things (IoT) refers to the ever-growing network of physical objects that displays an IP address for internet connectivity, and a certain kind of communication that occurs between these objects and other Internet-enabled devices and allied systems.

Among the panoply of applications enabled by the Internet of Things (IoT), smart and connected health care is a particularly important one. Many researchers have utilised IoT concepts to devise different kinds of models. Parameters like heartbeat and temperature can be sensed with low cost devices like TCRT1000 or LM35. Raspberry Pi can be used which has great accuracy. Hence, keeping in mind the versatility of the IoT, we have implemented the Temperature and Heartbeat Sensing Model using IoT while keeping the basic implementation using software interfacing of Raspberry Pi.

II. LITERATURE SURVEY

Dohr et al [1] monitors blood pressure level using Keep In Touch (KIT) and closed loop healthcare services. In KIT method, KIT is connected to the JAVA based mobile phone with the help of near field communication. It works on magnetic , inductive coupling and then the distance is short. After touching the KIT, the data is send to mobile phone. In closed loop services, the data is getting from mobile phone, then the data is send to the secure website. Using this website anybody can monitor patient's blood pressure level.

Junaid Mohammed et al [2] monitors patient's ECG wave anywhere in the world using IOIO- OTG Microcontroller. Android application is created for ECG Monitoring. IOIOOTG microcontroller is connected to android phone using USB cable (or) Bluetooth dongle. After collecting data, the wave is send to android application. Monitor and store ECG waves in that android based application.

Mohammed S. Jasses et al [3] focused on body temperature monitoring using Raspberry pi board in cloud based system. In that paper, Raspberry pi is monitor body temperature and then these parameters are transfer by wireless sensor networks (WSN). Then these data are added to the cloud based websites. Using this, website monitors body temperature.

Hasmah Mansor et al [4] monitors body temperature using LM35 temperature sensor. The LM35 temperature sensor is connected to the Arduino uno board. After that creating a website in SQL database format. Arduino uno board is connected to that website. Then sensor output is send to the website. Using this website, anybody can monitor body temperature in login process.

Mathan Kumar et al [5] discussed about monitors ECG, Respiration rate, heart rate and body temperature. These sensors are connected to PIC16F887A microcontroller. After collecting data from sensors, the data is upload to the website manually. For monitoring purpose created an android application and webpage for monitoring health status.

Karandeep Malhi et al [6] monitors body temperature, heart rate using C8051F020 microcontroller. Wearable sensors are used to collect data and then send to micro controller. Zigbee module is connected to this microcontroller and then that module is transfer data to the nearest receiver .

Nithin P. Jain et al [7] monitors temperature, blood pressure, heart rate of patient's. Microcontroller AT Mega 32 is used for connecting these sensors. GSM module is connected to this microcontroller. After collecting data, if the value is low SMS is send to the doctor.

III. SYSTEM ARCHITECTURE

The main idea of the designed system is to continuous monitoring of the patients over internet. The Proposed System architecture for IoT Healthcare is as shown in figure 1. The model consists of an Raspberry Pi 3(Model B), Temperature

sensor, Heart rate Sensor, ADC0808, Wi-Fi Module, and Regulated Power Supply.

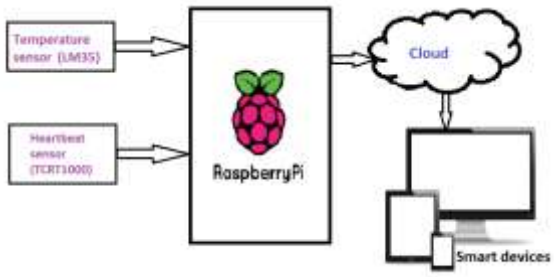

Figure 1: Block diagram of Patient Health Monitoring System

The average of normal body temperature for the human being is 98.6°F (37°C).This can be measured by the temperature sensor and transmitted to the monitoring system through the wireless device. The temperature greater than 98.6°F (37°C) will be considered as abnormal. The heartbeat sensor which is connected with Raspberry Pi is used to monitor the heartbeat of the patient. The collected data is updated in the cloud. The doctors, attender of the patient (authorized to view) and the patients can view the details through the web. The data is accessed by doctors through their user name and password. The doctors can view all the details associated with their patients. Information such as body temperature, heart rate is updated in the server.
An alert of the patient's data is sent to the mobile number via SMS, be it the doctor, a relative or the caretaker, whoever is registered for the same.

IV. AWS IoT

In 2006, Amazon Web Services (AWS) began offering IT infrastructure services to businesses in the form of web services—now commonly known as cloud computing. One of the key benefits of cloud computing is the opportunity to replace up-front capital infrastructure expenses with low variable costs that scale with your business. With the cloud, businesses no longer need to plan for and procure servers and other IT infrastructure weeks or months in advance. Instead, they can instantly spin up hundreds or thousands of servers in minutes and deliver results faster. Today, AWS provides a highly reliable, scalable, low-cost infrastructure platform in the cloud that powers hundreds of thousands of businesses in 190 countries around the world.[8]

V. IMPLEMENTATION

The figure below shows the working model of patient health monitoring system. In this system the central controller collects the data from the sensors and sends the data through WiFi. The data can be accessed anytime by the doctors by typing the corresponding unique IP address in any of the internet browser at the end user device (laptop, PC, mobile phone, tablet etc).

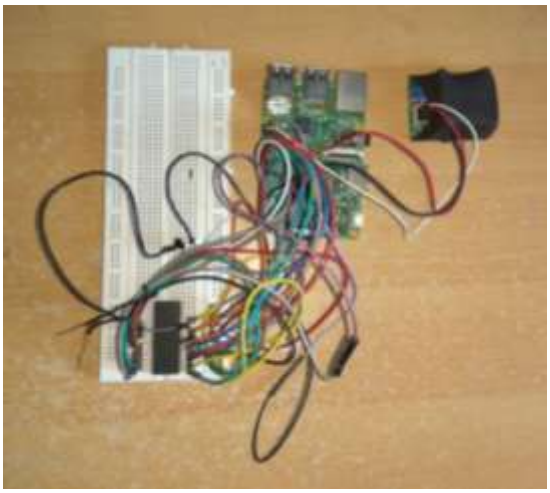

Figure 2:The Hardware setup

The system we are using is AWS IoT platform for obtaining the data from the sensors. The system takes the data from the heartbeat sensor for every 5 seconds. It is converted to BPM (Beats Per Minute) by multiplying by a factor of 12. This is updated in the database DynamoDB. It is displayed on the HTML page. The doctor can view the patient's health condition at anytime. An alert of the patient's data is sent to the mobile number via SMS, by using the services of TWILIO, a Cloud communications platform for building SMS, Voice & Messaging applications on an API built for global scale, be it a relative or the caretaker, whoever is registered for the same.

VI. RESULTS

The system was tested at different situations and scenarios.
Figure 3 shows the screenshot of the data from sensors being captured on the webpage.

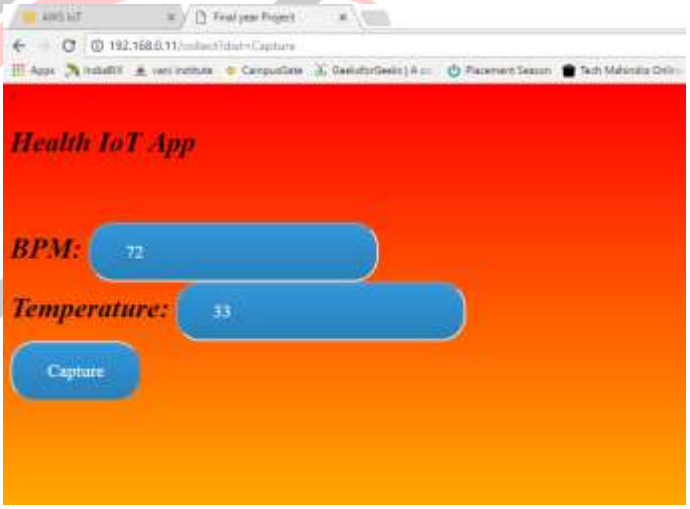

Figure 3: BPM and temperature shown on HTML Page

The data is updated automatically in the database AWS DynamoDB. This can be accessed under the 'Tables>Items' option.
Amazon DynamoDB is a fully managed NoSQL database service that provides fast and predictable performance with seamless scalability. You can use Amazon DynamoDB to create a database table that can store and retrieve any amount of data, and serve any level of request traffic. Amazon DynamoDB automatically spreads the data and traffic for the

table over a sufficient number of servers to handle the request capacity specified by the customer and the amount of data stored, while maintaining consistent and fast performance.[9]

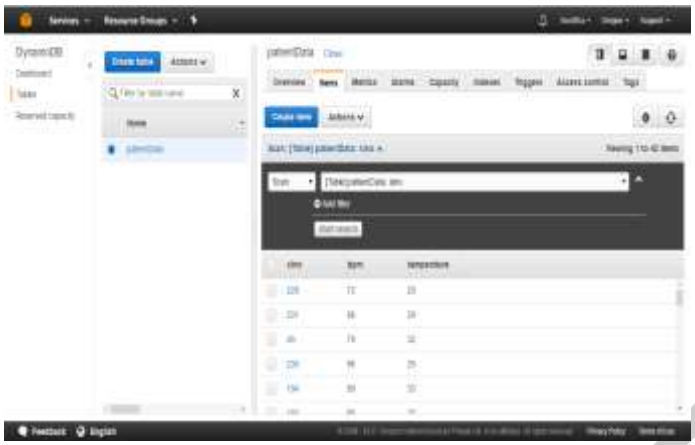

Figure 4: Patient Details Updated in Cloud

An SMS alert is received by the registered person's mobile, a screenshot of which can be seen in figure 5.

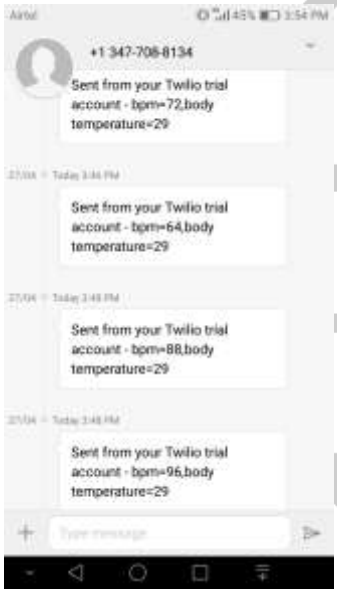

Figure 5: SMS Output

VII. CONCLUSION

This IoT health care system can provide early treatment and detect danger signs quite early to prevent the need for hospitalization. The length of hospital stay is minimized and the physician and nurses can be connected and monitor the patients based on the report generated by the real time sensors and daily clinical updates by the patient on the database server. The data is also viewed on a HTML Webpage, so the patient can know his health status. An SMS alert is sent to the doctor's cell phone, thus reducing time taken to react to the situation.

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[9]https://aws.amazon.com/documentation/dynamodb/?icmpid=docs_menu