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Research Article

IoT based virtual health care system by using smart sensors

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Abstract

Nowadays, the effect and spreading level of COVID 19 increases enormously. In this situation, patients who are all in the need of monitoring are having threats to go to the hospital and similarly doctors and nurses are also in treating to visit the patients at their home. In order to replace the physical patient check-up method, we are introducing Virtual Health care system in this paper. In this project four sensors have been used. They are Heart beat sensor, Pressure sensor, Temperature sensor and Glucose sensor. All of these sensors are interconnected with RaspberryPi and IoT technology. A doctor can monitor the patient's health without physically interact. Also, it eliminates the number of the patient's presence in the hospital, avoids the corona virus spreading and provides the time for better treatment.

Keywords: Internet of Things; RaspberryPi; Heart beat sensor; Blood pressure; Glucose sensor; Better treatment; COVID19.

Introduction

In recent years, health risks are growing daily at high speed every day. Worldwide average births per year are 131.4 million and death rate is 55.3 million. Sources: population reference bureau & the world factbook. This is a big problem around the world. Hence, it is time to overcome such problems [1]. The IoT based sensor technology receives data about the human body temperature, blood pressure, heart beat and Glucose sensor. This is undoubtedly more accessible via IOT platform through the Internet. This paper provides a health monitoring system that identifies human body conditions such as blood pressure, body temperature, heart rate, blood glucose concentration level.

The use of RaspberryPi and IoT is satisfactory in health supervision, and this paper gives the concept of both platforms [3]. A popular RaspberryPi platform offers a full Linux server on a small platform with IoT at a very low price. Raspberry allows interface services and mechanisms via the general purpose I/O interface [10].

By using this combination, the proposed structure is more effective. An IoT is connecting the devices and which provides the human interaction to a better life. This paper, which provides an overview of health care management technology, protects patients from future health problems, and helps doctors to take the right measurements at the appropriate time on the patient's health.

Existing system

In the existing system, Arduino UNO, Heart Beat sensor, Blood Pressure Sensor, LCD display and Power supply were used for health monitoring [4]. A power supply unit is required to provide the appropriate voltage supply. This unit consists of transformer, rectifier, filter and a regulator. The power supply of reduced voltage has been given to the Arduino board and it will drive the entire units connected to it [5].

A Heart beat sensor is used to measure the heart beat level and the blood pleasure sensor is used to measure the pleasure level of the body [3]. Based on the medical reports, certain level of boundary conditions was given to the sensors and if it exceeds means then the abnormal message shown in the LCD display by means of Arduino UNO board [12]. Thus, a patient can know their health conditions from their home itself.

Proposed system

In this work, four sensors have been used. They are Blood pressure Sensor for measuring

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Pressure level, Heart Beat Sensor for counting Heart Beats, Temperature Sensor for measuring the body temperature level and Glucose sensor for measuring the concentration of glucose level in the blood. The outputs of the above sensors are given to the Raspberry Pi as an input.

A single-phase supply is given to the Step-down Transformer and the reduced voltage will be given to the Raspberry Pi through Rectifier circuit. Based on the sensors input, the system provides continuous monitoring of a patient includes a data acquisition and processing of data from the patient and then this health-related data is sent to the medical staff through Internet of things (IoT) by using controller. The figure 1 shows the diagram of proposed system.

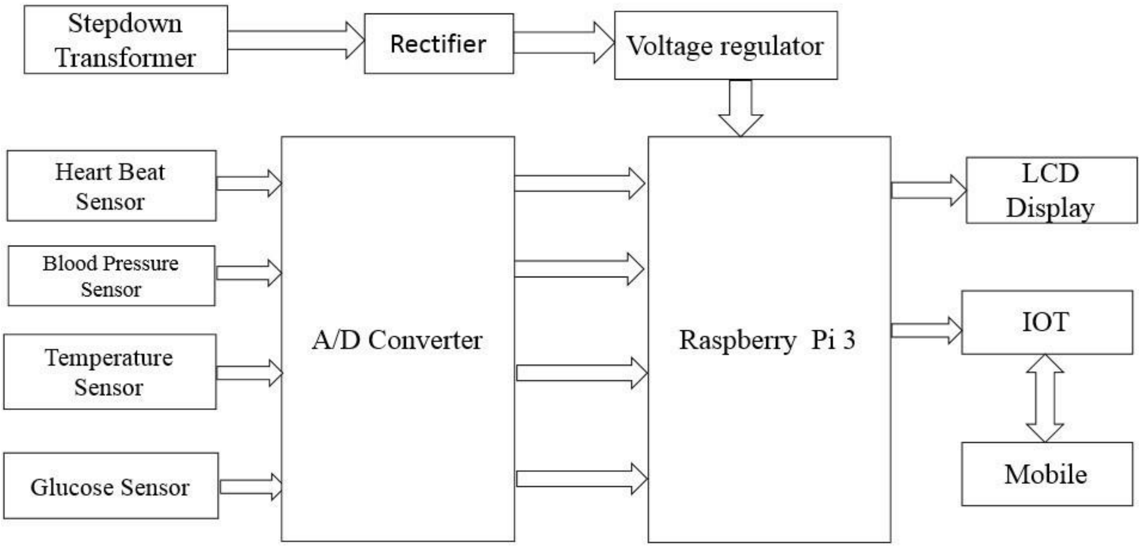

Figure 1. Block Diagram for proposed system

Hardware used

Heart beat sensor

The new version uses the TCRT1000 reflective optical sensor for photo plethysmography. The use of TCRT100 simplifies the build process of the sensor part of the project as both the infrared light emitter diode and the detector are arranged side by side in a leaded package, thus blocking the surrounding ambient light, which could otherwise affect the sensor performance. Figure 2 shows the Picture of Heart Beat sensor.

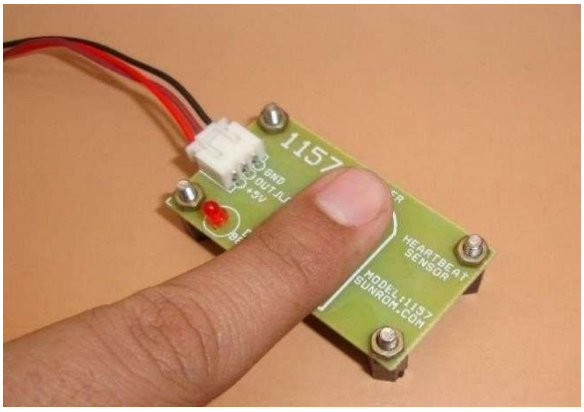

Figure 2. Heartbeat Sensor

It carries both sensor and signal conditioning unit and its output is a digital pulse which is synchronous with the heartbeat. The output pulse can be fed to either an ADC channel or a digital input pin of a microcontroller for further processing and retrieving the heart rate in beats per minute (BPM). The table 1shows the various levels of Heartbeats.

Table 1. BPM levels

Heart Beat Rate	State
60 BPM – 100 BPM	Normal
>100 BPM	High
<60 BPM	Low

Pressure sensor

The Vernier Blood Pressure Sensor is used to measure systemic arterial blood pressure in humans (non-invasively). When used with Logger *Pro*® 3.4 or newer, Logger Lite® or LabQuest®App1.2 or newer, it can measure mean arterial blood pressure and calculate both the systolic and diastolic blood pressure using the oscilometric method [6]. The active sensor in this unit is a Honeywell SSC Series pressure transducer. The sensor produces an output voltage that varies with the pressure measured in the cuff. It includes special circuitry to minimize errors caused by changes in temperature. We also provide a filtering circuit that conditions the signal from the pressure transducer. The output voltage from the Blood Pressure Sensor is linear with respect to pressure. The table 2 shows the condition levels of Blood pressure.

Table 2. BP Levels

BP rate conditions	Systole (mmHg)	Diastole (mmHg)
High	>120	>80
Normal	120	80
Low	<120	<80

Temperature sensor

The LM 35 sensor is highly used because its output voltage is linear with Celsius scaling of temperature. It does not provide any external trimming. It has a wide operating range. The maximum output is 5v. The output will increase10mV for every one degree rise in temperature. The range is from-55 degrees to +150 degrees.[7] There are three terminals as V_{cc}, Ground and the analog sensor. It consumes minimum amount of electricity. The Table 3 shows the different body temperature states. Figure 3 shows its picture.

Table 3. Temperature reading

Body Temperature (°C)	State
36.0 – 37.5	Normal
>37.5	High
<36.0	Low

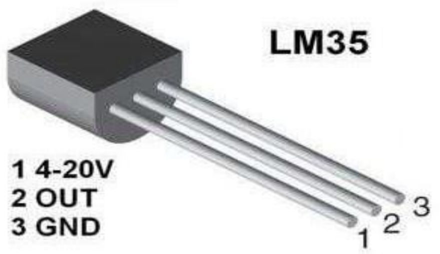

Figure 3. LM35 Temperature sensor

Glucose sensor

Glucose sensors are used to measure the blood glucose concentration of a patient and are an important part of managing diabetes mellitus. Type 1 and type 2 diabetes are the most common forms of diabetes. Type 1 diabetes is usually diagnosed in children and young adults and accounts for about 5% of all diagnosed cases of diabetes. Type 2 diabetes has been diagnosed in millions of Americans. According to diabetes report card 2012 issued by National Center for Chronic Disease Prevention and Health Promotion, 18.9% of US adults over 65 years old are diagnosed as diabetes in 2007–2009. Patients with Type 1 diabetes may test their blood sugar five to ten times a day in order for them to effectively monitor their blood sugar levels. Type 2 diabetics may also consider monitoring their blood sugar levels daily based on their risk for future health complications due to the disease [5]. In sports medicine, it is used to monitor physical conditions of athletes. Normal blood glucose levels range between 80–120 mg/dL with spikes reaching up to250 mg/dL after meals. The Table 4 shows the various ranges of blood glucose levels. Table 4 shows the ranges of blood glucose levels.

Table 4. Ranges of blood glucose levels

Blood Sugar Classification	Fasting Blood Sugar levels (mg/dL)	Post Meal sugar Levels (mg/dL)
Normal	70 – 100	70 – 140
Prediabetes	100 – 125	141 – 200
Diabetes	>125	>200

Raspberry PI3

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B whilst maintaining the popular board format the RaspberryPi3.

Model B brings you a more powerful processer,10x faster than the first generation Raspberry Pi. Additionally, it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs. The patients connect the sensors to their body and the other end of the sensors is connected to Raspberry Pi. The data acquired by sensors is stored in the Raspberry pi B+. The data values are shown on LCD display. Figure 4 shoes the Pin configuration of RaspberryPi 3.

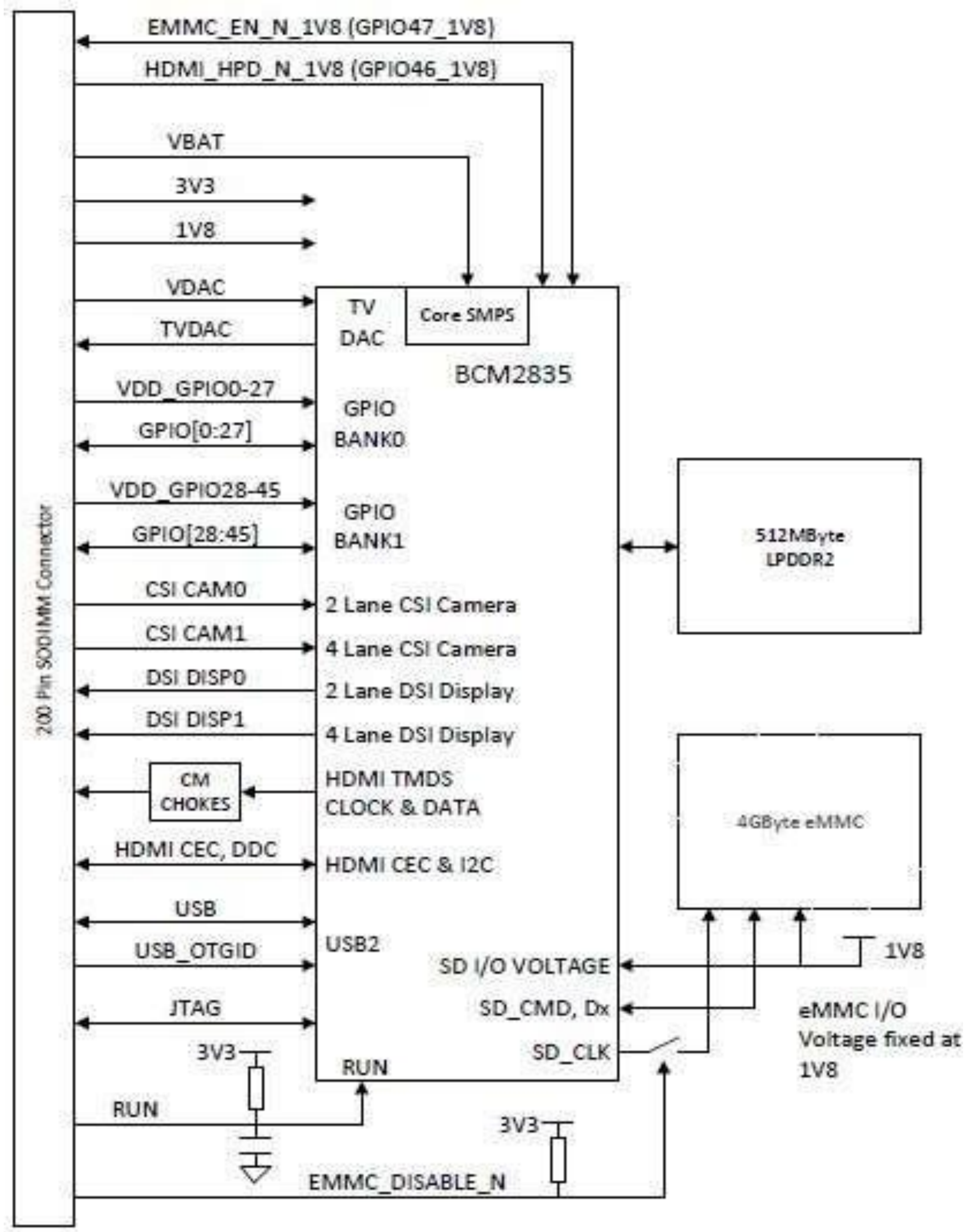

Figure 4. Pin configuration of RaspberryPi 3

Results and discussion

Two test cases have been taken from two different age peoples. From these results, we can come to know that it gives high result accuracy [10] and also gives better result for Glucose level [2].

Case 1:

This case has been taken from a person whose age is 21. The below result graph was plotted by measuring heath parameters like Blood Pressure, Heart Beat Range, Body temperature and Glucose level. Figure 5 shows the case 1 readings.

Case 2:

This case has been taken from a person whose age is 63. The below result graph was plotted by measuring heath parameters like Blood Pressure, Heart Beat Range, Body temperature and Glucose level. Figure 6 shows the case 2 readings.

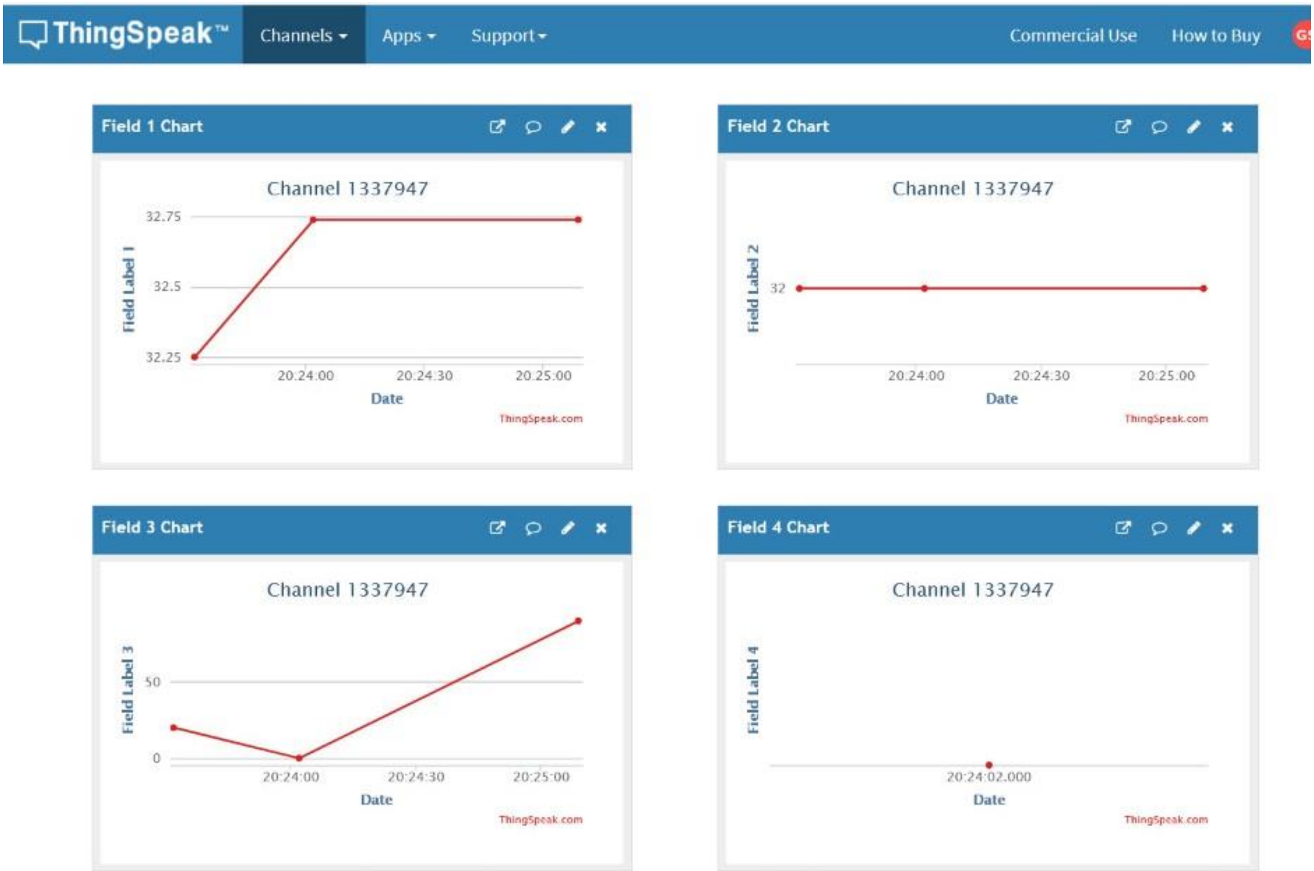

Figure 5. Case 1 Readings

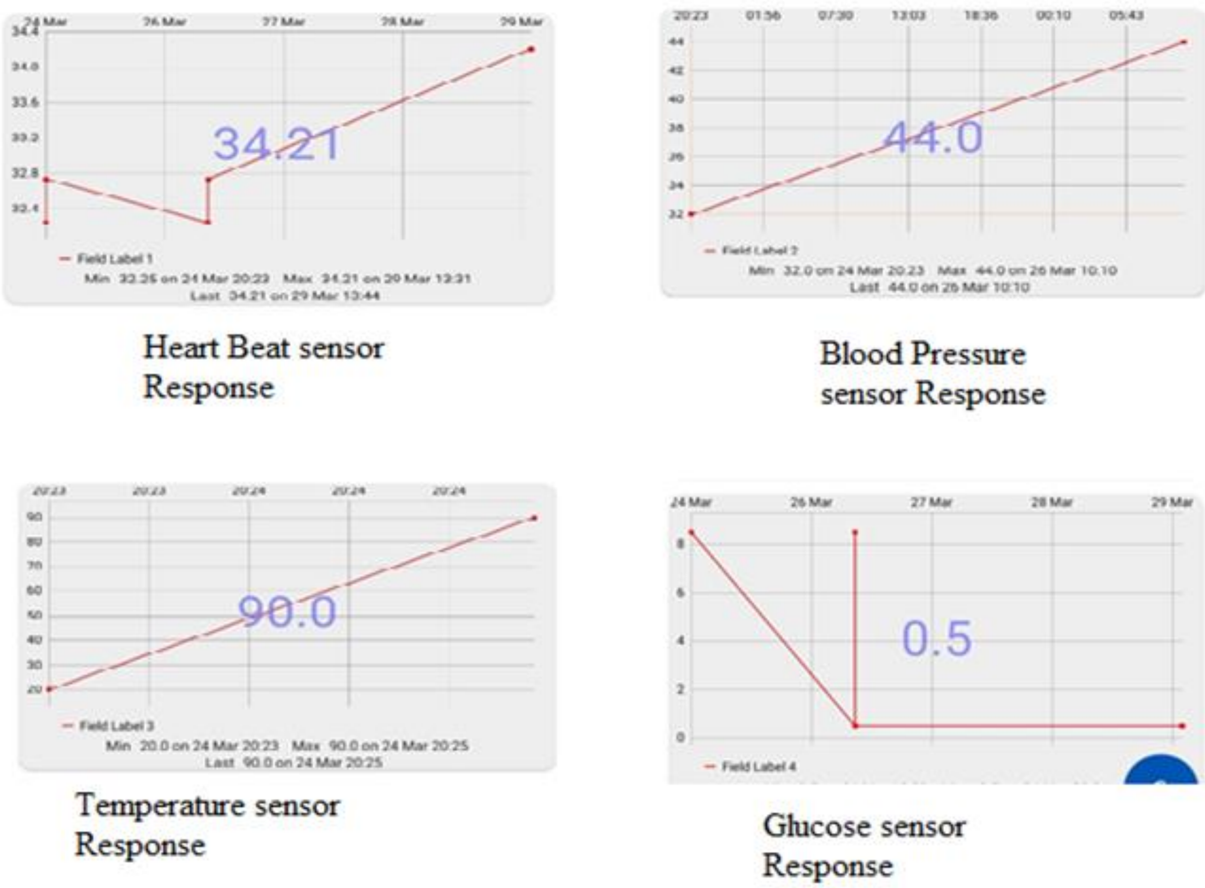

Figure 6. Case 2 Readings

Conclusion

The Internet of Things (IOT) technique is feasible to monitor vital functions of human no matter where they are and what they are doing. Additionally, the data acquired can be sent to the remote physicians with low cost, which ensures these experts be aware of patients' physical status continuously and in real-time. In this paper, we proposed an IOT-based monitoring system for pervasive healthcare. By this system, patient can monitor their physical signs such as blood pressure. Heart beat level as well as relevant environmental indicators. By this project a patient can check, monitor and get suggestions from doctor in their home itself.

Conflict of interest

Authors declared no conflict of interest.

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