Remote Health Care Monitoring System Using IoT SaaS

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Abstract*—Healthcare patient monitoring system is an IoT device which can be used by anyone to check on real time health readings such as temperature, Heart rate, Blood oxygen level and electro-cardiogram could be monitored remotely on a handy device. The device will automatically send alerts to the concerned in case of anemergency which here can be fluctuations in the readings of the sensors beyond normal range of operation. The device is built using pulse sensor, temperature sensor, SpO2 sensor, Humidity sensor, GSM and GPS attached to an Arduino which can transfer its data to servers using Wi-Fi module as well as send SMS updates using the GSM module. The servers can compute the data and present the data on hand held devices.

Keywords— ***Healthcare, Monitoring system, controller, sensors, IoT on cloud platform, Medical services,***

I. INTRODUCTION

Health is characterized as a full state of physical, mental, and social well-being and not merely a lack of illness. Healthis a fundamental element of people's need for a better life. Unfortunately, the global health problem has created a dilemma because of certain factors, such as poor health services, the presence of large gaps between rural and urban areas, physicians, and nurses unavailability during the hardest time. IoT is making any objects internally connectedin the recent decade and it has been considered as the next technological revolution. Smart health monitoring mechanism, smart parking, smart home, smart city, smart climate, industrial sites, and agricultural fields are some of the applications of IoT. The most tremendous use of IoT is in healthcare management which provides health and environment condition tracking facilities. IoT is nothing but linking computers to the internet utilizing sensors and networks. These connected components can be used on devices for health monitoring. The used sensors then forward the information to distant locations like M2M, which are machinery for computers, machines for people, handheld devices, or smartphones. It is a simple, energy-efficient,much smarter, scalable, and interoperable way of tracking and optimizing care to any health problem. Nowadays, modern systems are providing a flexible interface, assistant devices, and mental health management to lead a smart life for the human being.

Heart rate and body temperature are the two most significant indicators for human health. Heart rate is the per-minute amount of heartbeats, commonly known asthe pulse rate. To measure the pulse rate, an increase in the blood flow volume can be used by calculating the pulses. Normal heart rate ranges between 60 and 100 beats perminute for healthy people. The typical restful heart for adult males is roughly 70 bpm and for adult females 75 bpm. Female with
12 years of age and above, typically have higherrates of heart

in contrast with males. The temperature of human body is simply the heat of body and the sum of heat radiated by the body is scientifically determined.

The average person's body temperature relies on different factorssuch as ambient temperature, the person's gender, and his eating habits. In healthy adults, it is likely to range between 97.8 °F (36.5 °C) and 99 °F (37.2 °C). Different factors suchas fu, low-temperature hypothermia, or any other illness may lead to a change in body temperature. In almost all illnesses,fever is a typical indicator. Various methods exist to invasively and non-invasively assess the heart rate and body temperature. For the consumer, noninvasive approaches overa while have proven accurate and convenient. It is suggestedthat a healthcare should provide good room conditions to facilitate the patients. Some measures like room humidity, level of all gases like CO, and CO2 can determine the qualityof room environment. The toxic gases and certain levels of humidity are very harmful to patients. For optimum comfort,the room humidity should be between 30 and 65%. Some studies are done only for a smart home, not for dedicated healthcare. There are several fatal diseases like heart disease, diabetes, breast cancer, liver disorder, etc. in medical sector but the main concern of our developed system is to monitor the fundamental signs of all types of patients and the patient's room environment. This paper proposes a customized healthcare system that monitors

the pulse and body temperature of patients as well as room humidity, CO, and CO2 gas level of patient's room via sensors and transmits the data through Wi-Fi that enables the medical staffs to get data from the server. The developed system also provides a solution for the problem of maintaining a single database of patients in hospitals using a web server, apart from the personalization of critical health-related criteria. In this system, the gas sensor is used to identify an unexpected occurrence that contrasts the performance with the threshold and produces a PPM signal if the output value crosses the threshold.

II. LITERATURE SURVEY

Alexsis Bell et al. [1] developed a prototype for a wireless patient monitoring system. This system was measuring oxygen concentration in blood, pulse and temperature by interfacing with sensors. The drawback of the design was thermistor positioning, the blood oxygen concentration was not calibrated; the hardware requirement was more and lead to the high cost of the prototype.

Sagar R Patil et al. [2] designed patient monitoring using wireless technology. It used sensors for measuring the vital signs of patients. The drawback was the readings were not proper and showing glitches while showing the output.

Sohail Shaikh et al. designed [3] a system for monitoring patients using IoT. The main target was just the data transmission from patients to the doctors.

The drawback was the non-inclusion of MAC protocols for still efficient data transmission.

T K Ramesh et al. developed [4] a wireless network protocol for monitoring the patients. The comparison of wireless network protocols is done. The drawback was the communication in rural areas was not efficient.

Dr. Bharath Kumar G J proposed a design [5] for monitoring the patient's vegetative state using cloud computing and IoT. It shows to the family members the patient condition remotely. The main drawback is it's applicable for patients only in a vegetative state.

Sushan M etal proposed a design [6] for improving the safety of patient and surveillance monitoring. The drawback of the system was complex in clinical settings. The sensors data measurement was not appropriate.

Pratiksha W D et al. proposed a method [7] from which health monitoring of patients is done. Thepatient's only temperature and heart rate with the saline level were measured. The drawback was that the measurement of vital parameters was not measured.

S Nubenthan et al. designed a system [8] for continuous monitoring for dengue with the wireless monitor. The drawback was that the sensor data was not transmitted using GSM modules and the mobile based application was included.

Sachi marathe et al. designeda system [10] for patient monitoring with vital parameter measuring sensors. The design stored the data from sensors on to the cloud. The drawback was the results deviated by a factor of ± 3.

Kathikamani R et al. designed [11] monitoring system for patients using wireless technology. The data collected are stored on the cloud and are analyzed.

The drawback was not using web service application peripheral interface, it was on localhost. Using the above literature papers as a base, a design is proposed which fulfills the drawbacks of all the systems and was implemented.

III. METHODOLOGY ,COMPONENTS & BLOCK DIAGRAM

System consists of the basic vital sensors interfacing with the cloud and mobile application as shown in figure 1. The data is captured by sensors are sent to the processor Arduino where the data is acquired and processed. The data acquired by the processor is compared with the threshold values of the desired sensors. If the sensor values move equalor above the threshold, then an emergency message or alert ispassed to the doctors in the mobile application through a Wi-Fi module with the details of each sensor. This data is furtherpassed to the cloud for details changes of the past few hours data. The past few hours can be accessed on the website andthe data is stored in the cloud. The proposed system uses the sensors like pulse sensor (for measuring the heart rate), Temperature sensor (for measuring the body temperature) and SpO2 sensor (for measuring the SpO2 intake) as shown in figure1. The system measures the parameters in real-time and displays on the LCD and in the cloud which enables monitoring of patient health when the doctor is with the patient or wireless monitoring for any place. The flowchart of the proposed system continuous monitoring of the patient is shown in figure 2. The sensors data is sent to the cloud via the Wi-Fi module, if the sensors data are not in acceptable range then an alert message is sent onto the mobile application. The doctor can take the action very soon for helping the patients.

The basic hardware needed for the proposed model is pulse sensor, Temperature sensor, SpO2 sensor and Wi-Fi module, Humidity sensor, pressure sensor, Air quality sensor, Toxic gas sensor, GPS and GSM module.

Pulse sensor: it measures the heart rate. It has circuitry for noise cancellation. A finger is placed on the sensor; it calculates the amount of blood in the capillary tube based onthe amount of light reflected. The difference in the amount of light transmission and reflection is the result of the sensor.

Temperature sensor: The sensor measures the body temperature from -55 degree celsius to +150 degree Celsius. For every 10 degrees rise in temperature, the output changesby 10mv.

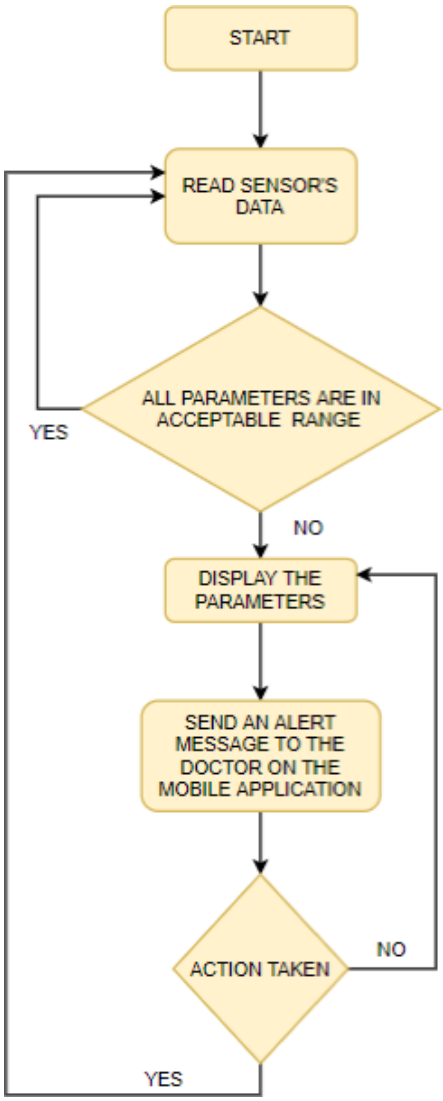

Fig 1: Flow Chart

SpO2

sensor: This sensor measures the oxygen content in the blood. A little beam of light passed through the blood within a finger. It measures the amount of change in light absorption.

Wi-Fi module: This module allows connectivity of the internet with the embedded applications. It uses the communication protocol. It transmits the values of sensors to the mobile application.

GSM module: It's a GSM modem with TTL output. It's a standard for the mobile telephones. This module sends the message to the mobile if there is a sensor value crosses the threshold.

Humidity sensor: The humidity sensor is a device that senses, measures, and reports the relative humidity (RH) of air or determines the amount of water vapour present in gas mixture (air) or pure gas.

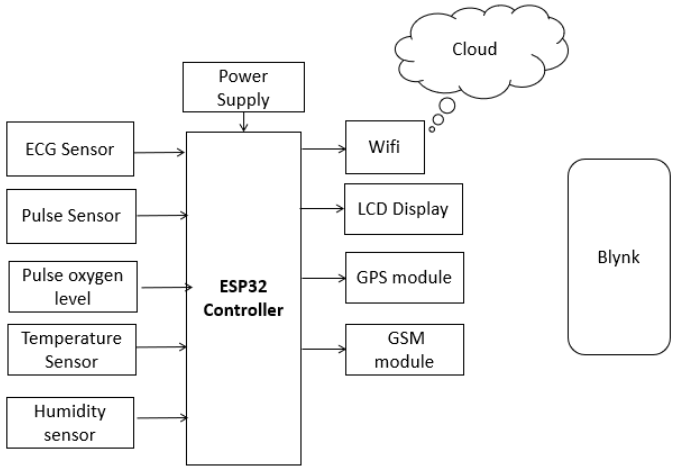

Fig 2: Block Diagram

IV. RESULT

The data were collected from sensors and sent to microcontroller for processing and again transmitted it to the customized cloud IoT network. Customized cloud/web serveris used for the graphical interpretation, and display of collected results. Web-app shows the current status and process of transactions. The HTTP protocol provides easy connectivity for the correspondence between a Wi-Fi moduleand the cloud/web server. The HTML user interface is updated every 15sec, allowing patients to be tracked in real- time.

All connected devices and medical equipment arecontrolled and linked with networks using hardware supported by ESP8266 board. In case of interface for doctorsand medical team, the COVID - 19 patient data visualization. Customized web app gives extensive functions to monitor and control the data received from the patient center via remote connection. As soon as web-app starts running on device, real time as well as historical data measurements related to patient health e.g body temperature, Blood pressure, Oxygen level, Electrocardiogram, etc. can be seen at any place via remote connectivity. The described paper with IoT system has potential to manage effective operations at hospitals, test laboratories, medicinal distributors and government offices.

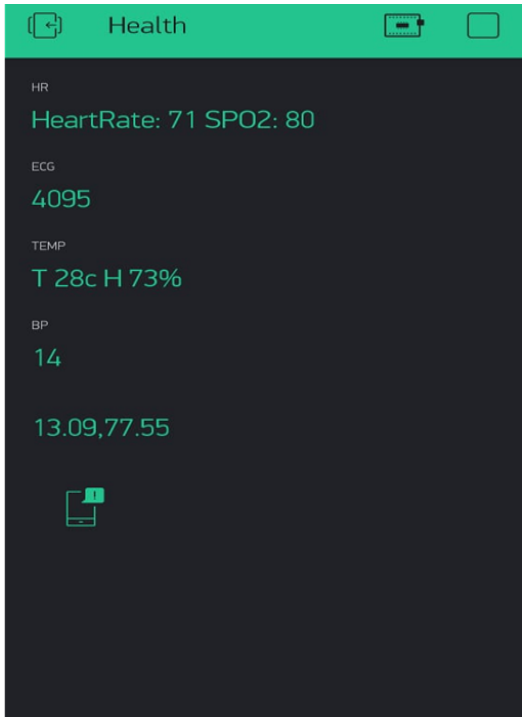

Fig 3: Blynk app

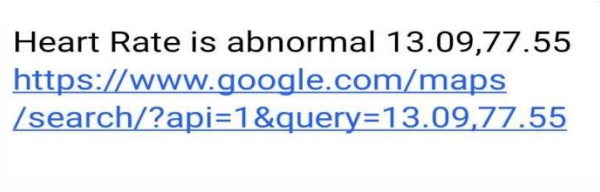

Fig 4:Alert message

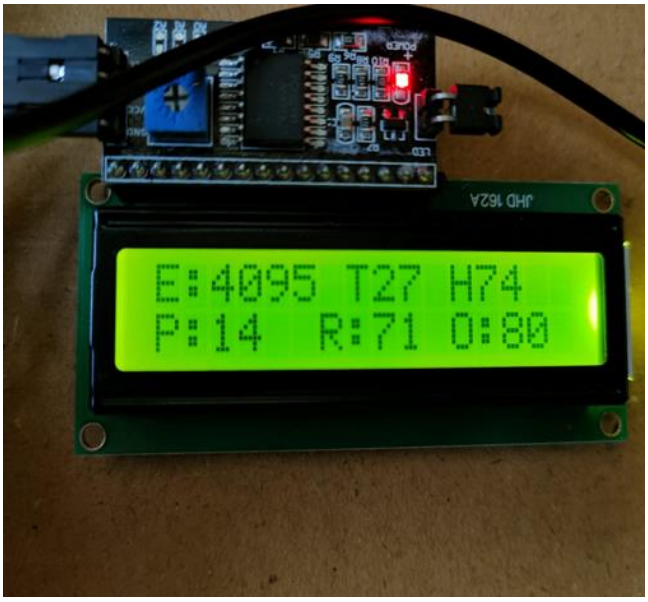

Fig 5: Paramters Displayed On LCD

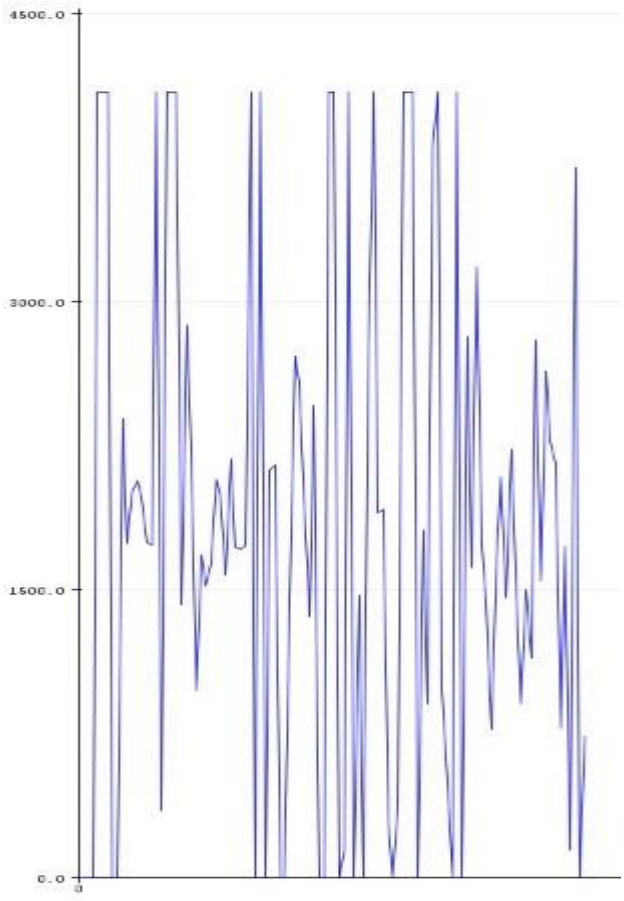

Fig 5:ECG graph

V. CONCLUSION

This system introduced smart healthcare to monitor the basic important signs of patients like heart rate, body temperature, and some measures of hospital room's condition such as room humidity. 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 analysed 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 novel coronavirus (COVID-19) treatment. The developed system will improve the current healthcare system that may protect lots of lives from death.

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