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Implementing of a Mobile Health Monitoring System for Covid-19 Patients Using IoT and Sound Commands

Ali M. Jasim[1]

1 Department of Communications Engineering, Iraq University College, Basra - Iraq
E-mail: e.alim.j.92@gmail.com

Abstract. The remote monitoring service has contributed to saving the lives of many patients; especially those suffer from chronic or infectious diseases or heart problems. Remote medical monitoring enables to assess the condition of the heart, monitor its beats, monitor body temperature, oxygen level, and etc. Today, in all countries of the world, the deadly Corona virus has appeared, so it is necessary to monitor the health status of patients remotely through various means. This paper introduces a mobile robot of health monitoring using sound commands to determine the movement direction of the robot and internet of things technique to send the measuring data of adopted sensors (heart beats, temperature and oxygen sensors) to the web server and store them in database. The proposed system aims to save doctor's life, time, facilitates of monitoring the huge number of patients, prevents infection from infected patients. The adopted system consists of a microcontroller on the transmitter side to process the speech signal and send the output data to the receiving side through the transmitter unit to move the robot according to the speech signal commands. the motors of the robot have been controlled the speed and direction using Wi-Fi microcontroller and H-bridge module in the receiving side.

Keywords: Health monitor system, Internet of things, ESP-32 Wi-Fi microcontroller, Heart rate sensor, Temperature sensor, Mobile robot.

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1. Introduction

The word "robot" evokes a variety of images such as its almost human form, cleaning machines, as a tool for tech projects, etc. Most of the debate about these machines is limited to the possibility of them outperforming us, or their quest for world domination, or even their revolt in the factories over their unfair working conditions.

Currently, in most countries, deaths are increasing due to day after day health problems. Death rate every year about 55.3 million people. This number is due to several reasons, including: Lack of medical staff, delay in giving Timely adequate treatment or lack of special resources in hospitals. Consequently, there is an urgent need to use some modern technologies to solve these problems, especially after all countries witnessed today a fierce war to overcome the greatest epidemic that afflicted the entire world, which is the Corona virus. This paper proposed a smart healthcare monitoring system using sound commands and IOT [1], [2].

Internet of thing (IOT) is a network concept to connect multipule devices (wearable, portable, house held device, etc.), network internally, also integrate hardware with software in network, and connected this with other network. the environment of IOT permits remotely transferring or supervising control from a certain network to another in that infrastructure. In the field of healthcare, IOT technique helps to monitor in real time system with flexibility and important vital function in any place and time.more Therefore, it can send the information data, which ensure monitoring of patients status in real time [1], [3], [4].

Now, researchers argue that robots may be used in the fight against one of the biggest health threats, the emerging corona virus. Robots can be effective in disinfection operations, measuring vital signs of disease, providing food to patients, as well as providing medicine at the times designated for it, especially in periods of global epidemics. Mobile robots can be used to find out the patient's status by moving around different places and hospitals to measure body temperature, heart rate, oxygen level, etc.

The slap of the new Corona may stimulate us to innovate in the field of robot in the future. That future, for which we must prepare with an army that does not carry weapons, but an army of robots capable of carrying medicine and storming areas controlled by real enemies - viruses.

In 2019, [5], R.Priyanka and M.Reji implemented a system gives heart rate, body temp and pulse sensor. the system adopted ESP32 wi-fi microcontroller to transmitt wireless data on IOT cloud to mobile BLYNK application, and arduino board to process the data. the data of patients will be recorded and stored over a time period. In 2019,[6], V. Vikram Gnanaraj, P.Ranjana and P. Thenmozhi proposed a system for patients control and monitoring and control. the system measures the air quality, pulse rate and temperature degree of the patient using the several sensors to collect the data and apply it to the Arduino baord for processing it. This system can be used by the every one. it can be used at hospitals,home or any other places. In 2019, [7], G.Ratna Jyothi and others proposed a health monitoring system to monitor the patient status and if there is any abnormal state in the sensed information, the alarm will turn on and a doctor will receive a message about the current patient's situation. This system adopted arduino board to process the health patient's parameters of the patient and sends the data using GSM module. In 2019, [8], Sowmya L and Nisha Joy proposed an embedded system to monitor patient health. The system monitors body temperature,heart rate and if any saline liquid level. if the sensed parameters become lower than the threshold value, the system informs doctor or care taker to save patients life. In 2020, [9], Nur Hudha Wijaya and others designed a system to give information on the patient's health status. The system measures of patient's temperature and heart rate. It recives the information data from the flow of blood on the finger for 60 sec and displayed the data on the LCD. In 2020,[10], Qunoot N. Alsahi and Ali F. Marhoon implemented a system of health care based on (IOT) for the measurement of temerature, pulse rate, ECG and spo2 using ESP32 Wi-Fi board for sensors controller and raspberry pi as a server. The doctor with this system can save the time of work to visit the patient(s) by monitoring them using Wi-Fi technology. This technology is adopted to make transmission the information data remotely. The information of patients are sent to the web server to be viewed in the web page from anywhere and stored in the database.

In the present work, the monitoring system is built on two main features. The first feature is to move the system robot in all directions depending on voice commands sent by a serial unidirectional

wireless communication unit with a range of 433.4-473 MHz capable of transmitting data up to 1 km. Another feature is to transfer patient status information wirelessly using Internet of Things technology to display it on the web page and mobile phone application.

2. Proposed System

The system detailedly consists of the following hardware components:

A. ***ESP-32 Board*****:** A development board that is distinguished by its amazing capabilities, its cheap price and its ability to connect to Wi-Fi and Bluetooth, as it is an easy to program. It has a dual core processor and a 32-bit architecture. Processor frequency up to 240 MHz, Wi-Fi with data transfer speeds of up to 150 Mbit / s, Flash memory size 4 MB, RAM size of 512 KB.

B. ***Arduino Board*****:** comprises of Atmal328P microcontroller. This unit contains 16 MHz crystal oscillators and 5 V regulator. Arduino processing unit is previously programmed with boot loaders to make the uploading of desired programs the uploading easirly on flash chip memory compared with different boards that regularly need a software user for programming them [11],[12]. The Arduino unit has been used here to process the mother sounf signal coming from the sound recognition module in the transmitter unit and then convert this data to HC-12 transmitter board to be sent wirelessly to the robot.

C. ***HC-12 wireless transmitter receiver unit*****:** it is a serial unidirectional wireless communication unit with a range of 433.4-473 MHz capable of transmitting data up to 1 km. it is used here to transmit the data from transmitter unit to reciver unit (mobile robot).

D. ***Sound Recognition Module*****:** It is an integrated board used for voice / speech recognition to control various projects. The board has the capacity to store up to 80 voice commands each with a duration of 1500 milliseconds (that is, approximately one or two words per command).

E. ***DC Motors and Drive Circuit*****:** common way to control the speed of the robot motors is to apply the motor off/on pulses of its power voltage. This method of speed control is termed Pulse Width Modulation, (PWM). The longer the on duration of pulse, the motor runs faster because it is taking high power for a longer time period. The shorter the off duration of pulse, the motor runs slower [13-14].

F. ***Heart Rate and Pulse Oximeter Sensor MAX30100*****:** this sensor is approved for measuring heart rate and oxygen level in the blood through a finger.

G. ***MLX90614 Infrared Temperature Sensor*****:** It is a sensor to measure the temperature of the body without the condition of contact; it uses the infrared feature to measure the temperature with a high accuracy of up to 0.02 degrees Celsius. The operating range of temparature is from-40 to +125 Celsius.

The diagram shown in Figure 1 illustrates the operation of the proposed system. The idea of the proposed system is focused on implementing a mobile robot with four directions of movement based on distinguishing voice commands sent wirelessly from the transmitter unit to get to the injured person. When the mobile robot reaches the patient or the injured, it measures the heart rate, blood oxygen level and body temperature. Then the robot sends the sensors information to the web page and mobile phone via the Internet.

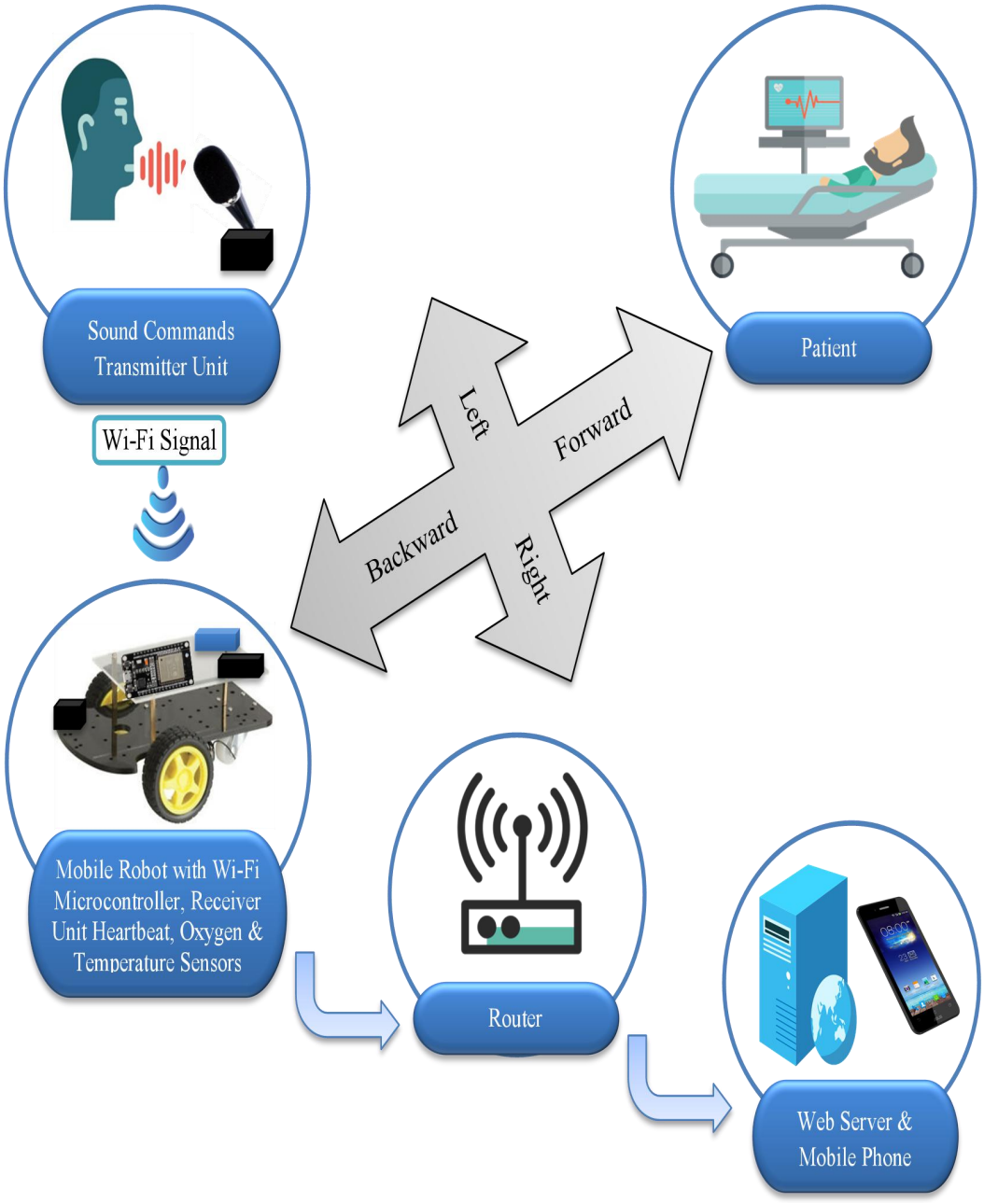


Fig. 1. Block diagram of the proposed home security system

The main goal of the proposed system is to implement a mobile robot to remotely monitor the disease status of people with Covid-19 epidemic, and it can be adopted by doctors to monitor the patient's status on the cloud of IoT based on real time. This can be accomplished by programming the Wi-Fi Controller (ESP32) as per requirement. C ++ is adopted to write the system program code and HTML languge is used here to program the adopted web page. The logic of used program can be described from the flowchart shown in Figure 2.

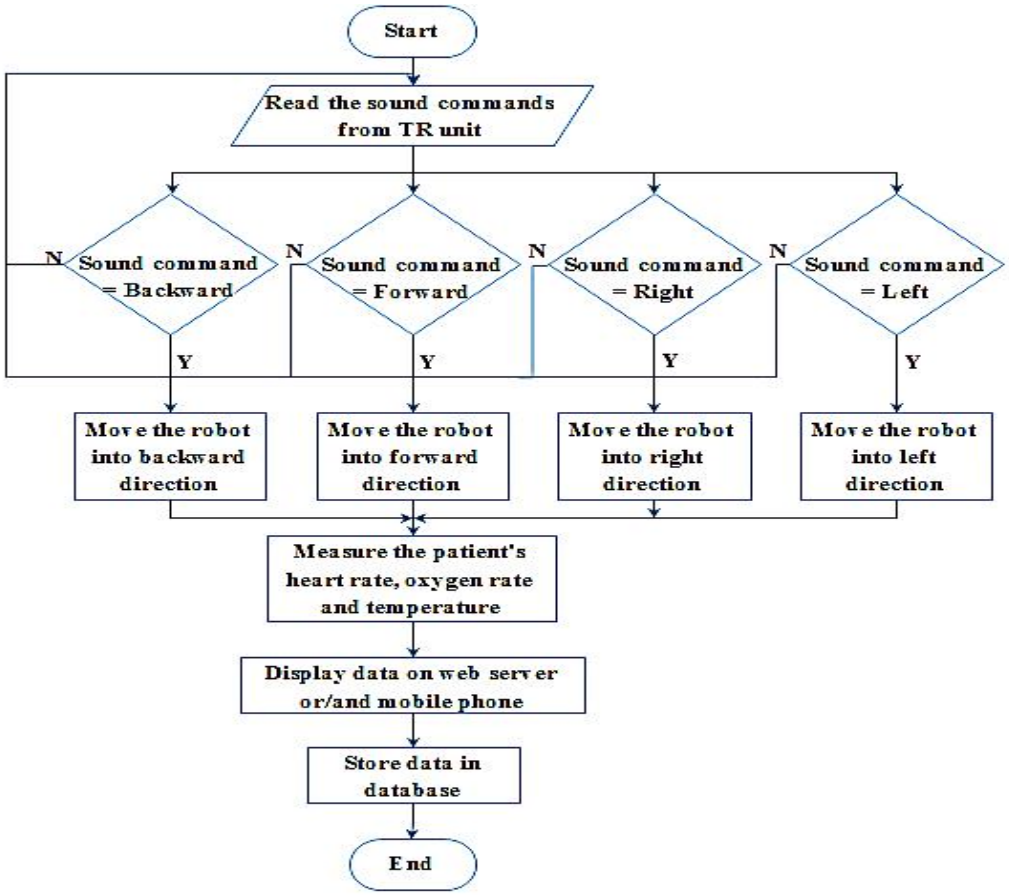
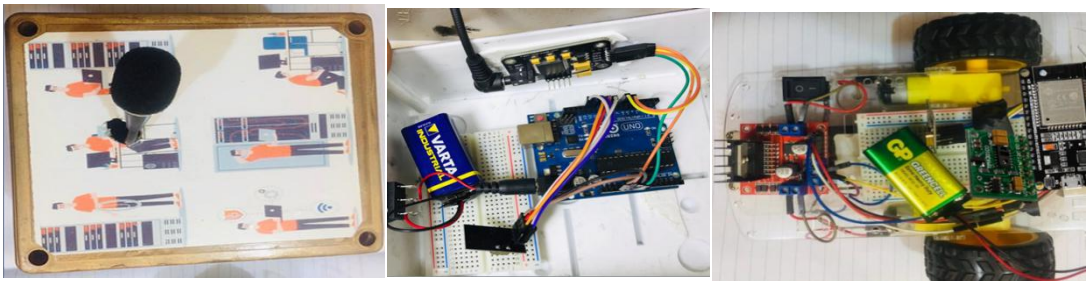


Fig.2. flowchart of the proposed system

3. Results and Discussions

3.1 Implementation mobile robot system using sound commands

Figure 3 shows the adopted robot implementation. The transmitter unit system in sub-figures a and b, where it is possible to speak to give sound commands to the Arduino board and via interfacing sound recognition module with Arduino. When saying the word “Forward”, the transmitter system will wirelessly send data via the HC-12 to the robot to move in the forward direction; and the words ‘’Backward’’, ‘’Right’’, ‘’Left’’ the transmitter system will send data to move robot in the backward, clockwise and anticlockwise directions respectievely by reciving data through HC-12 receiving unit. The sub-figure c shows the completely mobile car robot to move according to the reciving commands above from transmitter system using ESP-32 microcontroller and two dc motors with their drive board.



(a) (b) (c)

Fig.3. adopted robot implementation

3.2 Implementation patients healt monitoring system

Figure 4 shows the running of the adopting web server on the serial monitor.

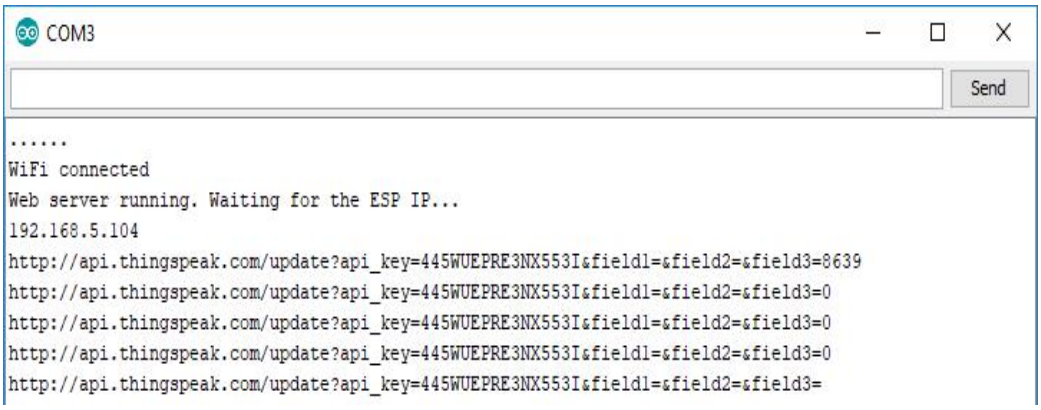
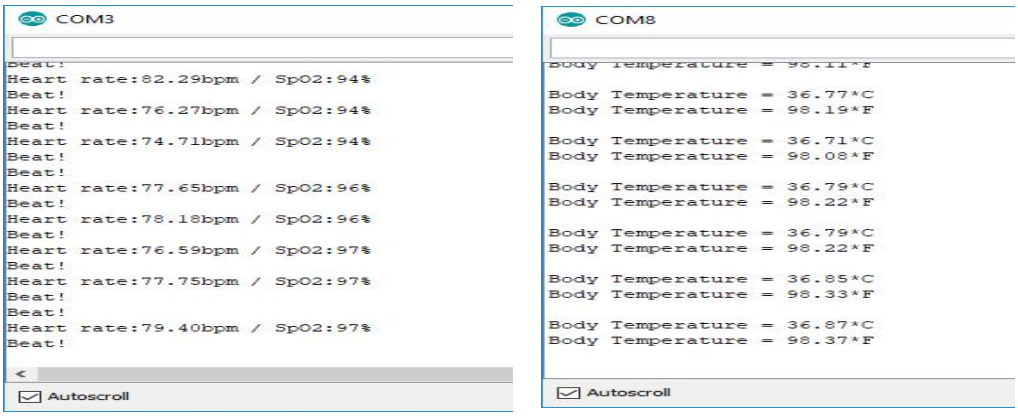


Fig.4. waste monitoring system using LCD

Figure 5 shows the display of the system sensors readings on the serial monitor for the health status of a person represented by reading the heart rate and blood oxygen level (Spo2) shown in Figure a; body temperature shown in Figure b.



(a) (b)

Fig.5. waste monitoring system using mobile application

The figure 6 below shows a web page designed using HTML languge to display the parameters of the patient's health status, such as heart rate, temperature, and oxygen level. The figure shows that the heart rate is 71.45 BPM, the measured body temperature is 36.01 degrees Celsius, and the oxygen level in the blood is 95%. All these readings were sent by the Wi-Fi microcontroller via the IoT cloud. Through the web page, the patient's condition is monitored periodically. also, the patient's health parameters have been displayed on an open source IoT application called Thinkspeak as shown in Figure 7. It can be used to retrieve and store data using the protocol HTTP.

Fig.6. a web page designed using HTML languge for monitoring patient's health status

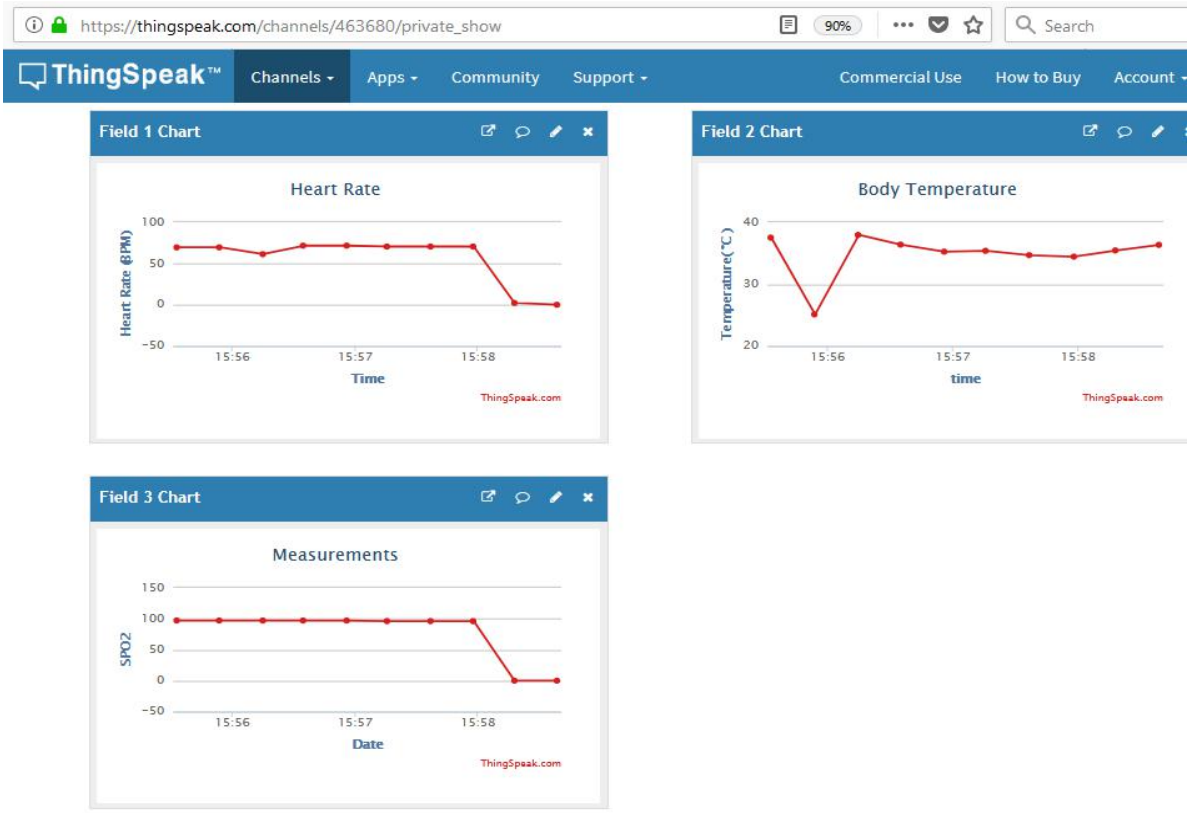


Fig.7. patient's health parameters displayed on an Thinkspeak

The displayed results of ThingSpeak can be are stored in the database as an Excel file shown in Figure 8

	A	B	C	D	E	F
10315	2018-06-1(	10314	0	1037.55	0	
10316	2018-06-1(	10315	0	1037.55	0	
10317	2018-06-1(	10316	0	1037.55	0	
10318	2018-06-1(	10317	0	1037.55	0	
10319	2018-06-1(	10318	0	1037.55	0	
10320	2018-06-1(	10319	0	1037.55	0	
10321	2018-06-1(	10320	0	24.87	0	
10322	2018-06-1(	10321	55.89	50.53	97	
10323	2018-06-1(	10322	55.89	37.75	97	
10324	2018-06-1(	10323	0	35.99	0	
10325	2018-06-1(	10324	71.45	35.21	95	
10326	2018-06-1(	10325	71.45	35.67	95	
10327	2018-06-1(	10326	22.97	35.75	0	
10328	2018-06-1(	10327	70.05	35.85	97	
10329	2018-06-1(	10328	70.05	37.59	97	
10330	2018-06-1(	10329	69.4	37.49	97	
10331	2018-06-1(	10330	69.4	25.11	97	
10332	2018-06-1(	10331	61.15	37.93	97	
10333	2018-06-1(	10332	71.51	36.37	97	
10334	2018-06-1(	10333	71.51	35.23	97	
10335	2018-06-1(	10334	70.42	35.37	96	
10336	2018-06-1(	10335	70.42	34.67	96	
10337	2018-06-1(	10336	70.42	34.43	96	
10338	2018-06-1(	10337	2.16	35.43	0	
10339	2018-06-1(	10338	0	36.33	0	

Fig. 8. The display of stored results of ThingSpeak

The Android application (ThingView) has been used to display the sensors measurements in the Android system for mobile which is associated with the ThingSpeak web site as shown in Figure 9.

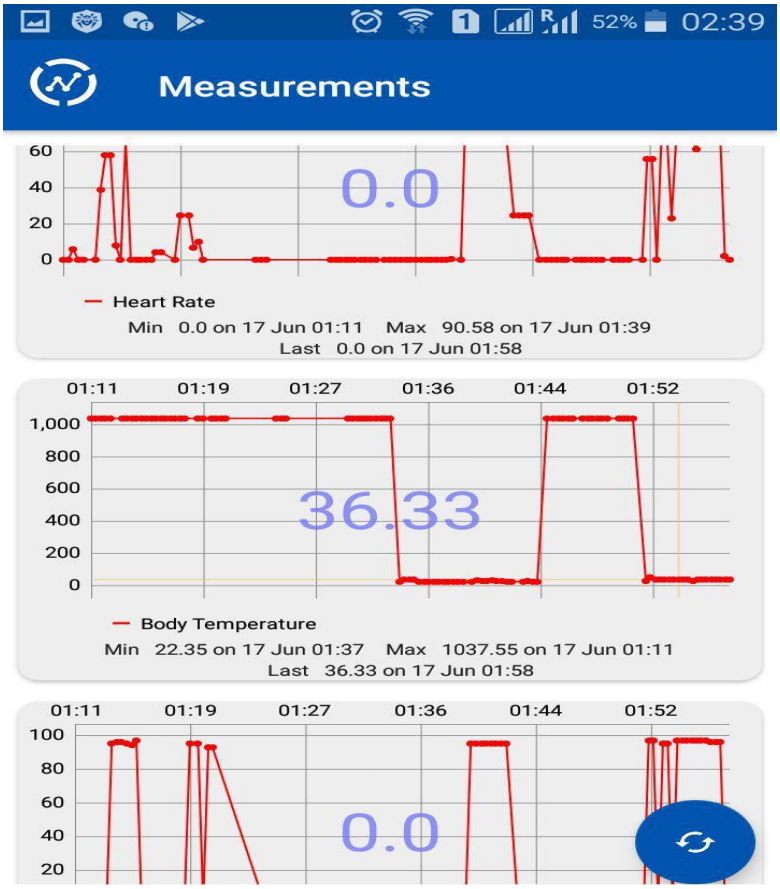


Fig.9. The parameter displed on (ThingView)

4. Conclusion

In this research, a mobile robot has been implemented to remotely monitor patients with infectious diseases by IoT and sound commands. This system is cheap and it can be adopted for monitoring the patient's health status espicially for covid 19 patients. Through this system, the patients health can be daily monitored and stored in a database. The practical results obtained from this system are the results of the medical examination for many people, and the results are very satisfactory. The system have an important features for doctors to be able to monitor the medical status of patients from any place and at any time to save thier life, time and efforts.

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Ali M. Jasim received the B.S. degree in electrical engineering, the M.S. degree in power and machines engineering from the university of basrah, in 2014 and 2017, respectively. His research fields includes control systems, power electronics, electrical power, renewable energy and programming.

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مجلة كلية العراق الجامعة للهندسة والعلوم التطبيقية

تنفيذ نظام متنقل لمراقبة الصحة لمرضى كوفيد 19 بأستخدام انترنت الاشياء والاوامر الصوتية

علي محمد جاسم[1]

[1]كلية العراق الجامعة – قسم هندسة الاتصالات – البصرة – العراق
البريد الالكتروني : e.alim.j.92@gmail.com

الملخص .ساهمت خدمة المراقبة عن بعد في إنقاذ حياة العديد من المرضى ؛ خاصة أولئك الذين يعانون من أمراض مزمنة أو معدية أو مشاكل في القلب. تمكن المراقبة الطبية عن بعد من تقييم حالة القلب ومراقبة دقاته ومراقبة درجة حرارة الجسم ومستوى الأكسجين وما إلى ذلك. واليوم ظهر في جميع دول العالم فيروس كورونا القاتل ، لذلك من الضروري مراقبة صحة ووضع المرضى عن بعد بشتى الوسائل. يقدم هذا البحث روبوتًا متحركًا للمراقبة الصحية باستخدام أوامر صوتية لتحديد اتجاه حركة الروبوت وتقنية إنترنت الأشياء لإرسال بيانات القياس الخاصة بأجهزة الاستشعار المعتمدة (دقات القلب ومستشعرات درجة الحرارة والأكسجين) إلى خادم الويب وتخزينها في قاعدة البيانات. يهدف النظام المقترح إلى إنقاذ حياة الطبيب ، المحافظة على الوقت ، وتسهيل مراقبة الأعداد الهائلة من المرضى ، ومنع العدوى من المرضى المصابين. يتكون النظام المعتمد من متحكم دقيق على جانب وحدة الارسال لمعالجة إشارة الكلام وإرسال بيانات الإخراج إلى جانب وحدة الاستقبال لتحريك الروبوت وفقًا لأوامر إشارة الكلام. تم التحكم في سرعة ةاتجاه محركات الروبوت باستخدام متحكم يدعم الإشارة اللاسلكية Wi-Fi Microcontroller ووحدة الجسر H-Bridge في جانب وحدة الاستقبال.