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Modern Application of Internet of Things in Healthcare System

***Ali Hadi Abdulwahid**

Department of Electrical Engineering Techniques
Engineering Technical College
Southern Technical University, Al Basrah, Iraq.

Abstract

The recent advancement in information and Communication Technology has led to the emergence of the Internet of Things (IoT). In the modern medical system, the use of IoT technology has brought so much convenience to doctors and patients, because IoT is suitable for a variety of medical fields (such as real-time monitoring, patient information manage ment, and health care management). Human body sensor network (BSN) technology is one of the core technologies that is being used in the development of IoT in the medical system. This technology is characterized by a little power supply and lightweight wireless sensor nodes that can be used to monitor patients. The research paper highlights the main requirements of modern medical systems based on BSN.

Keywords Remote health monitoring, Internet of Things, e-health; Arduino UNO

I. INTRODUCTION

In all applications supported by the Internet of Things (IoT), smart connectivity is a very important application, particularly in the healthcare sector. Network sensors are used to collect a lot of information about our health and with the information that is made available by the network sensors; there will be a positive improvement in the field of health care system. In particular, the provision of data or information about our health can: (1) Establish a positive predictive framework of disease at an early stage through the diagnostic and treatment response paradigm, promote the evolution of medical practice, (2) make treatment and management choices personalized, taking into account the individual's specific circumstances and needs, (3) help reduce medical costs while improving outcomes. In this article, we highlight the opportunities and challenges of the Internet of things in achieving the future healthcare vision [1-3].

In recent years, there has been a growing interest in portable sensor. Based on current technological trends, it is easy to imagine that soon portable sensors will be used for continuous physiological monitoring before performing your routine medical examination. During this time, the sensor we continue to record the signals associated with physiological parameters and then transmit the generated data to a database linked to the health record for the patient[4,5]. Not only does it provide traditional laboratory tests for physiological and metabolic state, it also provides a richer range to provide long period records , and with the help of support systems to the decision, the doctors can provide large amounts of observed data, then doctors can make a better prognosis about the health of the patients and recommend treatments as a means of early interventions [6,7]. This technology can have a transformative impact on the healthcare system by significantly reducing medical costs and improving the speed and accuracy of diagnosis, which can guarantee an effective quality improvement of healthcare system. The monitoring of health has been the main global challenges. Due to lack of adequate health control, the patient suffers from health problems when there are a lot of IoT devices nowadays to monitor the patient's health on the internet[8-11]. Health experts are also taking advantage of these smart devices to monitor their patients. With lots of New Start-up Health Care Technologies, IoT is rapidly revolutionizing the health industry. In this project, we will do a health monitoring system based on the Internet of Things (IoT), which will record the heart rate and body temperature of the patient, and send out an alarm when the reading exceeds the critical values. In this system, the health status of the patient can be monitored from any location via the Internet [12-15].

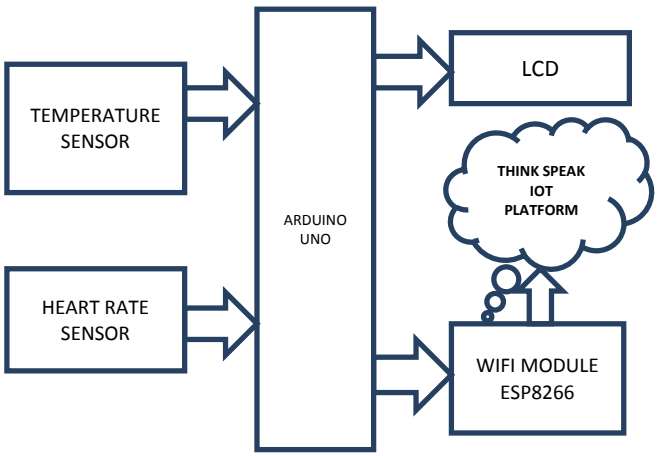


Fig. 1. System diagram

Figure 1 shows the proposed system of health monitoring. These health monitoring sensors are used to collect data, that is, data acquisition. This system can transmit the sensor data wirelessly by the controller over the internet, data processing is done on the server. All data are collected from the server point. It can be displayed on the website, that is, data management.

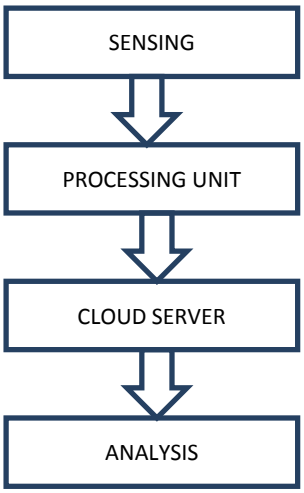


Fig. 2. System operation

Figure 2 shows the system flow chart. The results of the sensor acquisition are analyzed, that is, if abnormal behaviour is detected from the result, the contingency plan starts to inform the doctor about the patient's health status. Health is of paramount importance in our daily lives. The aims of this project are to develop a system that uses LM35 and sensors to provide body temperature and heart rate, respectively. These sensors are interfaced with the microcontroller. Arduino carries out wireless data transmission via the WiFi module. ESP8266 is used for wireless data transmission on IoT platforms [16-19].

II . RELATED WORK

The health monitoring equipment was designed based on the IoT device. The medical IoT devices include, the pulse reader, temperature sensor LM-35, character LCD and ESP8266 Wi-Fi modem are connected to Arduino UNO. The system is built in Arduino UNO. Arduino UNO is one of the most popular prototype boards on the Internet of Things projects, the materials required are:

1) ARDUINO UNO
2) WIFI MODULE ESP8266
3) TEMPERATURE SENSOR LM35
4) HEART RATE SENSOR

III. METHOD

In the field of health care, the number of Internet of Things users is steadily increasing, and solutions for various applications are also increasing, such as monitoring patients'vital signs and collecting patient data. This method helps to improve the accuracy of data and allows nurses to spend more time providing care.

1) Arduino UNO

The Arduino UNO is ATmega328 based microcontroller board. It is one of the most popular prototyping boards. The board comes with built-in Arduino boot loader. It has 14 GPIO pins, 6 PWM pins, 6 Analog inputs, a reset button, and holes for mounting pin headers. While programming the board, it can be connected to the PC using the USB port and the board can run on USB power. The Arduino UNO has 32 Kb Flash memories, 1 Kb EEPROM and 2 Kb SRAM. The board can be connected to different Arduino Shields for connectivity with Ethernet, Bluetooth, Wi-Fi, Zigbee or Cellular network and it can be connected to most of the IoT platforms[19,20].

2) Temperature Sensor

LM-35 is a precision IC temperature sensor whose output is proportional to the temperature. The sensor circuit is sealed; it is not affected by oxidation and other processes. Using LM-35, the temperature can be measured more accurately than with a Thermistor. The LM35 temperature sensor is a three pin device +VCC (Pin 1), output (Pin 2) and ground (Pin 3). The voltage range for operating LM35 is between 4V to 20V. The output pin of the LM-35 is connected to A1 pin of the Arduino because the output from the LM-35 is basically analogue[21].

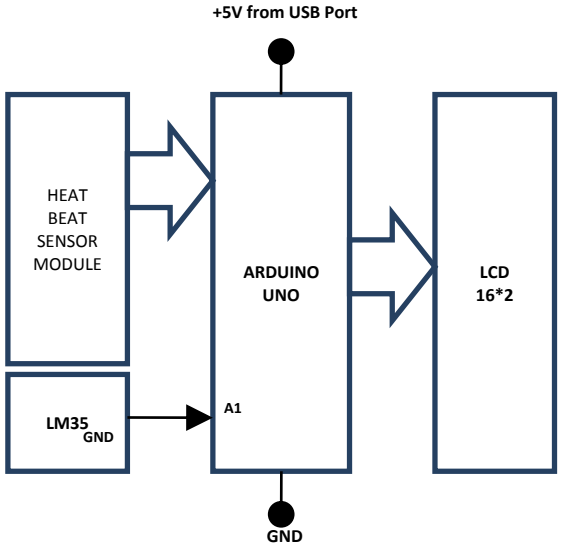


Fig. 3. Patient monitoring system

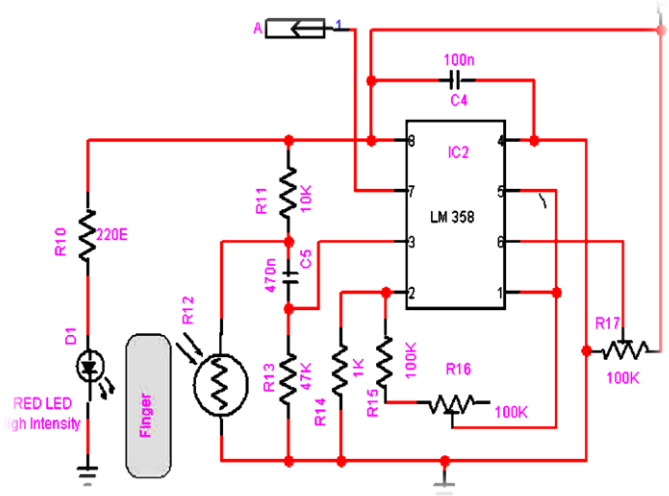
3) Heart rate sensor

The heartbeat sensor works behind the principle of Photoplethysmography (PPG). The technique provides valuable information related to our cardiovascular system. Recent advances in technology have revived interest in this technique, which is widely used in clinical physiological measurement and monitoring. According to the principle, the change in blood volume in an organ is measured by the change in the intensity of the light passing through it.

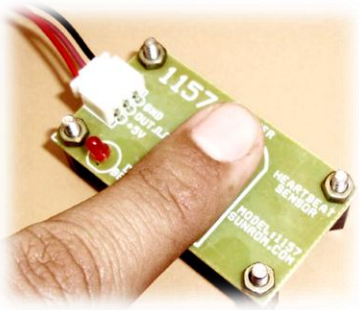
PPG utilizes low-intensity infrared (IR) light. When light passes through biological tissue, it is absorbed by bones, skin pigments, and veins and arterial blood. Because the blood absorbs light most strongly through the surrounding tissue, the PPG sensor can detect changes in blood flow because of changes in light intensity. The PPG sensor voltage signal is

proportional to the amount of blood passing through the blood vessels. Even small changes in blood volume can be detected by this method, although PPG cannot be used to quantify blood volume. Normally, the light source in the heartbeat sensor is an infrared LED, and the detector will be any Photo Detector.

The light source and detector are placed towards each other and human finger must be placed between the transmitter and the receiver. On the other hand, the light source and detector of the reflective sensor are adjacent to each other, and the human finger must be placed in front of the sensor. A simple Heartbeat Sensor consists of a sensor and a control circuit. The sensor part of the Heartbeat Sensor consists of an IR LED and a Photo Diode placed in a clip. The control circuit consists of an operational amplifier and other components that help in connecting the signal to a microcontroller[21,22].



(a)



(b)

Fig. 4. (a) Heartbeat Sensor Circuit Diagram
(b) Heartbeat Sensor Principle

The heartbeat sensor circuit diagram includes a photodetector and a bright red LED. The LED should have super-light intensity because if the detector detects a finger placed on the led, the maximum light will pass and propagate. When the heart pumps blood through the blood vessels, the fingers become slightly impermeable because there is less light from the LED to the detector. The detector signal generated by the heart rate changes. The detector's signals are different and it becomes an electrical pulse. This electrical signal is amplified, and the logic level signal output of the amplifier is + 5v.

4) ESP8266 Wi-Fi module

The ESP8266 Wi-Fi unit is used to deliver the Arduino motherboard with a Wi-Fi router so that it can access the cloud. Each ESP8266 module comes pre-programmed with an AT command set firmware. The module comes available in two models - ESP-01 and ESP-12. ESP-12 has 16 pins available for interfacing while ESP-01 has only 8 pins available for use.

Table 1. Technical specifications of Arduino

Item	Specification
Operating Voltage	5V
IO Current	40 mA
Program Memory	32kB
Frequency	16 MHz
Input / Output	14xDIO
ADC Pin	6x10 Bit

5) Think Speak IoT Platform

a) Use the Think speak platform to send data from any Internet-enabled device to the cloud.

b) Then configure actions and alerts in real time based on the data.

c) Using the Think speak provides a platform for developers to easily capture sensor data and turn it into useful information.

IIV. DISCUSSION

There are several ways to calculate heart rate, but here read only five pulses were used. In order to calculate the total beat in one minute is done by applying the following formula so as to define how the Heartbeat monitor project works:

Five_pusle_time = time2-time1;

Single_pulse_time = Five_pusle_time / 5;

Rate = 60000 / Single_pulse_time;

Where: time1 is the first value of the pulse counter; time2 is the value of the pulse count list; rate. It's the final heart rate. When the first pulse starts, the counter uses the timer function in the Arduino system millis ();. And take the first form of pulse counting millis ();. Then wait for five pulses. After five tight pulses are obtained again, the counter value is taken in time1, and then the original time spent on five pulses is obtained. Then divide it by 5 times to get a pulse. We could easily find the pulse in a minute and divert 600000 ms to a single pulse time. In this project, the sensor module heart-beat was used to detect Heart Beat. This sensor module contains a pair of IR that actually detects the heartbeat from the blood. The process by which the heart pumps blood to the body are known as the heartbeat, and when that happens, the concentration of blood in the body changes. And this kind of change becomes electrical current that can turn into a voltage

or a pulse. Figure 5 shown the monitoring circuit, which contains the Arduino UNO, the heartbeat sensor block, when the system are restarts with the LCD, the Arduino UNO controls the entire system, like reading the heartbeat sensor correctly, calculating the heart rate and sending these data to the LCD screen.

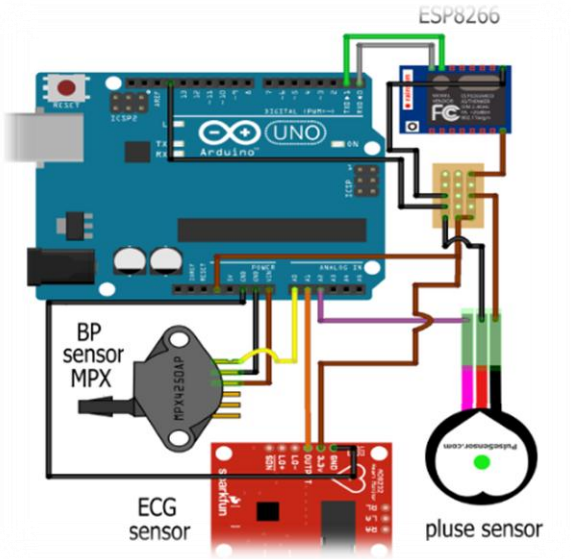


Fig. 5. Circuit Diagram for IoT based Patient Monitoring System using Arduino

Thingspeak provides a great tool for IoT based projects. Using the Thingspeak website, you can monitor our data and control our systems on the Internet, using the channels and Web pages provided by Thingspeak. Thingspeak "collects" sensor data and uses Thing speak to monitor patients heartbeat and temperature online using the Internet. The code uses a digital reading function to read the output of the heartbeat sensor unit with the millis () function, which is used to calculate the time and then calculate the heart rate.

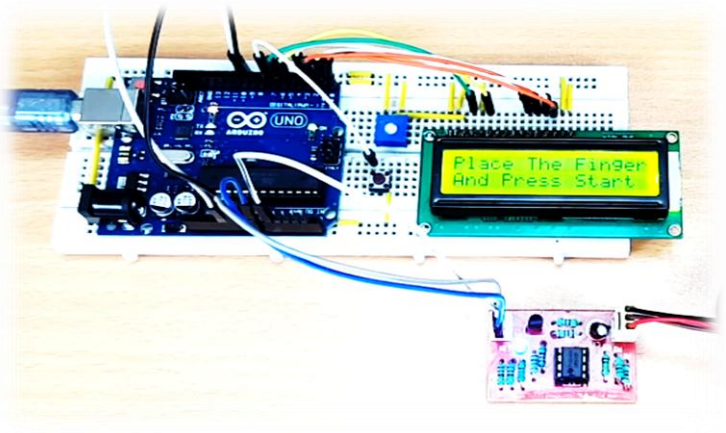


Fig. 6. shows the interface of the controller to the sensor and the LCD display.

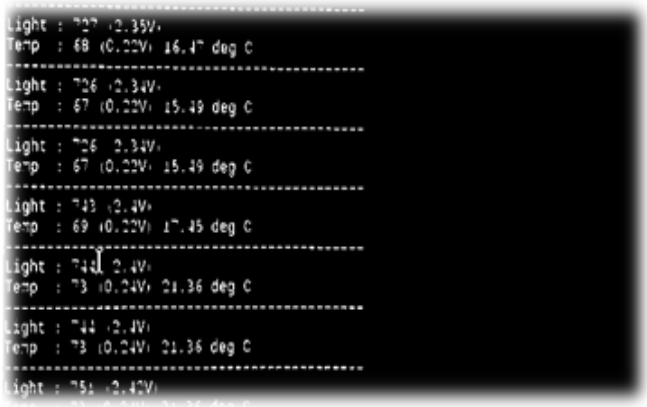


Fig. 7. shows the rate of the human heart beats, Temperature body, and displays it on the monitor screen

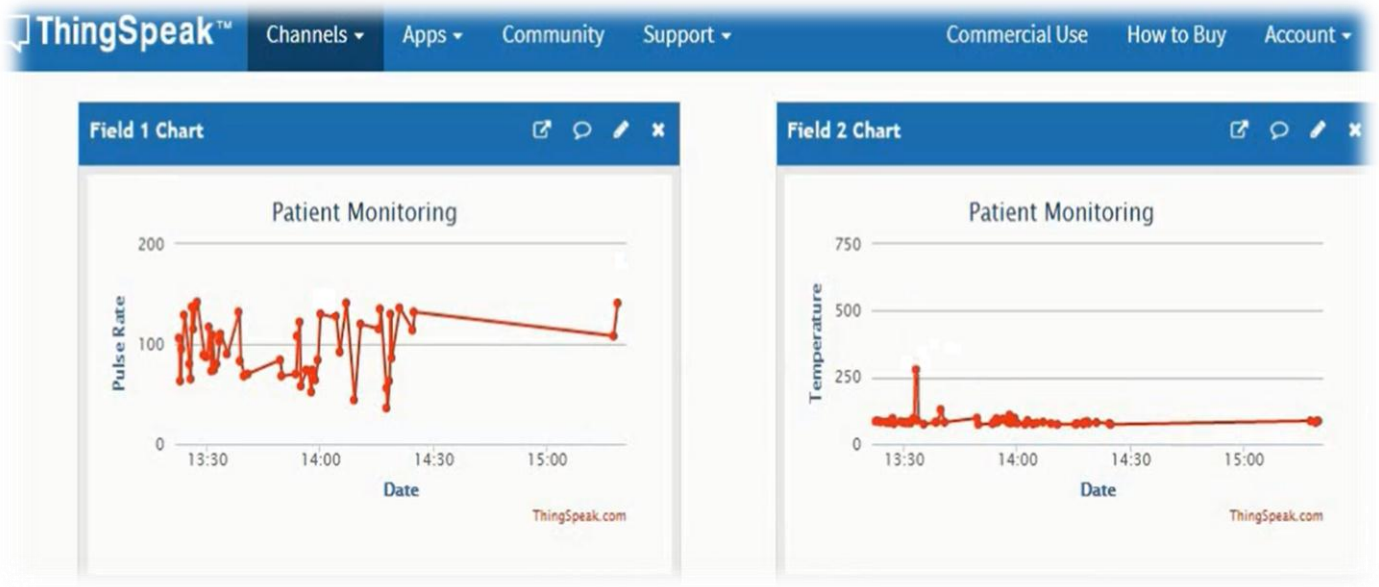


Fig. 8. shows the recording of health surveillance data on the Internet.

The results of system implementation show that sensory data is transmitted instantaneously with high accuracy. The previously stored data will also be displayed when the doctor chooses the patient, so it helps the doctor to track the patient's status. The normal result is that Arduino collects and stores restorative information through additional sensors.

VI. CONCLUSION

In this work, we propose the future direction of integrating remote health monitoring technology into clinical practice. These magazines, especially those with the Tunisian intelligence services provide an attractive option to monitor and record data in a variety of environments is currently much longer than expected in the laboratory. This treasure trove of data, after analysis and evaluation of the doctors in the image of easy assimilation, involves the possibility for health improvement and reduce costs. We must strive to overcome difficulties in design that need to be addressed before the systems can be developed for integration into clinical practice.

The main advantages of the Internet of Things are:

1. Cost reduction. By using the Internet of Things solutions and connected medical devices, healthcare providers can monitor patients in real time. This means that efficient data collection and management are involved, and unnecessary visits are reduced.
2. Better patient experience. Because patients are more involved in treatment through the Internet of Things (IoT) connection with the medical system, doctors have improved the accuracy of diagnosis, because there is the necessary patient data on hand.
3. Better management of drugs and medicine adherence: The Internet of Things solution enables hospital staff to reduce the time of searching for drugs, tracking supplies and medicines, hang up hospital hygiene habits, and effectively prevent hospital infections. The Internet of Things monitoring solution for health care can help patients comply with their treatment plans and help doctors track prescription compliance.
4. Reducing errors and waste: using IoT for data collection and workflow automation is an excellent way to reduce waste (such as unnecessary testing and expensive imaging), reduce system costs and minimize errors.
5. Improved treatment outcomes: Health care solutions that connect and use large data through cloud computing can provide nurses with the ability to access real-time data that can be used to make informed decisions and provide evidence-based treatment.

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