ESSENCE OF WEARABLE DEVICES IN DIAGNOSING COVID19

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ABSTRACT: As IOT has rapid development by 2020, the role of wearable devices plays a crucial role in daily life.As the name implies wearable devices can be worn on our skin.There are different types of wearable devices which are available in the market like fitbits, smart watches, head mounted displays, smartjewellery,smart clothing, smart health.During COVID-19 pandemic period these devices are used extensively. The main objective of this research is toprovideawareness ofthe role played by these devices in COVID-19 period.These devices are used in detecting symptoms of COVID-19 and help the patients in providing required medication. The information obtained from the patients is stored in the cloud using IOT. With this data the doctor candiagnose the patients condition and provide the required treatment.The data obtained from patients like their pulse rate, oxygen levels, etc isstored in the cloud.

Keywords: IOT, Wearable devices, COVID-19

INTRODUCTION

IOT means connecting various computing devices using Unique identifiers(UID'S) and sending data by a network without human-to computer interaction.Examples of various IOT devices are smart homes,wearable health monitoring devices,smart devices,etc.Wearable devices will monitor the information of patients health condition.The sensors used in these devices measure physiological signs like temperature, heartrate, bloodpressure ,respiratory rate and blood oxygen saturation is used to obtain patients results in ECGS(Electro cardiograms), EMGS(Electromyograms),etc.These sensors are arrangedin WBAN called as wireless body area network and arearranged on skin, clothing,persons tissue.With the data obtained from wearable devices we can get symptoms of COVID-19 and it can be considered as early warning to diagnose COVID-19.For example, a Fitbit of good quality is used to monitor heartrate and it also has SpO2 sensorto monitor oxygen levels. The status of oxygen levels is the best symptom for detecting COVID-19.This is how wearable devices and IOT are connected and used in diagnosing COVID-19.Also, there is a relation between IoT and cloud where IoT is used to generate huge data and Cloud provides the path to store that data.The technology of wearables is considered as smart electronic devices which has microcontrollers embedded in it.All these devices can be used on our body as accessories.Wearable devices are mostly used in the fields of medicine, education,entertainment and in many real time applications.

Wearable devices has 3 layers.The first layer is Sensors.A sensor has the ability to detect and respond to the input from physical environment.The input can be light, moisture,pressure etc. and the output is a signal which humans can read.A computer uses smart sensor which is considered as a real sensor.Second layer is the control and connectivity layer.To establish a connection between wearable devices and a home network the protocol used is BLE. BLE means Blue tooth low energy .The operating systems of mobiles like Android, iOS, Windows phone supports BLE.Third layer is the cloud in which wearable devices gives input and the

data is read. Cloud has the structure to process and store IoT data. There is a relationship between cloud and IoT.

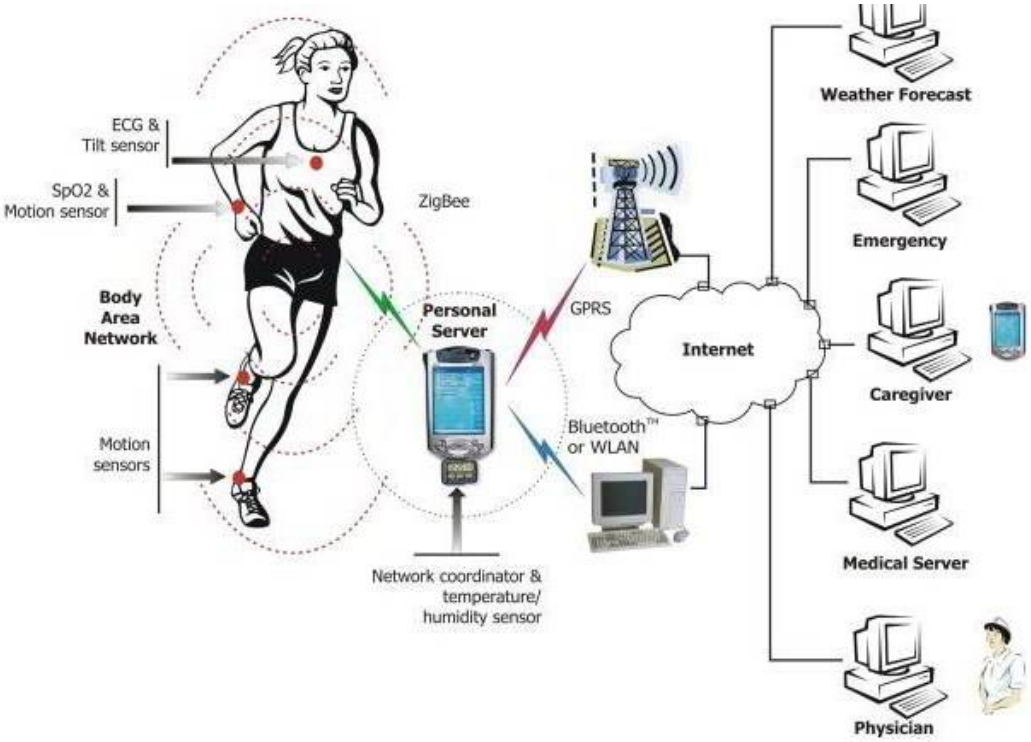

FIGURE 1:WEARABLE DEVICES CONNECTED WITH IoT

In figure 1, it shows how different sensors like Tilt sensor,SpO2and motion sensor are used in wearable devices and by using Zigbee,internet the required data is sent to the destinations. As per the present research, the information of the patients is recorded and sent to the cloud for storage purpose.A disease occurred with infection by SARS-CoV-2 is known as COVID-19.The symptoms for COVID-19 are fever, drycough, sore throat,loss of taste , smell,etc.This COVID-19 basically attacks the respiratory system.Sometimes this may also leads to Pneumonia

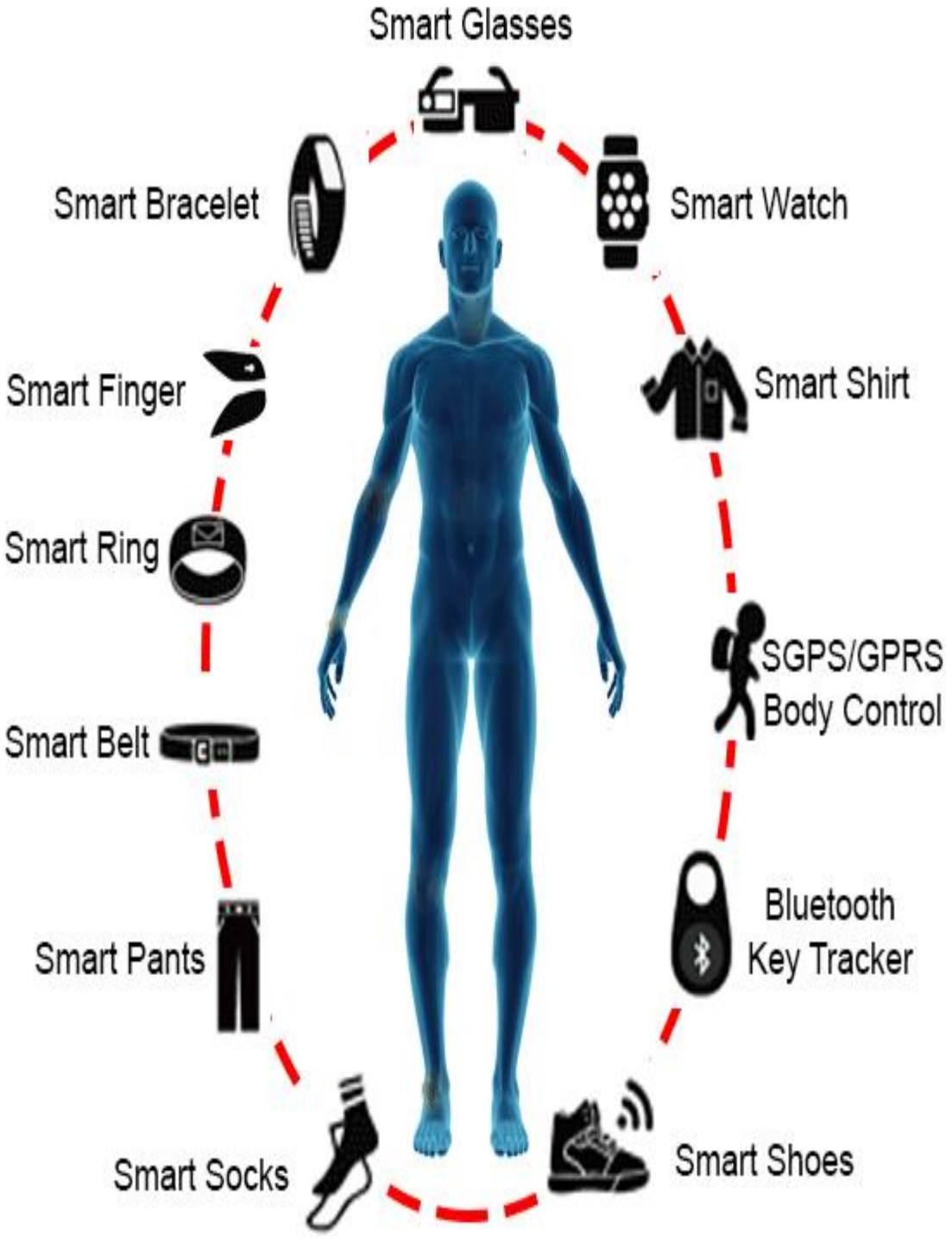

FIGURE 2:TYPES OF WEARABLE DEVICES

FIGURE 3:USUAGE OF WEARABLE DEVICES IN MEDICAL FIELD.

Figure 2 shows different types of wearable devices available in the market and figure 3 shows how these devices are used in medical field.

LITERATURE SURVEY:

In [1] Yuan-ting Zhang et. al discussed about medical equipment that comes under the category of wearable devices. These devices consists of senors which are part of Body sensor network(BSN) that helps to track the current health condition of an individual. This paper also proposed new standards for cufless blood pressure monitoring devices.

Performance evaluation of cufless blood pressure measuring devices is defined normatively by a standard called IEEE std 1708 proposed in [2]. Form of the device or the platform to which the device is embedded is not a consideration in this standard. This standard however is an exception for the sphygmomanometers that use cuffs to measure the blood pressure where they are wrapped around the wrist and then pressure is applied where it stops the blood flow. And when the pressure is released it gives the reading of BP in our body. This standard also provides guidelines to the manufacturers who manufactures wearble devices for monitoring the blood pressure.

In [3] Lisa Avila et. al have given a sort of review about some of the trending wearable devices like Fit bit Surge, Intel Curia and MICA, Ringly and Apple watch. The Fit bit Surge is a revolutionary development in Fit bit where it facilitates GPS tracking and monitoring the heart rate. The memory in this is enough to store a week's data about the person like users heart rate every second which can be used to review the person's health tentatively. These all information is displayed on the smart screen of the watch itself and more detailed data can be obtained from the application that runs on the user smartphone. Intel Curie is one wearable device where it is a fruitful product designed with the latest processors which are size of a button where it includes BLE, accelerometer and gyroscope. MICA (My Intelligent Communication Accessory) is a device which was manufactured by incorporating Intel Quark SE in it. This is type of bracelet that is capable of sending E-Mails and messages to the users. It calculates the distance and estimated time to reach a particular destination and alerts the user to start at a particular time to reach that destination. It also locates the nearby shops, restaurants and entertainment zones. A wearable device named ringly is of the size of a ring which sends E-Mail alerts, messages to the users and is capable of changing the colours according to the input received. The Apple watch has hit the market in the year 2015 where it has become a dream watch now to many users. It includes accelerometer and heart sensor and is able to provide detailed tracking of user with the help of GPS and Wi-Fi inbuilt.

In [4] VijayakumarNanjappan et. al have proposed the importance of clothing materials in daily lives of every individual as nowadays the wearable devices are being manufactured in such a way that they can be embedded into clothes. Also these are flexible to perform any gestures like bending or stretching the hand which could not be possible with conventional flat touch screen surfaces. The reason behind their widespread use is that they can be placed anywhere on the body and they can be travelled with the user. The challenges present in these devices are also presented so that they can be adopted more widely.

A bidirectional IOT gateway was proposed in [5] by Gopi Krishna P et. al which explains the importance of gateway in an IOT network. The major concern with IOT devices is hetrogenity where one device works with one protocol and other device works with an other where there comes a nedd for protocol conversion which can be taken care by a gateway. The proposed gateway works with both Zigbee and Wi-Fi enabled with MQTT protocol.

As in todays world almost every individual is facing health problems at a very small age there is an need for wearable devices which can track the health condition of a person. We pretty well know how IOT has blended into our lives making tedious tasks easy and monitoring a patient from the remote area is also made possible as it has emrged inot the helath sector. In [6] RittwikSood et. al have proposed a device named Sukoon which is a wearable device connected with IOT. It helps a person who is in an emergency condition by providing the details of him/her like her medical record, location of the person through GPS to the interested contacts, it also provides nearby medication places available etc.

In [7] B.S.S.Tejeshet. al have addressed the issues that are being faced in smart agriculture, smart home automation, smart street lights etc which uses IOT. In this paper authors have also presented the importance of IOT in every sector and also security issues in these areas are also presented.

Monitoring the temperature and humidity is possible through a sensor called DHT11 and there are specific sensors to monitor the quality of water. In [8],[10],[12] authors have proposed a system where these sensors are connected to IOT which could provide the advantage of storing the values of sensors in the cloud platform. Here we could know how the data can be actually stored in a cloud platform as in our research we are storing the values obtained from the pulse oximeter in cloud.

In [9] K Hari Kishore et. al have discussed the importance of a device which monitors the health of a patient by measuring his heart rate continuously. These values are stored in a cloud platform like Thing speak where data can be visualized later which helps the doctor treating the patient for any ailment to refer to the previous data.

A soil moisture monitoring system is proposed in [11] by E. Raghuveera et. al which can not only monitor moisture of the soil but it also automatically turns on the motor when soil moisture is less than or equal to the set threshold. Also remote monitoring concept is discussed in this paper where it is possible for the farmer to observe his field from a remote location and also can control the appliances like motor from there itself. The values are continuously stored in cloud by which prediction of soil condition is possible.

As the age progresses there might be a tendency of dementia in almost every individual. In [13] a telerobotic system is proposed which assists the people with above problem. This is one of the medical assisted robots which help the dementia patients in all aspects of their life.

In [14] Achanta S.D.M et. al have proposed a model that helps elderly people as well physically challenged persons. The model is related to gait parameters and this sytem accuracy varies depending upon the challenges and abilities of individuals. Changes in a person's lifestyle can be tracked by deploying these wearbale devices in gait analysis. This paper also proposed the existing gait analysis extension to IOT where tracking of the persons lifestyle and past records of the person can be tracked easily.

In [15] Rao K.R.R.M et. al have proposed a smart health care system that is connected through IOT. The proposed system is able to monitor the condition of patient like heart rate, temperature, ECG etc remotely and advice the necessary medication and support to the patient through internet. This system can also be helpful for elderly and physicaaly challenged people to obtain the medication.

IOT connected smart home system is gaining importance nowadays. All the appliances in home can be connected through a Wi-Fi module like ESP8266 ESP-01 where the status of each appliance can be monitored remotely from any place. Such type of system is disussed in [16] where the authors have considered some of the appliances that are mostly being used in homes and their monitoring through an application called Blynk.

In [17, [18], [19], [20] authors have discussed about the deadly virus Corona that has shook whole world in the year 2020. The common symptoms that could be regarded as an early warning of COVID-19 are drop in the oxygen levels, variations in heart rate and changes in body temperature etc. These papers have discussed about the wearable devices that track the above symptoms. In one of the paper a system is proposed where it focuses on No-Touch of the face as it is suggested not to touch our face unnecessarily which can transmit the virus into our respiratory system. Also the potential risks when a child is exposed to outer environment in this pandemic are also presented.In [22],[23],[24],[25],[26],[27], [28].[29] authors mentioned about the basic issues in an IOT system and algorithms and protocols used in IOT are also proposed.

PROPOSED MODEL

Generally, in existing model, Pulse oximeter is interfaced with Arduino. But in the proposedmodel,we will discuss about how the data is stored in cloud also.Here we use Arduino Nano.Arduino Nano is a flexible and small board which has a microcontroller embedded in it developed by Arduino.ccwhich is based on based on ATmega328p / Atmega168. ArduinoUNO is likeArduino. Only the difference is in size. It has an operating voltage of 5V where the input voltage is of 7 to 12v.The pinout of Arduino Nano has 14 digital pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins.

Microcontroller	Atmega328p/Atmega 168
Operating Voltage	5V
Input Voltage	7 – 12 V
Digital I/O Pins	14
PWM	6 out of 14 digital pins
Max. Current Rating	40mA
USB	Mini
Analog Pins	8
Flash Memory	16KB or 32KB
SRAM	1KB or 2KB
Crystal Oscillator	16 MHz
EEPROM	512bytes or 1KB
USART	Yes

TABLE 1: ARDUINO NANO SPECIFICATIONS

Table 1 shows various specifications of Arduino NANO.

MAX30100 is a sensor IC used in wearable health.It has combined pulse oximeter and heartrate monitor sensor solution.This IC is mostly used in medical monitoring devices.

OLEDs provide bright display on electronic devices and use less power than light-emitting diodes (LEDs) .

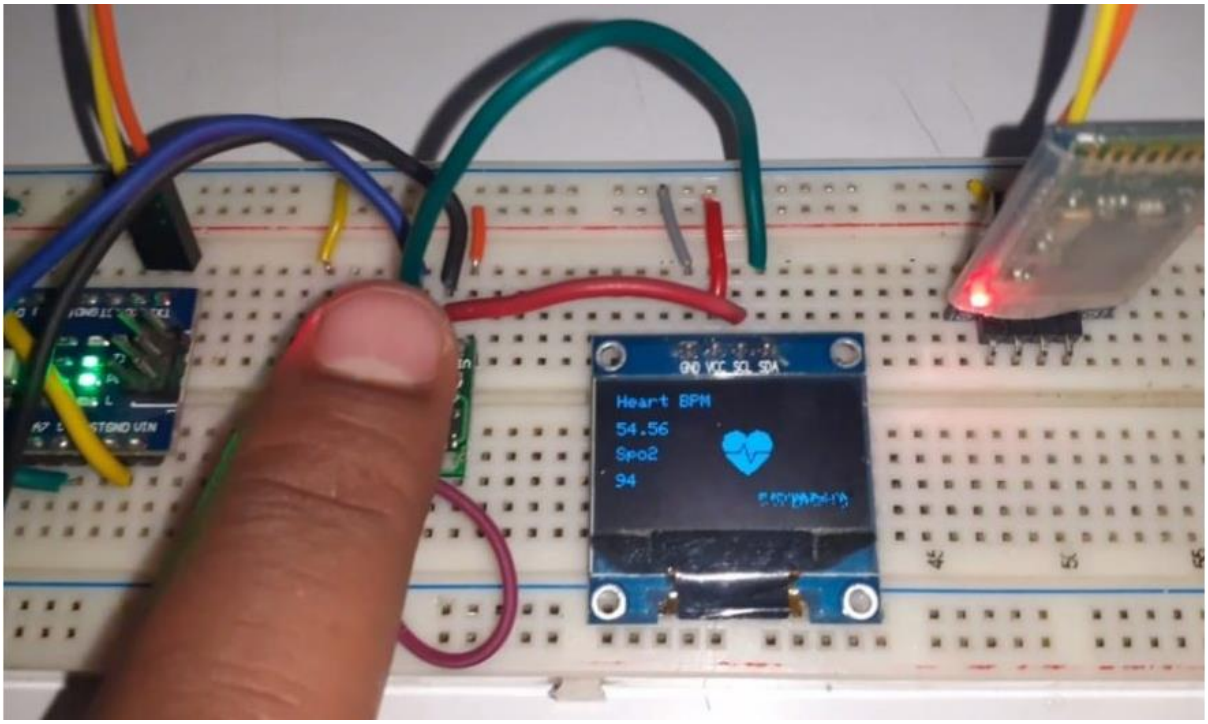

FIGURE 4:INTERFACING OF PULSEOXIMETER WITH ARDUINO NANO

In figure 4 it shows the interfacing of a pulseoximeter with ArduinoNano.From this we get BPM, SpO2 values of a patient. From BPM we get the heartbeat rate which is beats per minute and from SpO2 we get oxygen saturation which indicates the oxygen level. All the values are displayed on OLED. This helps doctors in providing treatment for corona patients.All these values are stored in a cloud platform like Think Speak.Think speak is defined as the platform for IoT which makes you to connect and store the sensor data in the cloud and develop the applications of IoT.

Results:

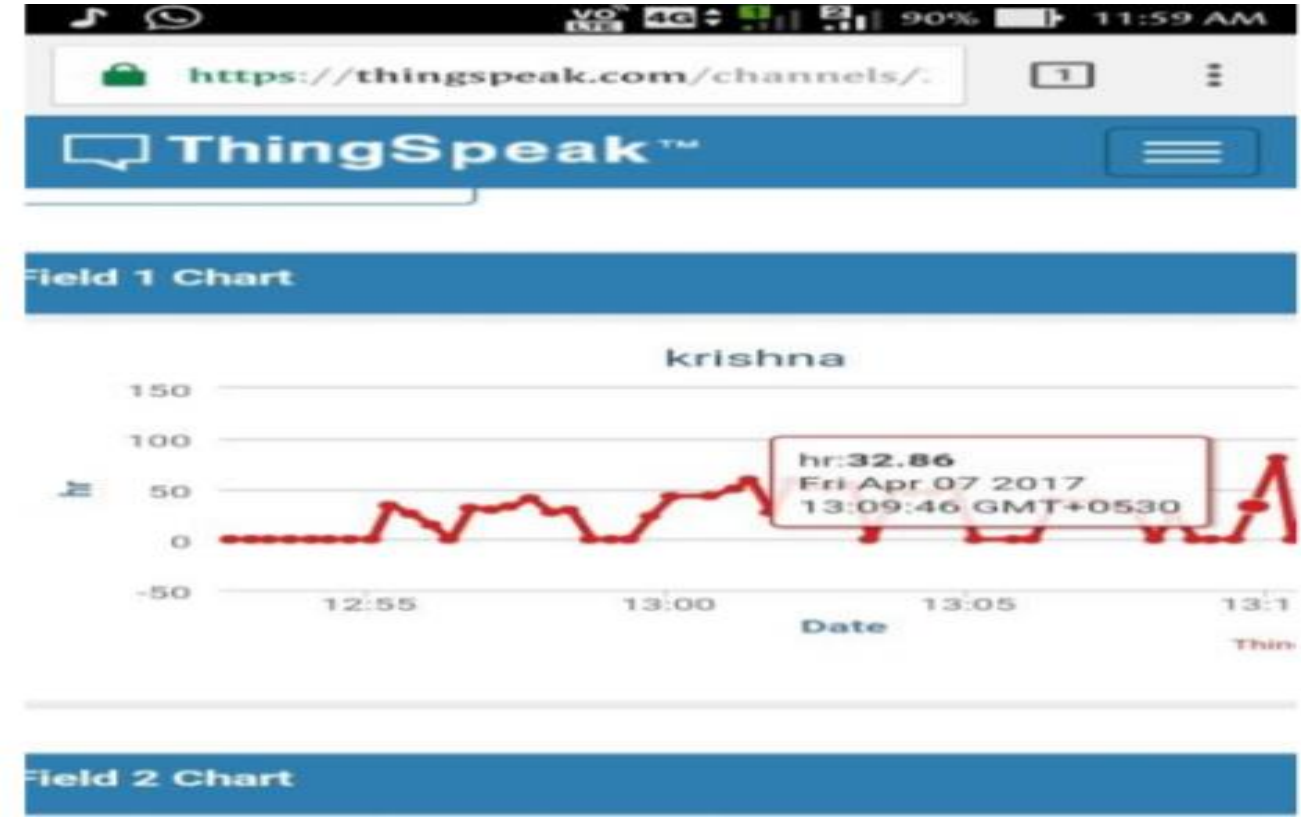

FIGURE 5: BPM VALUES

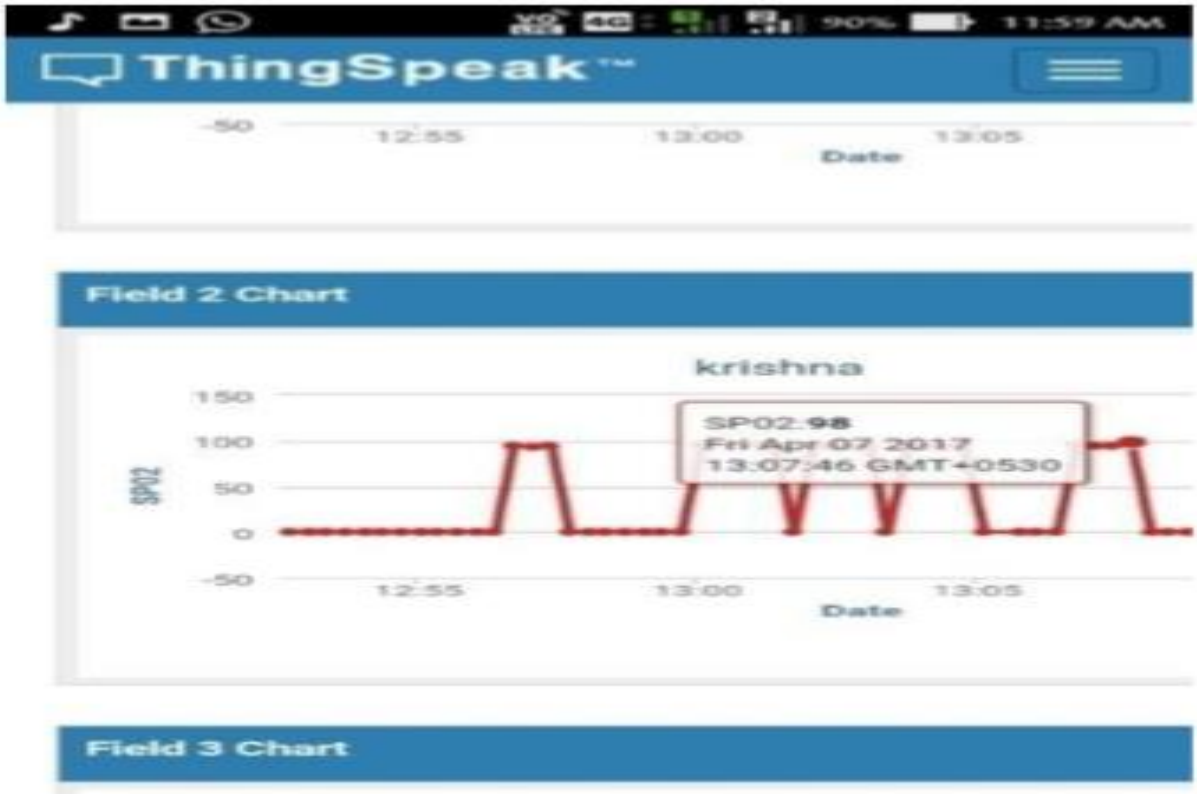

FIGURE 6:SpO2 values

Figure 5 shows the BPM values used for monitoring heartrate and figure 6 shows the SpO2 values to monitor oxygen levels.

PERFORMANCE ANALYSIS:

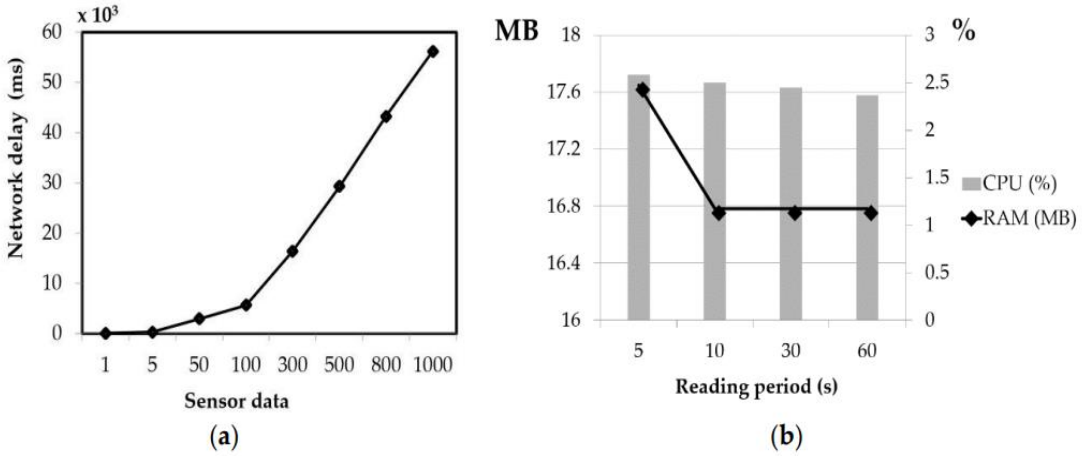

FIGURE 7: IoT-based sensor system's (a) network delayand (b) CPU and memory usage

Figure 7 shows the performance analysis of IoT based sensor system with network delay and the usage of CPU and memory.

CONCLUSION:

So, with this our aim of a doctor even located at a remote place can provide the treatment for corona patients by using IoT and store the data in cloud. Also this data can be retrieved whenever needed. Health Monitoring, approaching and providing required information to the necessary people who are in emergency, are some of the features of our proposed system .The data stored in the cloud is useful for doctors, patients and also to the management of hospitals in providing treatment. As the number of patients are increasing day by day it is difficult for the patients to go to hospitals and get treated. By using wearable devices , we can diagnose the disease at early stage and provide the necessary treatment.

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