iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** III **Month of publication:** March 2022

DOI: https://doi.org/10.22214/ijraset.2022.41077

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue III Mar 2022- Available at www.ijraset.com

IOT Based Smart Wearable Health Monitoring System for Corona Diagnosis

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AWHEC

Abstract: ***Corona virus or COVID-19 has shaken the entire world. According to a survey by WHO, more than 121 countries have been affected by the virus. The death toll keeps on rising in many countries whereas in some they are going down gradually. And among those who have lost their lives to the virus includes healthcare workers too. They are mainly getting infected due to close contact with covid patients. Over here comes the need for proper isolation and proper maintenance of social distancing. Globally strict lockdowns are being practiced and this has helped us to bring down the positivity rate, which points out that the maintenance of proper isolation and quarantine periods are of utmost importance. This is where the project plays its role in fighting the virus by providing remote diagnosis measurements of people in quarantine and thereby minimizing the need for healthcare workers to be in direct contact with patients. This project is a health band with an app named Corona Secure. COVID-19 is associated with particular symptoms: Fever, cough, shortness of breath or other breathing problems, chills, muscle pain, sore throat, loss of taste or smell, Heart rate (above 100 bpm), Oxygen saturation <92% .We will be able to use this device from staying inside our homes and it will track very essential health parameters such as body temperature, heartbeat, and sound sensor. These data will be sent to our cloud servers along, and with this the patient will have to fill up a survey form enquiring about some common symptoms of the coronavirus as per WHO guidelines. This will be continued for a normal quarantine period of 14 days as advised by WHO.***

I. INTRODUCTION

With the development of social economy and medical science, the national health insurance system is universal, resulting in a sharp increase in the number of inpatients, and the workload and pressure of medical staff. The monitoring of patients' clinical vital signs mainly include measuring the body temperature, pulse, respiration and blood pressure. These vital signs can measure the severity of a patient's illness. To achieve sensitivity, comfort, and durability in vital sign monitoring, to judge whether the individual is healthy, to understand the occurrence, development and outcome of the disease, and provide an accurate basis for the diagnosis and treatment of disease, we should try our best to monitor these vital signs. Therefore, the monitoring of human vital signs is an important aspect in medical diagnosis. However, the traditional method of monitoring vital signs has some defects. For example, medical personnel use the original method of artificial monitoring, and the process is complex. In the measurement, the medical staff is required to be in contact with the patients which pose high risk of disease transmission especially from covid infected patients. The monitoring of blood pressure, body temperature, pulse and respiration is often through mercury sphygmomanometer, mercury thermometer, and pulse oximeter, and then the specific data of each patient is manually written down, so it cannot be logged in the system without frequent involvement of the nurse. In addition, in measuring the patient's pulse, body temperature, blood pressure, the patient must stay still, and also the conventional used for measurement do have range limitations too.

The multiparameter physiological monitor used in intensive care units can monitor many vital signs, even though professional, it is bulky, inconvenient to carry, usually only in ICU, and is expensive. Therefore, the traditional vital signs monitoring system cannot meet the real-time monitoring of patients.

A. Objective

The objective is to solve these problems by using an electronic wristband that can monitor the vital signs of the human body and can transmit data to the nurse station computer in real-time, it can not only monitor vital signs, price is cheap, much comfortable for patients and also can reduce the workload of medical staff and thereby minimize the risk of them getting infected.

Therefore, in view of the traditional medical wristband in hospital, we want to design an electronic wristband, through sensor and chip to make bluetooth connect, to remote transmission of collected data into the computer, and to analyze vital signs data. The electronic wrist band has the advantages of complete function, beautiful and durable, small .etc. It has a broad application prospect, which has positive significance in monitoring the vital signs of patients

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B. Scope

In the world, Britain first proposed the concept and content of wireless medical service, the United States also took the lead in the establishment of a ward of coronary heart disease through wireless LAN, using various sensors to complete data collection and analysis. However, there hasn't been any relevant research on wristbands as a measurement/diagnosis tool.

Today, there are about 20 billion devices in the world that interact with each other, and by 2025 it is estimated to go up to 75 billion devices. This shows that in the coming years the cities that we live in will be smart cities that will keep pace with the more paced and planned life due to the boom in the IoT sector. This transformation will offer us many opportunities to make our life easier. One of these important opportunities is the e-health services that are closely related to all of us. IoT applications in the health sector are increasing day by day. People living in rural areas cannot benefit from preventive health services due to lack of infrastructure. As a result, the death rate in these regions is high. The COVID-19 is associated with typical symptoms. Their list is not short, but the most typical are: fever, cough, shortness of breath or other breathing problems, chills, muscle pain, sore throat, loss of taste or smell. Serious symptoms, among others, include elevated heart rate (above 100 bpm) and lower oxygen saturation <92%. The ideal COVID-19 wearable device would be capable of measuring as many mentioned parameters as possible in everyday conditions and being easy to use by the seniors, young, without special training and knowledge. Here, we present an idea of how to measure vital signs using the devices we all have like mobile phones, headsets, thermistors and development boards like Arduino or similar. In addition to basic engineering and health care knowledge it is quite enough to suspect a disease and ask for help.

II. LITERATURE SURVEY

In low-cost real-time group heart rate monitoring system by Davorin Kofjac et.al proposed two different architectures for evaluation of stress levels. First one is a client device for ECG and PPG and the second one is a standalone client device. A hybrid approach was concluded as the most effective method. The Human Ear canal: Investigation of its suitability for monitoring photo plethysmography and arterial oxygen saturation K. Budidh et.al proposed using the external auditory as an alternative monitoring site for estimating SpO2 on the hypothesis that the central site will be better perfused. A dual wavelength opto electronic probe with a processing system was developed to investigate suitability of PPG signals and SpO2 in the human auditory canal. Results suggest that the ear canal may be the suitable site for reliable monitoring of PPG and SpO2 even in the presence of peripheral vasoconstriction. In unobtrusive real-time heart rate variability analysis for the detection of orthostatic dysregulation Robert Richer et.al proposed a system which provides a real-time analysis of the user's heart rate variation on an Android-based mobile device throughout the day. The system used orthostatic dysregulation to detect disorder of the autonomic nervous system .ECG data were acquired and compared for every posture change. An IMU-based algorithm was used to trigger heart rate variability. Classifications were made based on heart rate variability and automatic assessment were done.

III. SYSTEM OVERVIEW

Embedded system is any electronic equipment with built in intelligence and dedicated software. All embedded systems use either a microprocessor or a microcontroller. The application of these micro controllers makes user-friendly cheaper solutions and enables to add features otherwise impossible to provide by other means. Embedded device can be defined as any device with a microprocessor or a microcontroller embedded in it and has relatively focused functionality. The software for the embedded system is called firmware. The firmware is written in assembly language for time or resource critical operation or using higher-level languages like C or Embedded C. The software will be simultaneously micro code simulation for the largest processor. An embedded system needs memory for two purposes: to store its program and to store its data. Unlike a desktop system, in which programs and data are stored in the same memory, embedded systems use different memories for each of the two different purposes. Because the typical embedded system does not have a hard disk drive from which to load its program, the program must be stored in a memory, even when the power is turned off. The embedded system needs special kinds of memory that will remember the program, even with no power. Since they are supported to perform only specific task, these programs are stored in ROM. Moreover they may need to know or minimal inputs from the user, hence the user interface like monitor, mouse and large keyboard etc. maybe absent. Embedded systems are also known as Real time systems. Since they respond to an input or event and produce the result with a guaranteed time period. This time period can be a few microseconds to days or months.

An embedded system is a special purpose computer system designed to perform a dedicated function. Unlike a general purpose computer such as a personal computer an embedded system performs one or a few predefined tasks usually with very specific requirements and often includes task specific hardware and mechanical parts not usually found in general purpose computers. Since the system is dedicated tospecific task design, design engineers can optimize it reducing the size and the cost of the product.

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Embedded systems are often mass produced benefiting from economies of scale. Physically, embedded systems range from portable devices such as digital watches and MP3 players to large stationary installations like traffic lights factory controllers or the systems controlling nuclear power plants. In terms of complexity embedded systems run from simple with a single microcontroller chip to very complexwith multiple units, peripherals and networks mounted inside a large chassis or enclosure.
Mobile phones or handled computers share some elements with embedded systems such as the operating systems and microprocessors which power them but are not truly embedded systems themselves because they tend to be more general purpose allowing different applications to be loaded and peripherals to be connected.

A. Characteristics

1) Embedded systems are used to do some specific task rather than a general purpose computer for multitasking.
2) Embedded systems are not always separate devices. Most often they are built into devices they control.
3) It often runs with limited computer hardware resources.
4) The software written for embedded systems is called firmware & is stored in ROM or flash memory chips rather than a disk drive.

B. Advantages of Embedded System

1) High performance: the integration of various ICs shortens the travelling route and time of data to be transmitted resulting in higher performance
2) Low power consumption: the integration of various ICs eliminates buffers and other interface circuits. As the number of components is reduced, less power will be consumed.
3) Slimmer and more compact: housed in a single separate package, the chip is smaller in size and therefore occupies less space on the PCB. Hence products using embedded system are slimmer and more compact
4) Lower system costs: in the past several chips in separate packages were required to configure a system. now, just one system on –chip can replace all of these, dramatically reducing the packaging cost

C. Applications

1) Home appliances
2) Office automation
3) Telecommunication
4) Instrumentation
5) Entertainment
6) Aerospace
7) Robotic systems

IV. METHODOLOGY

A. Block Diagram

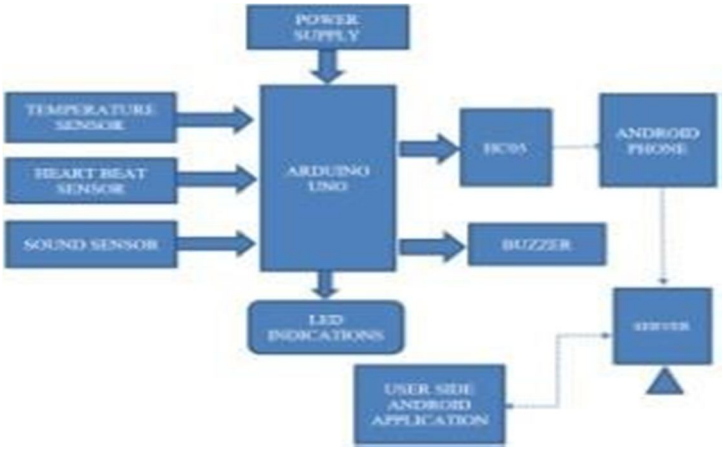


Fig.4.1 Block Diagram

1) *Power Supply:* Here a 9v battery provides for the whole system. The microcontroller needs 5v. so it is converted through a 7805 regulator. Two capacitors are also there, one for filtering and other for cleaning the damages. The microcontroller and other devices get power supply from Ac to Dc adapter through 7805,5vregulator. The adapter output will be 12v DC Non-regulated. The 7805 voltage regulator are used to convert 12v to 5v DC
2) *Arduino UNO:* Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its hardware products are licensed under a CC-BY-SA license, while software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone.
3) *Heartbeat Sensor:* The basic heartbeat sensor consists of a light-emitting diode and a detector like a light detecting resistor or a photodiode. The heartbeat pulses cause a variation in the flow of blood to different regions of the body.
4) *Temperature Sensor:* A thermistor is a type of resistor whose resistance is dependent on temperature, more so than in standard resistors. The word is a combination of thermal and resistor. Thermistors are widely used as inrush current limiters, temperature sensors (negative temperature coefficient or NTC type typically), self-resetting overcurrent protectors, and self-regulating heating elements (positive temperature coefficient or PTC type typically).
5) *Sound Sensor:* A sound sensor is defined as a module that detects sound waves through its intensity and converts them into electrical signals.
6) *Buzzer:* A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.
7) *LED Indications:* A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.
8) *Bluetooth Module (HC05):* HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with a controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data
9) *Android Device:* Android is an operating system based on Linux with a Java programming interface. It provides tools, e.g. a compiler, debugger and a device emulator as well as its own Java Virtual machine (Dalvik Virtual Machine - DVM). Android is created by the Open Handset Alliance which is led by Google. Android uses a special virtual machine, e.g. the Dalvik Virtual Machine. Dalvik uses special byte code. Therefore you cannot run standard Java byte code on Android. Android provides a tool "dx" which allows to convert Java Class files into "dex" (Dalvik Executable) files. Android applications are packed into an .apk (Android Package) file by the program "aapt" (Android Asset Packaging Tool) to simplify development Google provides the Android Development Tools (ADT) for Eclipse. The ADT performs automatically the conversion from class to dex files and creates the apk during deployment. Android supports 2-D and 3-D graphics using the OpenGL libraries and supports data storage in a SQLite database.

B. Circuit Diagram

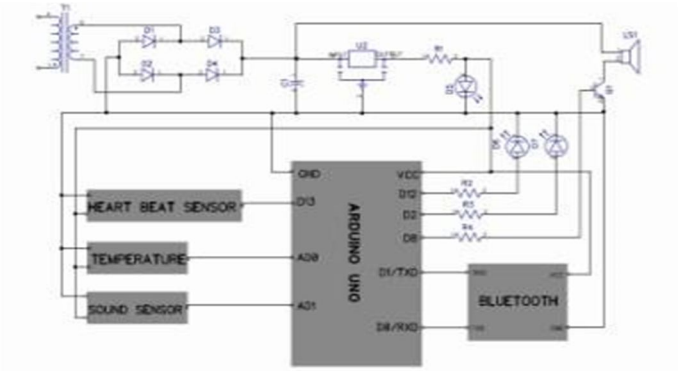


Fig.4.2 Circuit Diagram

Circuit diagram describes the architecture of the proposed IOT BASED SMART WEARABLE HEALTH MONITORING SYSTEM. This system consists of Arduino UNO microcontroller, power supply, camera, buzzer, Heartbeat sensor, temperature sensor, sound sensor, HC05 Bluetooth module, and LED indications. The core part of our circuit is Arduino UNO. It has 6 Analog and 14 Digital pins. So it has 20 controlling pins. The pin on a chip whose behavior can be controlled by the user at run time. The buzzer, and LED indications are connected digital pins.

The Heartbeat sensor, temperature sensor and sound sensor are connected to analog pins of Arduino. The Bluetooth module is connected to the TXD and RXD pins of Arduino. The power supply section consists mainly of a bridge rectifier. The output of the bridge rectifier is not the pure pulsating DC. So we want to obtain pure DC output, we filter the signal using RC filter. It is the combination of resistors and capacitors. The filtered output is pure DC. The 12v DC is divided using a voltage regulator into 5v DC. That 5V DC output is fed to the Arduino UNO microcontroller.

C. Working

Data from heartbeat sensor, NTC thermistor and sound sensor are fed to the Arduino UNO which is then processed, and this data from Arduino UNO is transmitted to the patient's mobile app via HC05 Bluetooth module. The Android app will track the current geo location of the patient or quarantined person and it will be sent with data getting from Arduino device to server including patient ID, date and time. Sending all the data to the server and is stored in the database (computation of these data and regular surveillance for 14 days is done. If any chances of COVID is being found then the data will be directly sent to a local registered hospital along with GPS LOCATION from the mobile. Health authorities have another app to view the details of every patient by typing the patient ID. If the person removes the wearable device all the readings will become zero.

V. HARDWARE AND SOFTWARE IMPLEMENTATION

A. Hardware Description

1) Arduino UNO

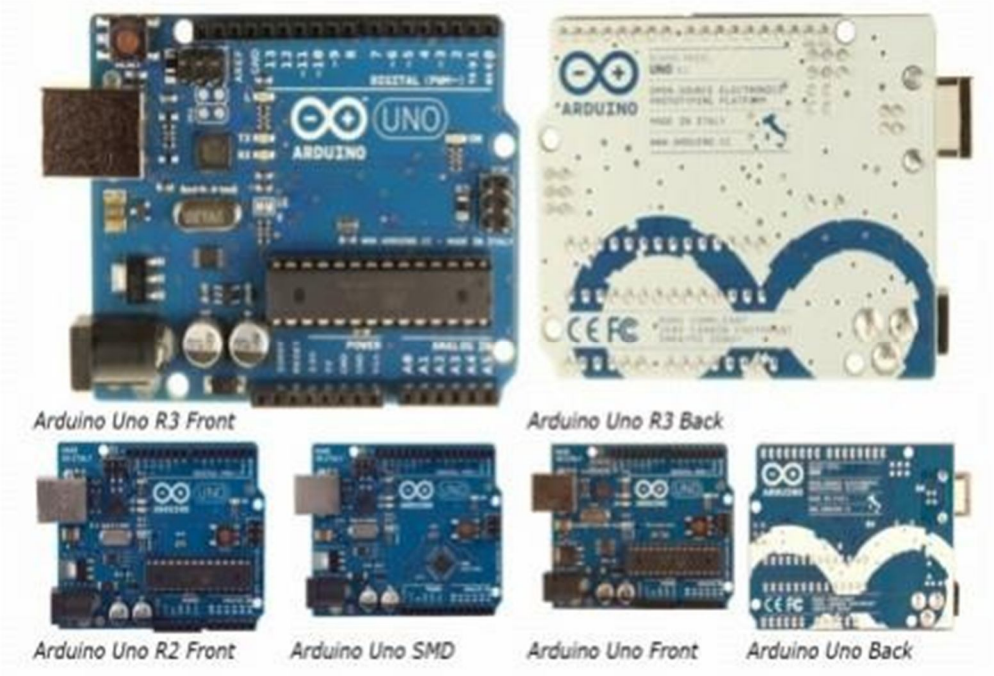


Fig.5.1 Arduino UNO board

a) Overview

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. It features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-

serial converter.
Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.
Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that uses the AVR, which operates with 5V and with the Arduino Duo that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

b) Summary

Microcontroller ATmega328 Operating Voltage 5V
Input Voltage (recommended) 7-12V Input Voltage (limits) 6-20V
Digital I/O Pins 14 (of which 6 provide PWM output)

6 Analog Input Pins
DC Current per I/O Pin 40 mA DC Current for 3.3V Pin 50 mA
Flash Memory 32 KB (ATmega328) of which 0.5 KB used by bootloader SRAM 2 KB (ATmega328) EEPROM 1 KB (ATmega328)
Clock Speed 16 MHz

Schematic & Reference Design
EAGLE files: arduino-uno-Rev3-reference-design.zip (NOTE: works with Eagle 6.0 and newer) Schematic: arduino-uno-Rev3-schematic.pdf
Note: The Arduino reference design can use an Atmega8, 168, or 328, Current models use an ATmega328, but an Atmega8 is shown in the schematic for reference. The pin configuration is identical on all three processors.

c) Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.
External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.
The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7- 12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50mA.
- GND. Ground pins.

d) Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

e) Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip. ● External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function. ● SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

  The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference () function.

Additionally, some pins have specialized functionality:

- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analogReference (). ● Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board. The mapping for the Atmega8, 168, and 328 is identical.

f) Communication

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a.inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

g) Programming

The Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino Uno comes pre-burned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available . The ATmega16U2/8U2 is loaded with a DFU bootloader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.
- On Rev2 or later boards: there is a resistor that pulls the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode. We can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU bootloader). See this user-contributed tutorial for more information.

h) Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half- second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto- reset by connecting a 110 ohm resistor from 5V to the reset line; see this forum thread for details.

i) USB Overcurrent Protection

The Arduino Uno has a resettable poly fuse that protects your computer's USB ports from shorts and over current. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

j) Physical Characteristics

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Four screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100 mil spacing of the other pins.

2) Power Supply

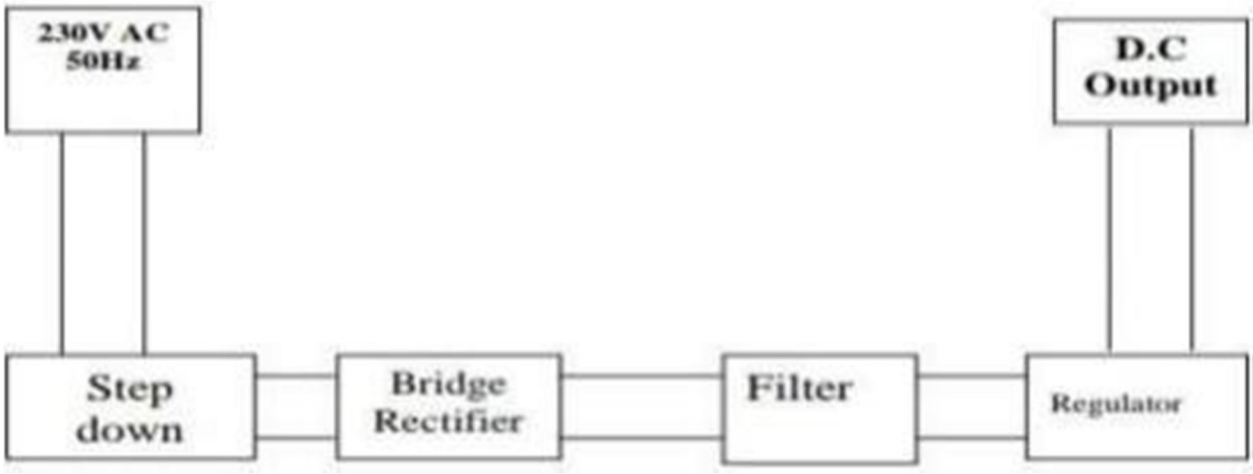


Fig.5.2 Power supply block diagram

The input to the circuit is applied from the regulated power supply. The ac. input i.e., 230v from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating dc voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage. Power supply is a device or system that supplies electrical or other types of energy to an output load or group of loads.

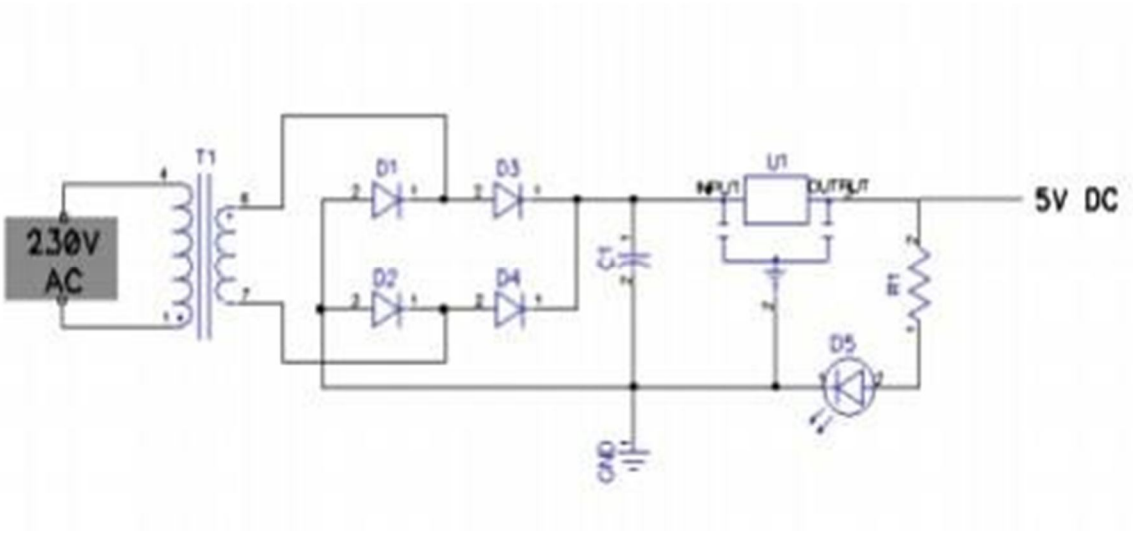


Fig.5.3 Power supply circuit diagram

A simple AC powered linear power supply usually uses a transformer to convert the voltage from the wall outlet (mains) to a different, usually a lower voltage. If it is used to produce DC a rectifier circuit is employed either as a single chip, an array of diodes sometimes called a diode bridge or Bridge Rectifier, both for full wave rectification or a single diode yielding a half wave (pulsating) output. More elaborate configurations rectify the AC voltage at first to pulsating DC. Then a capacitor smooths out part of the pulses giving a type of DC voltage. The smaller pulses remaining are known as ripple. Because of a full wave rectification they occur at twice the mains frequency .Finally depending on the requirements of the load, a linear regulator may be used to reduce the ripple, sometimes also allowing for adjustment of the output to the desired but lower voltage.

3) Rectifier

The output from the transformer is fed to the rectifier. It converts A.C. into pulsating DC. The rectifier may be a half wave or a full wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability and full wave rectification.

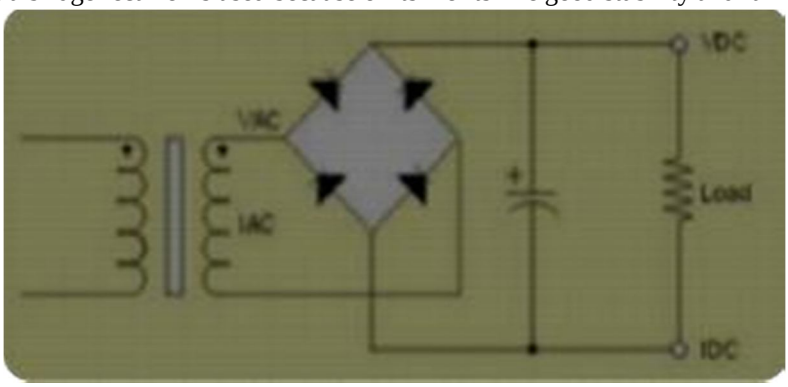


Fig.5.4 Rectifier

The Bridge rectifier is a circuit, which converts an ac voltage to dc voltage using both half cycles of the input ac voltage. The Bridge rectifier circuit is shown in the figure. The circuit has four diodes connected to form a bridge. The ac input voltage is applied to the diagonally opposite ends of the bridge. The load resistance is connected between the other two ends of the bridge. For the positive half cycle of the input ac voltage, diodes D1 and D3 conduct, whereas diodes D2 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance RL and hence the load current flows through RL.

For the negative half cycle of the input ac voltage, diodes D2 and D4 conduct whereas, D1 and D3 remain OFF. The conducting diodes D2 and D4 will be in series with the load resistance RL and hence the current flows through RL in the same direction as in the previous half cycle. Thus a bi-directional wave is converted into a unidirectional wave.

4) Filter

Capacitive filter is used in this project. It removes the ripples from the output of the rectifier and smoothens the D.C. Output received from this filter is constant until the mains voltage and load is maintained constant. However, if either of the two is varied, D.C. voltage received at this point changes. Therefore a regulator is applied at the output stage.

5) Voltage Regulator

As the name itself implies, it regulates the input applied to it. A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12V are required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used.

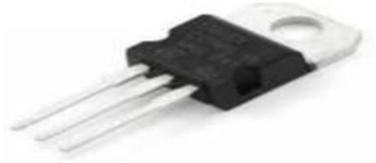


Fig.5.5 Voltage regulator

The voltage regulator is a device, which maintains the output voltage constant irrespective of the change in supply variations, load variations and temperature variations. Regulator IC units contain the circuitry for reference source, comparator, amplifier, control device and overload protection, all in a single IC. Other features are, Output Current up to 1A, Output Voltages of 5v, Thermal Overload Protection, Short Circuit Protection, Output Transistor Safe Operating Area Protection.

The 78xx (sometimes LM78xx) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the first number 78 represents positive supply and the xx is replaced with two digits, indicating the output voltage. 78xx ICs have three terminals and are commonly found in the TO220 form factor, although smaller surface-mount and larger TO3 packages are available. These devices support an input voltage anywhere from a couple of volts over the intended output voltage, up to a maximum of 35 to 40 volts depending on the make, and typically provide 1 or 1.5 amperes of current. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation.

The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents. These are monolithic integrated circuits designed as fixed voltage regulators for a wide variety of applications including local, on card regulation. These regulators employ internal current limiting, thermal solution and safe area compensation.

They can also be used with external components to obtain adjustable voltages and current.Its features are;

a) Output Current up to1A
b) Output Voltages of 5,6,8, 9,10, 12, 15,18, 24 volts
c) Thermal Overload Protection
d) Short Circuit Protection
e) Output Transistor Safe Operating Area Protection

6) Resistors

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the same time, act to lower voltage levels within circuits. In electronic circuits, resistors are used to limit current flow, to adjust signal levels, bias active elements, and terminate transmission lines among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

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Fig.5.6 Resistor

7) Capacitors

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store electrical energy temporarily in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors (plates) separated by a dielectric (i.e. an insulator that can store energy by becoming polarized). The conductors can be thin films, foils or sintered beads of metal or conductive electrolyte, etc. The non conducting dielectric acts to increase the capacitor's charge capacity. A dielectric can be glass, ceramic, plastic film, air, vacuums, paper, mica, oxide layer etc. Capacitors are widely used as parts of electrical circuits in many common electrical devices.



Fig.5.7 Capacitor

8) LED

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the colour of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.



Fig.5.8 LED

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9) Diode (1N4007)

1N4007 is a rectifier diode, designed specifically for circuits that need to convert alternating current to direct current. It can pass currents of up to 1 A, and have peak inverse voltage (PIV) rating of 1,000 V.



Fig.5.9 Diode

Features

a) Maximum Recurrent Peak Reverse Voltage 1000V
b) Maximum RMS Voltage 700V
c) Maximum DC Blocking Voltage 1000V
d) Average Forward Current: 1.0A
e) Peak Forward Surge Current: 30A
f) Maximum Instantaneous Forward Voltage: 1.0V
g) Maximum DC Reverse Current At Rated DC Blocking Voltage: 5.0µA @ 25°C
h) Typical Junction Capacitance: 15Pf
i) Typical Reverse Recovery Time: 2.0us
j) Mounting Type: Through Hole

10) BC547

BC547 is an NPN Bipolar Junction Transistor. Mostly it is used for the switching purpose as well as for amplification purposes. Similar to the other transistors BC547 is also used for the amplification of current. The smaller amount of current at the base is used to control the larger amount of currents at collector and emitter as well. Its basic applications are switching and amplification.

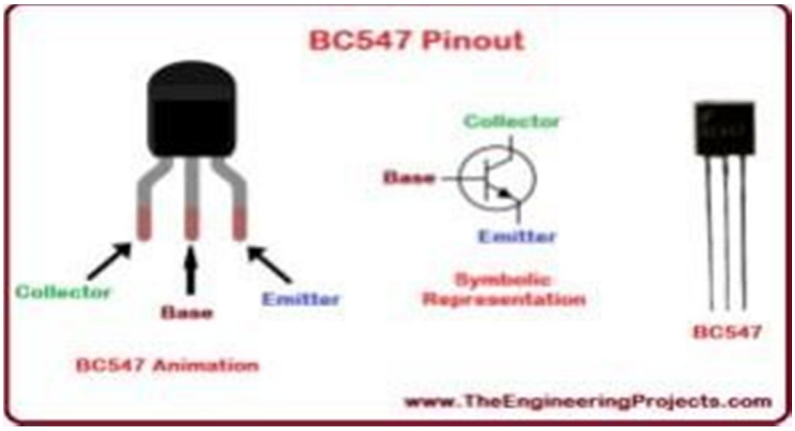


Fig.5.10 Transistor

Features

a) BC547 can be used for switching purposes.
b) We can also use it for amplification purposes.
c) The gain of DC current (hFE) = 800 A
d) Continuous IC (collector current) = 100mA
e) VBE (emitter-base voltage) = 6V
f) IB (base current) = 5mA
g) The polarity of the transistor is NPN
h) The transition frequency is 300MHz
i) It is obtainable in semiconductor package like-92
j) Power dissipation is 625mW

11) Heartbeat Sensor



Fig.5.11 Heartbeat sensor

The working of the Pulse/Heart beat sensor is very simple. The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side we have some circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our human body. This can either be your Finger tip or your ear tips, but it should be placed directly on top of a vein.

Now the LED emits light which will fall on the vein directly. The veins will have blood flow inside them only when the heart is pumping, so if we monitor the flow of blood we can monitor the heart beats as well. If the flow of blood is detected then the ambient light sensor will pick up more light since they will be reflected by the blood, this minor change in received light is analyzed over time to determine our heart beats.

Using the pulse sensor is straight forward, but positioning it in the right way matters. Since all the electronics on the sensor are directly exposed it is also recommended to cover the sensor with hot glue, vinyl tape or other nonconductive materials. Also it is not recommended to handle these sensors with wet hands. The flat side of the sensor should be placed on top of the vein and a slight pressure should be applied on top of it, normally clips or Velcro tapes are used to attain this pressure.

To use the sensor simply power it using the Vcc and ground pins, the sensor can operate both at +5V or 3.3V system. Once powered, connect the Signal pin to the ADC pin of the microcontroller to monitor the change in output voltage. If you are using a development board like Arduino then you can use the readily available code which will make things a lot easier.

Features

a) Biometric Pulse Rate or Heart Rate detecting sensor
b) Plug and Play type sensor
c) Operating Voltage: +5V or +3.3V
d) Current Consumption: 4mA
e) Inbuilt Amplification and Noise cancellation circuit.
f) Diameter: 0.625”
g) Thickness: 0.125” Thick

12) Temperature Sensor



Fig.5.12 Thermistor

Thermistor is an electronic component used to calculate the temperature. This is a type of resistor whose resistance varies with change in temperature. These NTC thermistors are made up from the combination of metal oxides which is passed through a sintering process which gives negative electrical resistance versus temperature (R/T) relationship to it. Due to having a large negative slope a small change in temperature causes a huge change in electrical resistance.

Basically, there are two types of thermistor one is NTC (Negative Temperature Coefficient) and second one is PTC (Positive Temperature Coefficient). If the thermistor is NTC type then it decreases the resistance as increase in temperature and PTC behavior is just opposite to the NTC. A thermistor is connected with any electrical circuit to measure the temperature of the body or the substance. This thermistor's operating temperature range is -55 °C to 125 °C, the range of the temperature is dependent upon the base resistance.

Important Parameters

a) Zero-power Resistance of Thermistor: (R)

The convenient reference point for thermistors provided by resistance is at 25 °C (substantially at room temperature).The formula by which the resistance of the thermistor is specified:

R=R0 expB (1/T-1/T0)

Where, R = Resistance in ambient temperature T (K) R0 = Resistance in ambient temperature T0 (K)

b) Material Constant: (B)

Material constant B controls the slope of the RT characteristics as shown in figure. B value vary according to the temperature and defined between two temperature 25°C and 85°C by the formula: negative electrical resistance versus temperature relationship.

B25/85 = ln (R85/R25) / (1/T – 1/T0) . B25/85 is the value used to compare and characterize different ceramics. Tolerance on this value is caused by material composition.

c) Temperature Coefficient of Resistance: (α)

This value shows the sensitivity of a sensor according to temperature changes. It defined as: α= Δ B/ T2

The formula represents that the relative tolerance on α is equal to the relative tolerance on B-value.

d) Thermal Time constant

This is the time period in which the thermistor’s temperature will rapidly change 63.2% of its temperature (T0) difference from ambient temperature (T1).

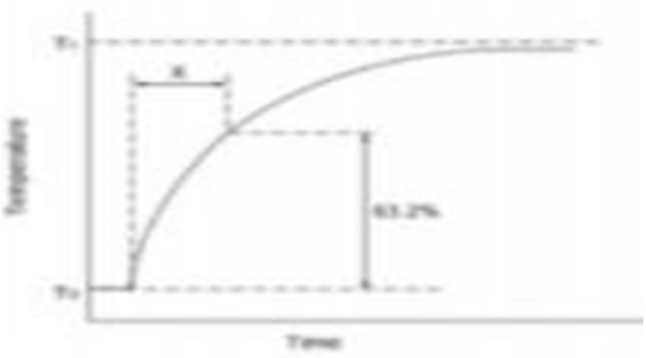


Fig.5.13. Thermal time constant characteristic of thermistor.

e) Thermal Dissipation Constant

The amount of electric power P (mW) consumed in T1 (ambient temperature) and T2 (rises thermistor temperature), there is a formula as follows:

P = C (T2-T1)

Where, C is the thermal dissipation constant.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue III Mar 2022- Available at www.ijraset.com

13) Sound Sensor



Fig.5.14 Sound sensor

The sound sensor is one type of module used to notice the sound. Generally, this module is used to detect the intensity of sound. The applications of this module mainly include switch, security, as well as monitoring. The accuracy of this sensor can be changed for the ease of usage.

This sensor employs a microphone to provide input to the buffer, peak detector and an amplifier. This sensor notices a sound, & processes an o/p voltage signal to a microcontroller. After that, it executes required processing.

This sensor is capable of determining noise levels within DB's or decibels at 3 kHz 6 kHz frequencies approximately wherever the human ear is sensitive. In smartphones, there is an android application namely decibel meter used to measure the sound level. This sensor includes three pins which include the following.

a) Pin1 (VCC): 3.3V DC to 5V DC
b) Pin2 (GND): This is aground pin
c) Pin3 (DO): This is an output pin

14) Buzzer



Fig.5.15 Buzzer

A buzzer or beeper is an audio signaling device which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

a) *Mechanical:* A joy buzzer is an example of a purely mechanical buzzer. They require drivers.
b) *Piezoelectric:* A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

Modern Applications: While technological advancements have caused buzzers to be impractical and undesirable, there are still instances in which buzzers and similar circuits may be used. Present day applications include:

- Educational purposes
- Annunciator Panels
- Electronic metronomes
- Game show lock-out device
- Microwave ovens and another household appliance.

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15) Bluetooth Module (HC05)



Fig.5.16 BT Module

HC-05 is a compact Bluetooth Module (5V Serial TTL). The module has a built-in Voltage regulator and 3V3 to 5V level converter that can be used to interface with 5V Micro-controllers. The module has only 5 pins (Standard 2.54mm berg strip) VCC, GND, TX, RX and RESET.
The module is factory configured in transparent Mode and hence there is no command required for normal operation. The HC-05 is a Drop-in replacement for wired serial connections, transparent usage. We can use it simply for serial port replacement to establish connection between MCU and GPS, PC to our embedded project / Robot etc. . Any serial stream from 9600 to 115200 bps can be passed seamlessly from your PC/PDA/MOBILE to your target board.

Specification:
a) Support Master & Slave Mode
b) Bluetooth core V 2.0 compliant
c) Support UART interface to host system
d) Serial communications @ 9600-115200bps
e) No Setup/Initial command required
f) Breadboard Compatible
g) Onboard Status and Power LED
h) Encrypted connection
i) Frequency: 2.4~2.524 GHz
j) Built-in Chip antenna
k) Power Supply: +5V

Pin out for the module are:
- GND Ground- Ground Level of Power supply,
- 5V Power Supply pin for Power Supply Input (5V)
- RXD Receive Pin for Data Reception
- TXD Transmit Pin for Data Transmission
- RST Reset- Reset Input (Internally Pulled-Up)

B. PCB Designing
- *Basic Steps In PCB Manufacturing:* Forming a printed circuit board is essential and the most prominent step in the formation of one electronic device. For a device to work properly the components we planned to use should be well placed in a PCB. In this section we are explaining about the formation of our PCB. The design of a PCB can be considered as the last step in electronic circuit designing. In the electronic circuit performance and reliability depends on the productivity of PCB. Assembling and servicing ability also depends on the design. A proper PCB ensures that various components are interconnected as per the circuit diagram. Once they have been placed on the PCB in their proper positions and subsequently soldered PCB design and fabrication techniques have undergone so much of development that it has become a subject in itself. Double sided PCBs, multiplayer PCBs with plated through holes (PTH), flexible PCBs, etc are only some of the developments.

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Manufacturing of PCB involves the following steps:

- ✓ Print and etch
- ✓ Print, plate and etch

The single sided PCBs are usually using the print and etch method and the double-sided plates through hole boards are made by print, plate and etch method. The production of multiplayer boards uses both techniques.

- *Penalization:* The schematic or the artwork of this circuit applied by the customer is transformed to working positive or negative films. The circuit is repeated conveniently to accommodate economically as many circuits as possible in a panel, which can be operated in every sequent step in the PCBs process. This is called penalization.
- *Drilling:* This is the state of the art operation. Very small holes are drilled with a high speed CNC drilling machine.
- *Plating:* The heart of the PCB manufacturing process lies in the electrolytic plating process. The holes drilled are treated both mechanically and chemically before depositing the copper by the electrolytic copper plating process
- *Etching:* Once a multiplayer board is drilled and electroless copper is deposited the image available in the form of a firm is transferred on to the outside by photo printing process. The boards are then made with copper and tin. This is called etching.
- *Solder Mask:* Since PCB design may call for very close spacing conductors, a solder mask has to be applied on both sides of the circuit to avoid bridging of conductors. This ink is applied by screening. This is dried, exposed to UV, developed in a mild alkaline solution and finally treated by both UV and thermal energy.
- *Hot air leveling:* After the above-mentioned process, the circuit pads are soldered using a hot air leveling process while removing the board from the solder path, hot air blown on both the sides of the board through air knives in the machine leaving the board soldered and leveled.

Fabrication of demonstration unit

- ✓ The total circuit diagram and list of components are prepared and procurement of the components is done.
- ✓ The components layout and interconnection track diagram are prepared and hole drilling as per the size of the components is done
- ✓ To remove the unwanted copper other than the track part the board is etched and it is washed with plenty of water and is dried well.

1) PCB Layout

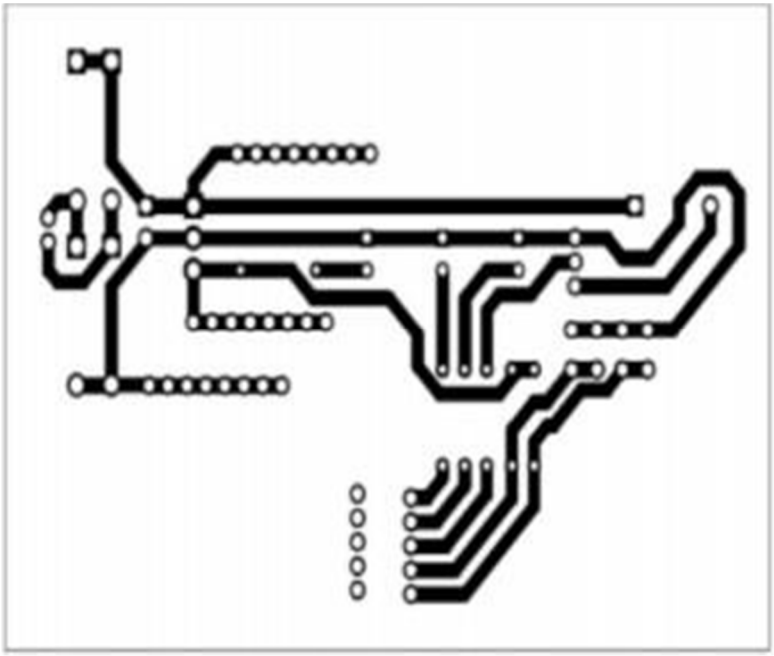


Fig.5.17 PCB Layout

2) Component Layout

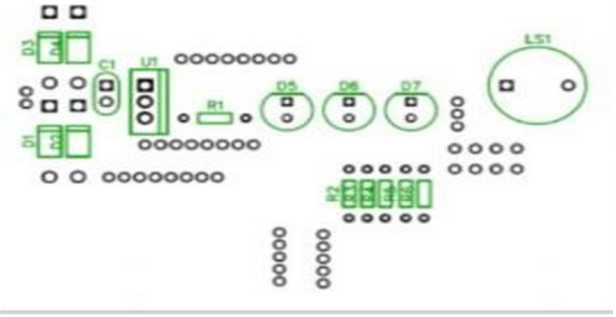


Fig.5.18 Component layout

C. Software Description

1) Diptrace

DipTrace is EDA/CAD software for creating schematic diagrams and printed circuit boards. The developers provide multilingual interfaces and tutorials (currently available in English and 21 other languages). DipTrace has 4 modules: Schematic Capture Editor, PCB Layout Editor with built-in shape- based auto-router and 3D Preview & Export, Component Editor, and Pattern Editor.

DipTrace is an advanced PCB design software application that consists of 4 modules PCB Layout with efficient auto-router and auto-placer, schematic capture, component and pattern editors that allow you to design your own component libraries. DipTrace has a powerful automatic router, superior to many routers included in other PCB layout packages. It can route a single layer and multilayer circuit boards, and there is an option to auto route a single layer board with jumper wires, if required. DipTrace also provides you with external auto router support.

Smart manual routing tools allow users to finalize the design and to get the results they want in a blink of an eye. There are a number of verification features that allow you to control the accuracy of your project. DipTrace modules allow you to exchange schematics, layouts and libraries with other EDA and CAD packages. Output formats are DXF, Gerber, Drill and G-code.

a) Basic Features

- Simple UI
- Multi-sheet and hierarchical schematics
- High-speed shape-based autorouter
- Smart manual routing tools
- Differential pairs
- Wide import / export capabilities
- Advanced verifications with real-time DRC
- Real-time 3D PCB preview & STEP export
- ODB++ and Gerber manufacturing outputs

b) Schematic Capture

Advanced circuit design tool with support of multi-sheet and multi-level hierarchical schematics that delivers a number of features for visual and logical pin connections. Cross- module management ensures that principal circuits can be easily converted to PCB, back annotated, or imported/exported from/to other EDA, CAD formats and net-lists. DipTrace Schematic has ERC Verification and Spice export for external simulation.

c) PCB Layout

Engineering tool for board design with smart manual routing, differential pairs, shape-based autorouter, advanced verification, and wide import/export capabilities. Design requirements are defined by net classes, class-to-class rules, and detailed settings by object types for each class or layer. When routing with real-time DRC, the program reports errors on the fly before actually making them. DRC also checks length and phase tolerances for differential pairs.

The board can be previewed in 3D and exported to STEP format for mechanical CAD modeling. Design Rule Check with in-depth detailing and Net Connectivity verification procedures are available.

d) 3D Preview and Export

This module includes real-time 3D preview & export features. It shows the model of a manufactured printed circuit board with all components installed. Rotate the board in three axes, zoom in and out in real time, change colors of the board, copper areas, solder mask, silkscreen, and background. 3D preview works on all stages of the design. Board can be exported to STEP or VRML 2.0 formats for mechanical CAD modelling. More than 6500 3D models of PCB packages are supplied for free. Externally designed 3D models in *.wrl,*.step, *.iges, and *.3ds formats can be uploaded and attached to patterns in PatternEditor or PCB Layout.

e) Pattern Editor

Draw patterns with various types of shapes, pads, holes, and dimensions. Circle, Lines (headers, DIP), Square (QFP), Matrix (BGA), Rectangle (RQFP), and Zig-Zag standard templates. Creation of pattern is basically selecting a template, entering a couple of vital parameters, drawing the silkscreen, and launching automatic pad renumbering. Custom templates can be created for non-standard patterns. DXF import makes creating complex layouts easier.

Steps:

- open diptrace->select schematic
- pick and place components
- save schematic
- file->convert to PCB
- route correctly then file - > preview f)click silk to show layout g)click traces to show component

2) Python

Python is a high-level, interpreted, interactive and object oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently whereas the other languages use punctuations. It has fewer syntactic constructions than other languages. Python features a dynamic type system and automatic memory management and supports multiple programming paradigms, including object-oriented, imperative, functional programming, and procedural styles. It has a large and comprehensive standard library. Python interpreters are available for many operating systems, allowing Python code to run on a wide variety of systems. CPython, the reference implementation of Python, is open source software and has a community-based development model, asdo nearly all of its variant implementations. C Python is managed by the non-profit Python Software Foundation. Python is a multi-paradigm programming language: object-oriented programming and structured programming are fully supported, and many language features support functional programming and aspect-oriented programming (including by meta programming and meta objects (magic methods). Many other paradigms are supported via extensions, including design by contract and logic programming. Python uses dynamic typing and a mix of reference counting and a cycle-detecting garbage collector for memory management. An important feature of Python is dynamic name resolution (late binding), which binds method and variable names during program execution. The design of Python offers some support for functional programming in the Lisp tradition. The language has filter(), map(), and reduce() functions; list comprehensions, dictionaries, and sets; and generator expressions. The standard library has two modules (itertools and functools) that implement functional tools borrowed from Haskell and Standard ML.

a) Python's Features Include

- *Easy-to-learn:* Python has few keywords, simple structure, and a clearly defined syntax. This allows a student to pick up the language quickly.
- *Easy-to-read:* Python code is more clearly defined and visible to the eyes. • Easy-to maintain: Python's source code is fairly easy-to-maintain.
- *A broad standard library:* Python's bulk of the library is very portable and cross platform compatible on UNIX, Windows, and Macintosh.
- *Interactive Mode:* Python has support for an interactive mode, which allows interactive testing and debugging of snippets of code.
- *Portable:* Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
- *Extendable:* You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.
- *Databases:* Python provides interfaces to all major commercial databases.
- *GUI Programming:* Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.
- *Scalable:* Python provides a better structure and support for large programs than shell scripting.

b) Python has five standard data types

- Numbers
- String
- List
- Tuple
- Dictionary

c) Types of Operator `Python language supports the following types of operators

- Arithmetic Operators
- Comparison (Relational) Operators
- Assignment Operators
- Logical Operators
- Bitwise Operators
- Membership Operators
- Identity Operators

3) Android Studio

Android Studio is the official Integrated Development Environment (IDE) for Android app development, based on IntelliJ IDEA . On top of IntelliJ's powerful code editor and developer tools, Android Studio offers even more features that enhance your productivity when building Android apps, such as:

- A flexible Gradle-based build system
- A fast and feature-rich emulator
- A unified environment where you can develop for all Android devices
- Apply Changes to push code and resource changes to your running app without restarting your app
- Code templates and GitHub integration to help you build common app features and import sample code
- Extensive testing tools and frameworks
- Lint tools to catch performance, usability, version compatibility, and other problems ● C++ and NDK support
- Built-in support for Google Cloud Platform, making it easy to integrate Google Cloud Messaging and App Engine

a) Project Structure

Each project in Android Studio contains one or more modules with source code files and resource files. Types of modules include:

- Android app modules
- Library modules
- Google App Engine modules

By default, Android Studio displays your project files in the Android project view. This view is organized by modules to provide quick access to your project's key source files.

All the build files are visible at the top level under Gradle Scripts and each app module contains the following folders:

- Manifests: Contains the AndroidManifest.xml file.
- Java: Contains the Java source code files, including JUnit test code.
- Res: Contains all non-code resources, such as XML layouts, UI strings, and bitmap images.

4) Pycharm

PyCharm is the most popular IDE used for the Python scripting language. It is developed by the Czech company jetBrains.it provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems and supports web development with Django.

a) Pycharm Features

PyCharm offers some of the best features to its users and developers in the following aspects:

- Code completion and inspection Advanced debugging Support for web programming and frameworks such as Django and Flask Features of PyCharm Besides, a developer will find PyCharm comfortable to work with because of the features mentioned below:
- Code Completion PyCharm enables smoother code completion whether it is for built in or for an external package.
- SQLAlchemy as Debugger You can set a breakpoint, pause in the debugger and can see the SQL representation of the user expression for SQL Language code.
- Git Visualization in Editor when coding in Python, queries are normal for a developer. You can check the last commit easily in PyCharm as it has the blue sections that can define the difference between the last commit and the current one.
- Code Coverage in Editor You can run .py files outside PyCharm Editor as well marking it as code coverage details elsewhere in the project tree, in the summary section etc.

D. Flowchart

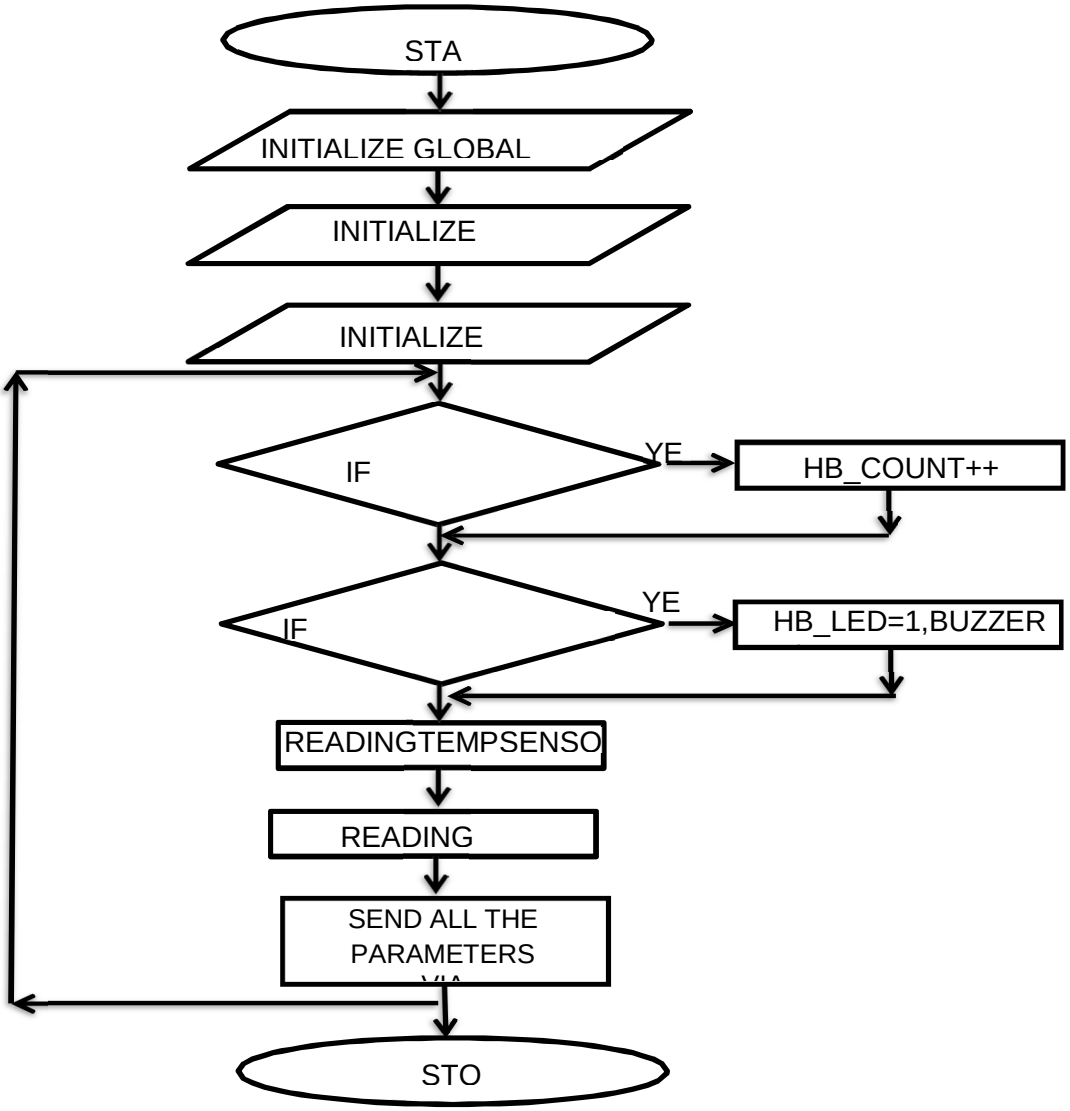


Fig.5.19 Flowchart

VI. RESULT

'We have implemented the proposed system successfully, the picture below shows the hardware of the system. Using the device we took the heart rate, temperature, cough intensity and location of a person. All the results are sent to the database, MySQL.

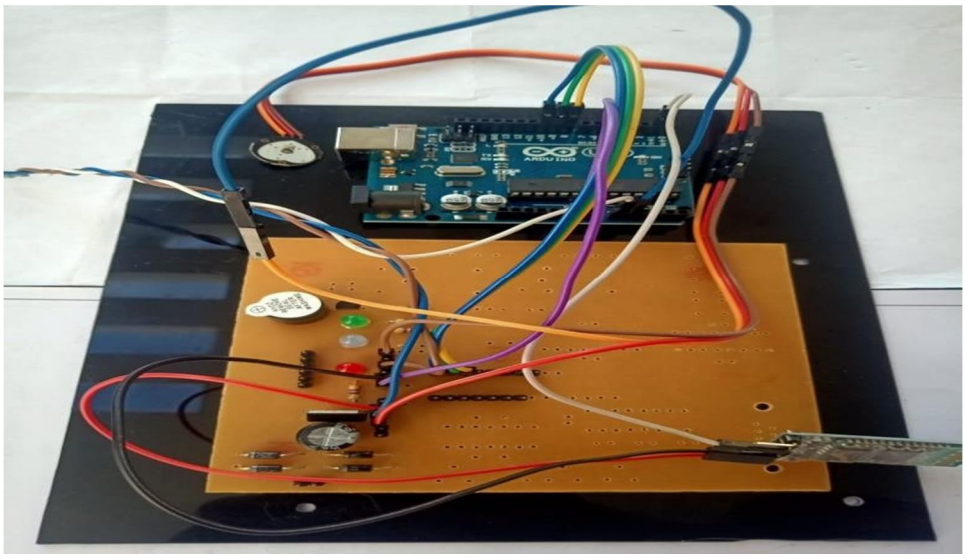
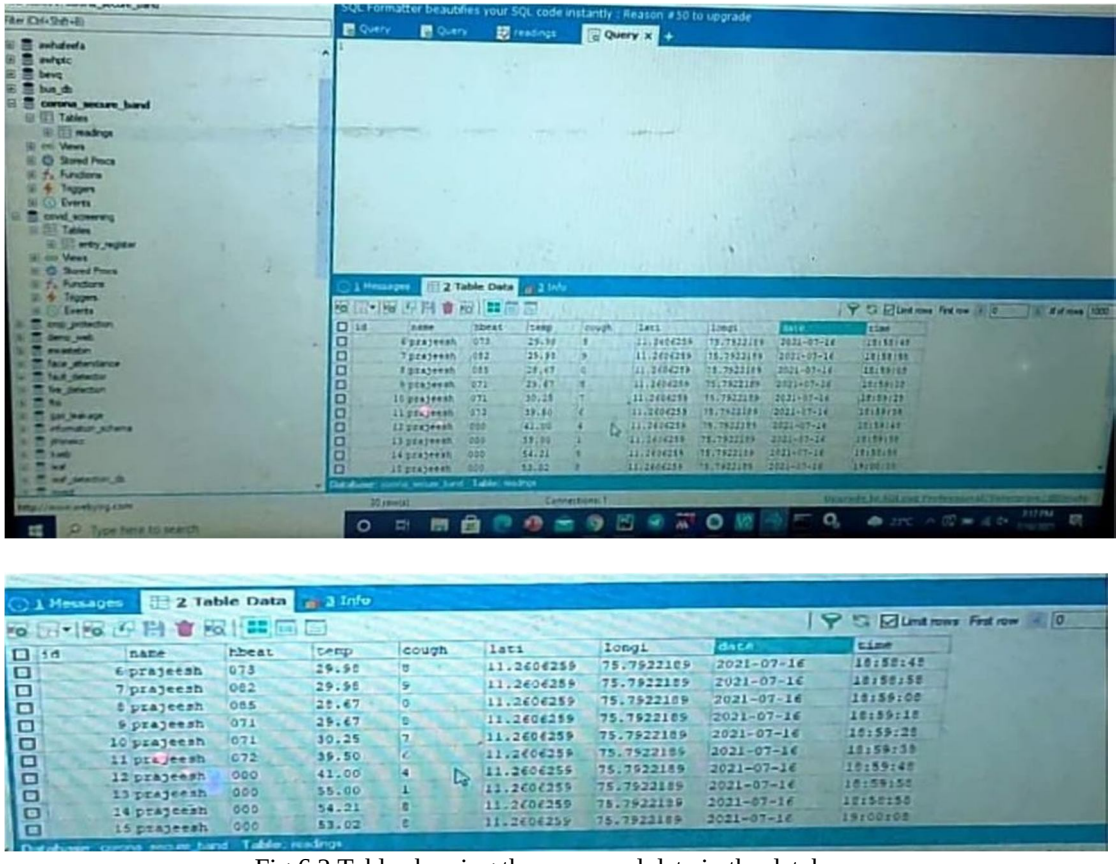


Fig.6.1 System hardware

The figure below shows the results of measurements of the person in MySQL database. This is the interface of the database when accessed through SQLyog. The table presents the data such as the patient ID, heartbeat, temperature, cough intensity, location and the time at which the particular data was measured.



id	name	hbeat	temp	cough	lati	longi	date	time
6	prajeesh	073	29.98	8	11.2606259	75.7922189	2021-07-16	18:58:48
7	prajeesh	082	29.98	9	11.2606259	75.7922189	2021-07-16	18:58:58
8	prajeesh	085	28.67	0	11.2606259	75.7922189	2021-07-16	18:59:08
9	prajeesh	071	29.67	8	11.2606259	75.7922189	2021-07-16	18:59:18
10	prajeesh	071	30.25	7	11.2606259	75.7922189	2021-07-16	18:59:28
11	prajeesh	072	39.50	6	11.2606259	75.7922189	2021-07-16	18:59:38
12	prajeesh	000	41.00	4	11.2606259	75.7922189	2021-07-16	18:59:48
13	prajeesh	000	55.00	1	11.2606259	75.7922189	2021-07-16	18:59:58
14	prajeesh	000	54.21	8	11.2606259	75.7922189	2021-07-16	19:00:08
15	prajeesh	000	53.02	8	11.2606259	75.7922189	2021-07-16	19:00:18

Fig.6.2 Table showing the measured data in the database

Below is a picture of the display of the user app giving the location of the person. When the doctor or any other medical staff wants to know the location of the patient during the time of measuring a particular data, he/she just needs to click on the particular data row and the app will automatically pop-up Google Maps to display the exact location. Just like this we took the location of the person.

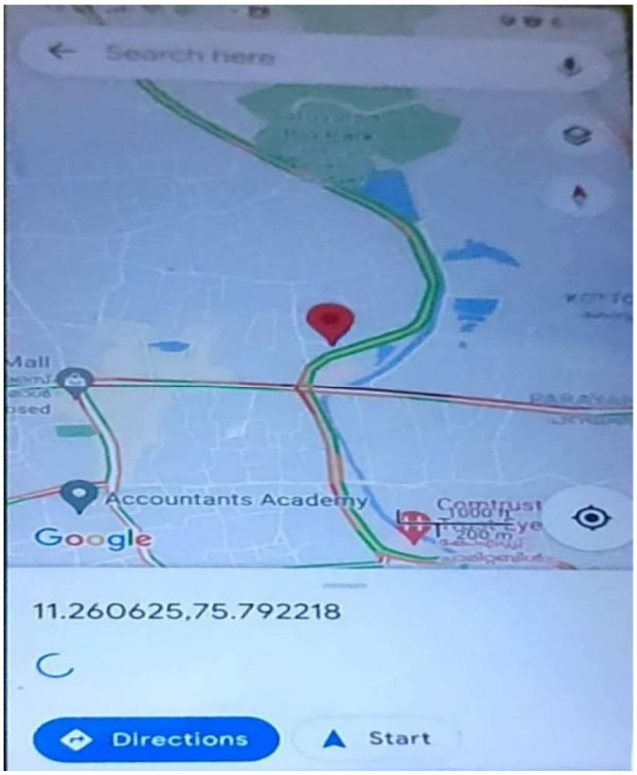


Fig.6.3 Google map opens up to display patient location

In the receiver side we used a user app to access the details of the person. It shows the patient ID, heartbeat, temperature, cough intensity, location and the time at which the particular data was measured in an easily readable manner in a tabular form. The real time new data gets updated to the app without any need of refreshing.



Fig.6.4 Interface of the user app

All the pictures above are examples of data output during the demonstration of “IOT BASED SMART WEARABLE HEALTH MONITORING SYSTEM FOR CORONA DIAGNOSIS” and are Verified to give accurate measures.

VII. MERITS AND DEMERITS

A. *Merits*

The merits of this project are that it helps to avoid direct contact with patients and thereby maintain social distancing and avoid risk of disease transmission. It will track the patient's conditions on a real time basis so that in case some crucial changes in the parameters that are being measured occur, the medical staff can be aware of it even if they are not near the patient.

B. *Demerits*

The demerit of this project is that it requires network connectivity continuously without any break in order to maintain continuous uploading of data to the database.

VIII. CONCLUSION & FUTURE SCOPE

This paper parents a low cost and flexible design of medical device for the purposes of measuring and tracking of covid-19 symptoms. The simplest configuration only uses portable electronic devices with sensors and mobile phones and it is capable of detecting health parameters of patients. The principle can be extended to more sensors to track heart rate, temperature and oxygen saturation. The simplest analog circuits for signal processing are given. Also, the methodology of software processing and feature extraction on the microcontroller side is presented. The approach yielded good and stable results and could be considered as one of the feasible solutions in symptoms detecting during covid-19.

Today, many services can be reached with internet technology and the number of applications that use this technology is constantly increasing. IoT technology is expanding day by day to include different sectors and applications. One of them is the smart health sector and this sector offers incredible opportunities for us with new applications. The monitoring of the patients, who should be kept under constant surveillance, in the hospital environment is very difficult with the existing infrastructure and methods. Patients under surveillance in hospitals are dependent on bedding and this makes the patients uncomfortable.

1) It will help to observe social distancing to check COVID-19 spread
2) We can add a camera and machine learning algorithm to detect whether the visitor is wearing a mask or not.
3) Facilitate memory slot for using the device even when network connection is lost

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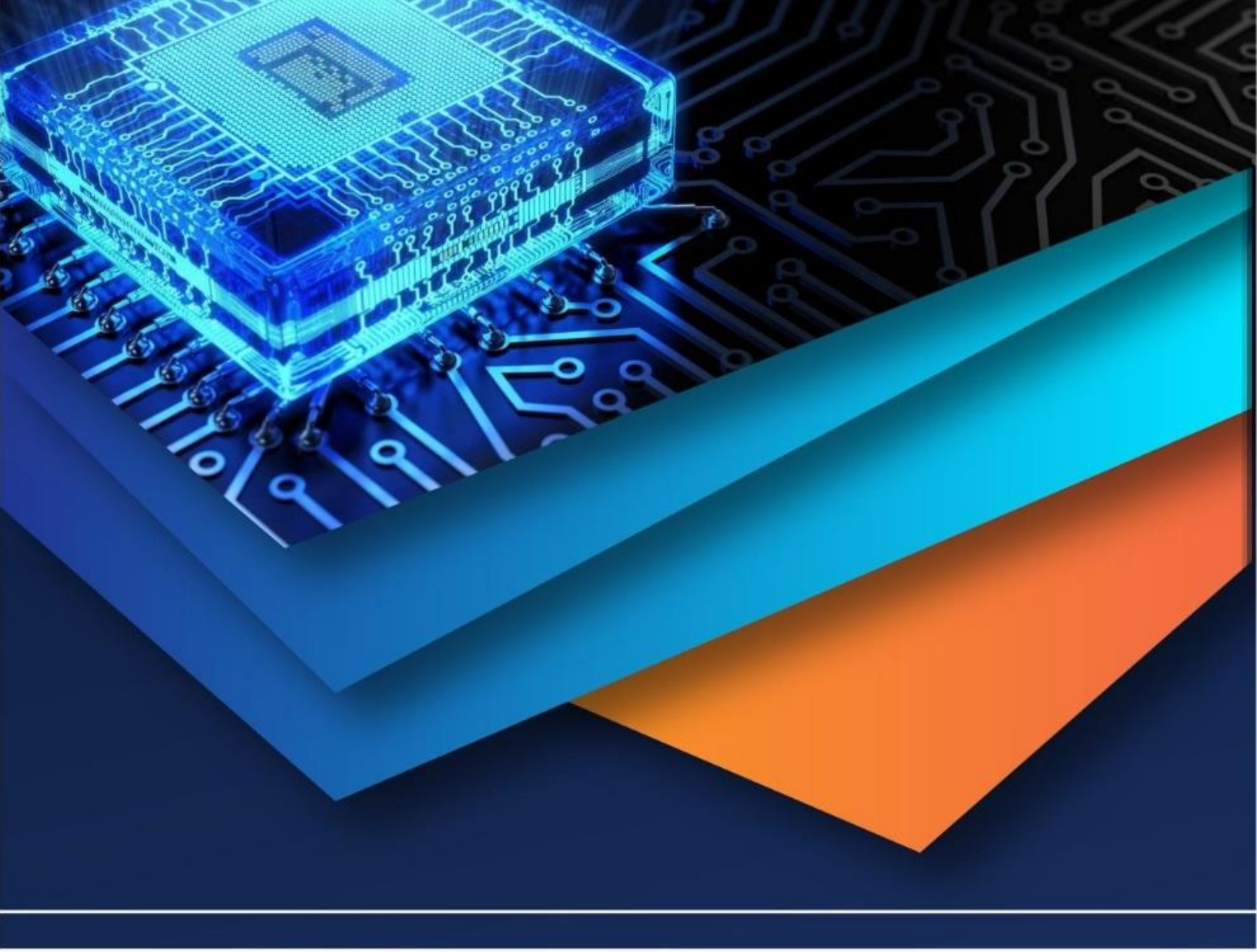
A. Program

```
#include <math.h> #define ledPin 10
#define data_led 11
#define buzzer 12
const int hbeat_pin = A0; /* Heartbeat O/P pin */ const int tempr = A1;
const int cough = A2; int hbeat_count=0;
int count=0,hb_val=0; int hbeat_adc_val;
int cough_val=0;
bool flag=0,hbeat_flag=0; char temp[5];
float temp_val;
float A = 1.019849522e-03, B = 2.283505444e-04, C = 2.519202697e-07;
float T,logRt,Tf,Tc; float Thermistor(int Vo)
{
logRt = log(10000.0*((1024.0/Vo-1)));
T = (1.0 / (A + B*logRt + C*logRt*logRt*logRt)); // We get the temperature value in Kelvin from this Stein-Hart equation
Tc = T - 273.15; // Convert Kelvin to Celcius
Tf = (Tc * 1.8) + 32.0; // Convert Kelvin to Fahrenheit return Tc;
}
void setup()
{
Serial.begin(9600);//serial communication enabling by 9600 baud rate pinMode(ledPin, OUTPUT);
pinMode(data_led, OUTPUT); pinMode(buzzer, OUTPUT); pinMode(hbeat_pin, INPUT); pinMode(tempr, INPUT);
pinMode(cough, INPUT);
// initialize timer1

noInterrupts(); // disable all interrupts TCCR1A = 0;
TCCR1B = 0;
TCNT1 = 0;
OCR1A = 31250; // compare match register 16MHz/256/2Hz TCCR1B |= (1 << WGM12); // CTC mode
TCCR1B |= (1 << CS12); // 256 prescaler
TIMSK1 |= (1 << OCIE1A); // enable timer compare interrupt interrupts(); // enable all interrupts
}
ISR(TIMER1_COMPA_vect) // timer compare interrupt service routine { count++;

digitalWrite(ledPin, digitalRead(ledPin) ^ 1); // toggle LED pin if(count>=20)
{
hb_val=        hbeat_count; hb_val=hb_val*6;
hbeat_count=0; flag=1; count=0;
}
}
void convert(unsigned int a)
{
unsigned char b; b=a/1000; b=b+(0x30);
```

```
Serial.write(b); a=a%1000;
b=a/100;
b=b+(0x30);
Serial.write(b); a=a%100;
b=a/10; b=b+(0x30);
Serial.write(b); b=a%10; b=b+(0x30);
Serial.write(b);
}
void loop()
{
int temp_read= Thermistor(analogRead(tempr)); /* Read Temperature */ temp_val=temp_read;
hbeat_adc_val = analogRead(hbeat_pin); /* Read Temperature */ cough_val = analogRead(cough);
if(hbeat_adc_val<100)hbeat_flag=1;
if(hbeat_adc_val>100&&hbeat_flag==1)
{
hbeat_flag=0; hbeat_count++;
}
if(hbeat_count>90)
{
digitalWrite(buzzer,HIGH); delay(10); digitalWrite(buzzer,LOW); delay(10);
}
convert(hb_val);
Serial.write(',');
dtostrf(temp_val,4,3,temp); for(int i=0;i<=4;i++)
{
Serial.write(temp[i]);
}
Serial.write(','); convert(cough_val); Serial.write('*');
Serial.write('\n');
digitalWrite(data_led,HIGH); digitalWrite(buzzer,HIGH); delay(500);
digitalWrite(data_led,LOW); digitalWrite(buzzer,LOW); flag=0;
hbeat_count=0;
}
```



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