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IoT based Heart Rate Monitoring and Body Temperature Monitoring

Ms. N. Zahira Jahan[1], Mr.R.Thirumoorthi[2]

[1]Associate Professor, Department of MCA, Nandha Engineering College (Autonomous), Erode-52.
[2]Student, Final M.C.A., Nandha Engineering College (Autonomous), Erode-52.

ABSTRACT

Internet of Things (IoT) is inter - communication of embedded devices mistreatment networking technologies. The IoT are one amongst the vital trends in future, will have an effect on the networking, business and communication. During this paper, proposing a foreign sensing parameter of the material body that consists of pulse and temperature. The parameters that area unit used for sensing and observation can send the information through wireless sensors. Adding an online based mostly observant helps to stay track of the regular health standing of a patient. The sensing knowledge is unceasingly collected in an exceedingly cloud and send as SMS regarding patient condition to the patient's care taker. It'll facilitate to seek out any unseen issues to endure attainable diagnosing. Experimental results prove the planned system is user friendly, reliable, economical.

Keywords: IoT, Heart rate sensors, Health monitoring, Health diagnosis.

INTRODUCTION

In the world of Internet of Things (IoT) when we have all the technologies to revolutionize our life, it's a great idea to develop new pulse and body temperature monitoring systems.

The advanced connectivity of devices aid in automation is possible in nearly all fields. Everyone today is so busy in their lives, even they forget to take care of their health. By keeping all these things in minds, technology really proves to be an asset for an individual. With the advancement in technology, lots of smart or medical sensors came into existence that continuously analyzes individual patient activity and automatically predicts a heart attack before the patient feels sick. Therefore, identifying the correct sensors is important.

In the medical field, nowadays patient take actively part in collecting and reviewing their reports. In this digitized world, various wireless communication standards have allowed the sensor to develop from traditional forms i.e. require active patient participation to passive form i.e. require no need for patient participation.

Today's large number of passive sensors are used that constantly monitor individual patient essential signs and store that data or share it wirelessly with Human-Healthcare professionals. By combining analytics and sensor data, reports are made that describe the early health condition of the patient. Depending on the requirement various types of sensors are being deployed.

Recently, the research of Human-Health monitoring systems has moved from basic reasoning of wearable sensor readings to the advanced level of data processing to give more information that is valuable to the end users either to doctor or to patient. Habitual diseases have a powerful influence on Human- Healthcare where cost of curing chance of attack is natural among people. Changes in analytical structure and depth of health and social care forces to study new modernization technique, which could be a help to these obstacles.

Author for correspondence:
Department of MCA, Nandha Engineering College (Autonomous), Erode-52

Elderly people need to make regular visit to the doctor for their health signs test results. Observing on regular basis of essential signs is compulsory as they are main signs of well-being of one's individual health. These vital signs include,

- Pulse rate
- Body temperature

The goal is to develop a low power, more reliable, non- intrusive, are the essential signs monitor which gather information on the body and send the parameters through wireless technology. There must be a proper method of transmission and to display the signal after the data is processed. Rate Per Minutes (RPM) is one of the main technology which will help us to monitor the patients. It will help to those who are not in reach of common clinical settings, which will increase the access to care and reduce the cost of delivering Human-Healthcare.

In many developing countries, Human-Healthcare is frequently defined as a major problem. i.e., almost as much as 8% of the population who can has access to 20% of the country's medical resources. This inability to access proper Human-Healthcare for rural populations paired with rapidly increasing cardiovascular disease rates poses a serious problem.

In this paper, proposing a remote monitoring and sensing parameter of the human body which consists of pulse and temperature. The parameters that are used for sensing and observing will send the data through wireless sensors. Adding a web based observing helps to keep track of the regular health status of a patient. The sensing data will be collected in cloud continuously and will be used to inform patient to any unseen problem to undergo possible diagnosis.

RELATED WORK

In early days, patients health details will be known when patient go for checking with doctor in emergency situations. Manually all the readings will be taken using mechanical devices. Current readings will be preserved on paper, when later need then again readings need to be checked. So constant human observation and interaction is needed in this case.

Later, some electronic devices are used to check human health care such as

- Blood Glucose Monitors
- Blood Pressure Monitors
- Pedometers
- Allergy, Sinus & Asthma Relief
- Electric Massagers
- Weighing Scales
- Pain Relievers
- Thermometers

But the data can be viewed but not stored. After few inventions, devices are able to store data in device itself. In this type, cannot analyze health condition of the patients by doctor or caretaker from remote place.

HARDWARE COMPONENTS

Requirements

- Arduino Uno
- Pulse Sensor
- Temperature Sensor
- Breadboard
- 10 k Potentio Meter
- GSM Module
- 16x2 LCD Display
- WIFI Module
- Jumper Wires

Arduino UNO

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable.It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the ArduinoNano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for

some versions of the hardware are also available. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0.The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases.The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform.The ATmega328 on the Arduino Uno comes preprogrammed with a bootloader that allows uploading new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol.The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Features

- Microcontroller: ATmega328.
- Operating Voltage: 5V.
- Input Voltage 7-12V.
- Input Voltage 6-20V.
- Digital I/O Pins: 14
- Analog Input Pins: 6.
- DC Current per I/O Pin: 40 mA.
- DC Current for 3.3V Pin: 50 mA.

Fig.1 Arduino Uno Board

Pulse sensor

Pulse Sensor is designed to plug-and-play heart-rate sensor for Arduino. The sensor clips onto a fingertip or earlobe and plugs right into Arduino. The front of the sensor is the pretty side with the Heart logo. This is the side that makes contact with the skin. On the front there is a small round hole, which is where the LED shines through from the back, and there is also a little square just under the LED. The square is an ambient light sensor to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or other capillary tissue, and sensor reads the amount of light that bounces back. The other side of the sensor is where the rest of the parts are mounted. This sensor monitors the flow of blood through the finger and is designed to give digital output of the heartbeat when a finger is placed on it.proposed a system about Efficient Sensor Network for Vehicle Security. Today vehicle theft rate is very high,greater challenges are coming from thieves thus tracking alarming systems are being deployed with an increasingly popularity .

Features

- Biometric Pulse Rate or Heart Rate detecting sensor.
- Plug and Play type sensor.
- Operating Voltage: +5V or +3.3V.
- Current Consumption: 4mA.
- Inbuilt Amplification and Noise cancellation circuit.
- Diameter: 0.625”
- Thickness: 0.125” Thick

Fig. 2 Pulse Sensor

Temperature sensor

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C).It can measure temperature more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidation.The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.The LM35 has an output voltage that is proportional to the Celsius temperature.The scale factor is .01V/°C.

The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4°C at room temperature and +/- 0.8°C Over a range of 0°C to +100°C.Another important characteristic of the LM35 is that it draws only 60 micro amps from its supply and possesses a low self-heating capability.The LM35 comes in many different packages such as TO-92 plastic transistor-like package,T0-46 metal can transistor-like package,8-lead surface mount SO-8 small outline package.

Features

- Calibrated directly in Degree Celsius
- Linear at 10.0 mV/°C scale factor.
- 0.5°C accuracy guarantee-able
- Rated for full -55°C to a 150°C range.
- Suitable for remote applications.
- Low cost due to wafer-level trimming.
- Operates from 4 to 30 volts.

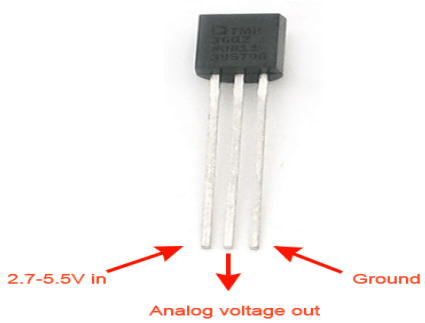

Fig. 3 Temperature Sensor

Bread board

A breadboard is aconstruction base for prototyping of electronics.Originally itwasliterally abread board, a polished piece of wood used for slicing bread.In the 1970s the solderlessbreadboard (a.k.a. plugboard, a terminal array board) became available and nowadays the term "breadboard" is commonly used to refer to these.

Because the solderless breadboard doesnot require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design. For this reason, solderless breadboards are also popular with students and in technological education. Older breadboard types did not have this property.

A stripboard (Veroboard) and similar prototyping printed circuit boards, which are used to build semi-permanent soldered prototypes or one-offs, cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units .

A "full size" terminal breadboard strip typically consists of around 56 to 65 rows of connectors, each row containing the above-mentioned two sets of connected clips (A to E and F to J). Together with bus strips on each side this makes up a typical 784 to 910 tie point solderless breadboard. "Small size" strips typically come with around 30 rows. Miniature solderless breadboards as small as 17 rows (no bus strips, 170 tie points) can be found, but these are only suitable for smallandsimple designs.

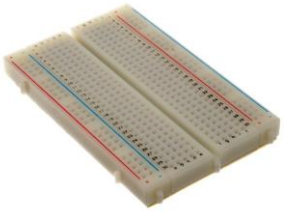

Fig. 4 Bread Board

10 K Potential meter

Potentiometers also known as POT, are nothing but variable resistors. They can provide a variable resistance by simply varying the knob on top of its head. It can be classified based on two main parameters. One is their Resistance (R-ohms) itself and the other is its Power (P-Watts) rating.The value or resistance decides how much opposition it provides to the flow of current.

The greater the resistor value the smaller the current will flow. Some standard values for a potentiometer are 500Ω, 1K, 2K, 5K, 10K, 22K, 47K, 50K, 100K, 220K, 470K, 500K, 1 M.Resistors are also classified based on how much current it can allow; this is called Power (wattage) rating.

Features

- Type: Rotary a.k.a Radio POT
- Available in different resistance values like 500Ω, 1K, 2K, 5K, 10K, 22K, 47K, 50K, 100K, 220K, 470K, 500K, 1 M.
- Power Rating: 0.3W
- Maximum Input Voltage: 200Vdc
- Rotational Life: 2000K cycles.

Fig. 5 10 k Potentio Meter

GSM Modules

GSM is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile devices such as mobile phones and tablets. It was first deployed in Finland in December 1991. As of 2014, it has become the global standard for mobile communications – with over 90% market share, operating in over 193 countries and territories.

2G networks developed as a replacement for first generation (1G) analog cellular networks, and the GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution, or EGPRS).Subsequently, the 3GPP developed third-generation (3G) UMTS standards, followed by fourth-generation (4G) LTE Advanced standards, which do not form part of the ETSI GSM standard."GSM" is a trademark owned by the GSM Association. It may also refer to the (initially) most common voice codec used, Full Rate.

Features

- Improved spectrum efficiency.
- International roaming.
- Compatibility with integrated services digital network (ISDN)
- Support for new services.
- SIM phonebook management.
- Fixed dialing number (FDN)
- Real time clock with alarm management.
- High-quality speech.

Fig. 6 GSM Module

16 *2 LCD Display

Liquid crystal display (LCD) screens are by far the most popular screens for electronics today. If you look around you, you're likely to see at least one or two, possibly on your microwave or landline caller ID box.Your LCD has a total of 16 pins. Here's what each pin is designed to do:Pins 1 and 16: These are your power and ground. Pin 3: Used to adjust the brightness of the LCD.Pins 4–6: Used to operate the LCD.Pins 7–14: Used as data lines.Pins 15–16: Used to power the LCD's backlight.

This is a prototype model for IoT based pulse rate monitor. It can be designed as a wearable watch or ear plug. In a wearable design, the character LCD could be removed and the entire circuit can be shifted to small controller board or SOC.

When the circuit is powered by the battery, the Arduino starts reading the pulse rate from the pulse sensor and the ambient temperature from the LM-35 temperature sensor. The pulse sensor has an infrared LED and a photo transistor which help detect pulse at the tip of the finger or earlobe. Whenever it detects pulse, its IR LED flashes. The flash of the IR LED is detected by the phototransistor and its resistance changes when the pulse is changed.

The heartbeat of a normal adult ranges from 60 to 100 per minute. For detecting beats per minute (BPM), first an interrupt is set which triggers in every 2 Milliseconds. So, the sampling rate by the Arduino to detect pulse is 500 Hz. This sampling rate is sufficient to detect any pulse rate.

Features

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is build by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight

Fig. 7 16*2 LCD Display

Wi-Fi Module

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by manufacturer Espressif Systems in Shanghai, China.The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer Ai-Thinker. This small module allows

microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.ESP8266 module is low cost standalone wireless transceiver that can be used for end-point IoT developments.To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate.

Features

- 802.11 b/g/n protocol.
- Wi-Fi Direct (P2P), soft-AP.
- Integrated TCP/IP protocol stack.
- Integrated TR switch, balun, LNA, power amplifier and matching network.
- Integrated PLL, regulators, and power management units.
- +19.5dBm output power in 802.11b mode.
- Integrated temperature sensor.
- Supports antenna diversity.

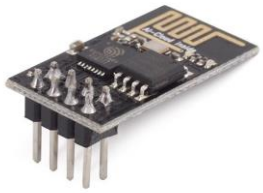

Fig. 8 WIFI Module

Jumper wires

Jump wires (also called jumper wires) for solderless breadboarding can be obtained in ready-to-use jump wire sets or can be manually manufactured. The latter can become tedious work for larger circuits. Ready-to-use jump wires come in different qualities, some even with tiny plugs attached to the wire ends. Jump wire material for ready-made or homemade wires should usually be 22 AWG (0.33 mm^2) solid copper, tin-plated wire - assuming no tiny plugs are to be attached to the wire ends. The wire ends should be stripped $^3/_{16}$ to $^5/_{16}$ in (4.8 to 7.9 mm). Shorter stripped wires might result in bad contact with the board's spring clips (insulation being caught in the springs). Longer stripped wires increase the likelihood of short-circuits on the board. Needle-nose pliers and tweezers are helpful when inserting or removing wires, particularly on crowded boards.

Differently colored wires and color-coding discipline are often adhered to for consistency. However, the number of available colors is typically far fewer than the number of signal types or paths. Typically, a few wire colors are reserved for the supply voltages and ground (e.g., red, blue, black), some are reserved for main signals, and the rest are simply used where convenient. Some ready-to-use jump wire sets use the color to indicate the length of the wires, but these sets do not allow a meaningful color-coding schema.

Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into. Male-to-male jumper wires are the most common and what you likely will use most often. When connecting two ports on a breadboard, a male-to-male wire is need.

Fig. 9 Jumper Wires

METHODOLOGY

- Sensing Module
- SMS Module
- Cloud Module

Sensing module

A heart rate monitor (HRM) is a personal monitoring device that allows one to measure/display heart rate in real time. Sensing module consist pulse sensor and temperature sensor are attached to the patient's body for perceiving health data from the patient. These sensors collect the readings from the patient. The sensors which are attached to the patient's body are then send to the Arduino. The arduino will send the readings and store it in to the cloud continuously.

Sms module

GSM module is used to establish communication between health kit and doctors or care takers. GSM module consists of a GSM modem assembled together with power supply circuit and communication interfaces (like RS232, USB, etc) with the computer. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. When a doctor or patient's care taker need to know the health status of patient, then they can send 'Get' SMS to the GSM SIM number. Now the arduino in the kit will receive the SMS and send the current pulse and temperature rate to the requested mobile number. It helps doctor or patient's care taker to know the patient details even they are far away from patient.

Cloud module

The patient's health details will be loaded in Thingspeak cloud continuously. The data is read from the sensors through Arduino and is posted into the cloud. The information in the cloud can be accessed from anywhere and at any time as it stored there permanently. The data in the cloud will be accessed through a personal computer or any smart device to check the conditions of the patient. The data is accessed by hospital server to take care of the patient. The information in all these conditions is regularly shared with a caretaker and he can, from anywhere, access the data to check the patient's status. Based on the history of data about patient in the cloud, action is taken according to the situation of the patient irrespective of the location of the patient. Then doctors will suggest the required medicines to patient health condition observed in server.

FUTURE SCOPES AND CONCLUSION

In Real-time heath monitoring system using Arduino can be integrated or implemented in hardware using various types of sensors to detect the human-health conditions. Technology plays an important role in today's world. Using this technology remote patients health can be monitored by a doctor at his clinic. The patient's data is collected over longer duration than considering one time data if abnormality is observed in the parameters doctor immediately responds and alerts the caretaker of the patient for the further action to be taken. Here only the body temperature and heart beat are monitored this can be further extended to other parameters like. In future, a portable Human-Health monitoring system can be designed using Arduino.

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