Smart Water Monitoring System

A mini-project report submitted for
Internet of Things(Semester V)

by

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(sign with date)

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Approval Sheet

Project Report Approval

This project report entitled by **Smart Water Monitoring System** by **Chhajed Pushpak Aakesh , Dsouza Rebecca Christopher , and Feaba Johnson** is approved as mini project in Third year Engineering, Information Technology.

Examiners

1.———————————

2.———————————

Date:

Place:

Abstract

Since the water monitoring system is a critical implementation for the issue of pollution of water, with increase in the development of technology and advancement in the Internet of Things (IOT) environment, the real time water monitoring system is remotely monitored by the means of storing the data, transmission and processing. This paper presents a smart water quality monitoring with sensor interface device in internet of things. The smart water monitoring system consists of design board, sensors, Wi-Fi module and personal computer. It is programmed in high speed integrated circuit hardware description language and embedded c programming language. The proposed system collects the two parameters of water such as water level and temperature of water with high speed from various sensors using thing speak.

Keywords – Internet of Things (IOT); smart water parameters; Sensors; Wi-Fi; and Thing Speak

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Lab Outcomes

LO1: Identify the requirements for the real world problems.

LO2: Conduct a survey of several available literatures in the preferred field of study.

LO3: Study and enhance software/hardware skills.

LO4: Demonstrate and build the project successfully by hardware requirements, coding, emulating and testing.

LO5: To report, present and demonstrate an ability to work in teams and manage the conduct of the research study.

Rubrics for the assessment (LO1):

Indicator	Very Poor	Poor	Average	Good	Excellent
Timeline (2)	More than a 3session late (0)	More than a 2session late (0.5)	More than a 2session late (1)	More than a 1session late (1.5)	Early or on time (2)
Identify real world problems(4)	NA (0)	Very poor identification of real world problems(1)	Poor identification of real world problems(2)	Good identification of real world problems.(3)	Accurate identification of the real world problems. (4)
Design the problem solution (4)	No requirement analysis is done(0)	Very poor requirement analysis is done(1)	Poor requirement analysis is done(2)	Good requirement analysis is done(3)	Requirement analysis done with best solution design(4)

Marks:

Rubrics for the assessment (LO2):

Indicator	Very Poor	Poor	Average	Good	Excellent
Timeline (2)	More than a 3session late (0)	More than a 2session late (0.5)	More than a 2session late (1)	More than a 1session late (1.5)	Early or on time (2)
Selection of Sources(8)	No information is gathered from a range of sources.(0)	Information is gathered from a limited number of sources.(2)	Sources rely heavily on a small number of sources and are not considered to be from authoritative sources(4)	Information is gathered from a range of sources but do not entirely reflect the breadth of the debate(6)	Information is gathered from a wide range of journals, books and related authoritative research materials.(8)
Formatting and Presentation of Assignment (4)	Document contains many errors in formatting, punctuation and writing was incoherent. (0)	Document contains many errors in punctuation and formatting. Referencing is not consistent with chosen style guide. Writing style lacks clarity.(1)	Document contains few errors in formatting and punctuation . Style of referencing is generally consistent with chosen style guide. Writing style is coherent(2)	Document contains few errors in formatting and punctuation . Style of referencing is generally consistent with chosen style guide. Writing style is coherent(3)	Document is professionally presented with virtually no errors in punctuation and is in the correct format. The style of referencing is consistent with chosen style guide. Writing style is clear and engaging(4)

Marks (7)

LO3: Study and enhance software/hardware skills.

Rubrics for the assessment:

Indicator	Very Poor	Poor	Average	Good	Excellent
Timeline (2)	More than a 3session late (0)	More than a 2session late (0.5)	More than a 2session late (1)	More than a 1session late (1.5)	Early or on time (2)
Installation of Arduino IDE/Raspbian OS(4) Programming	NA(0)	Installation not done(1)	Installation With some drivers(2)	Installation without drivers(3)	Installation with drivers done(4)
Interfacing of sensors to Arduino/Raspberry board	NA(0)	Unable to do connection and but required output not obtained.(1)	Able to do connection and but required output not obtained(2)	Able to do connection and required output is obtained and no libraries are installed(3)	Able to do connection and required output is obtained and libraries are installed(4)
Sending data on ThingSpeak ,Analysis of Data	NA(0)	No data sent onthingspeak(1)	Data sent on thingspeak and no analysis done(2)	Data sent onthingspeak and some analysis notdone(3)	Data sent on thingspeak and analysis done(4)

Marks:

LO4: Demonstrate and build the project successfully by hardware requirements, coding, emulating and testing.

Rubrics for the assessment (LO4):

Indicator	Very Poor	Poor	Average	Good	Excellent
Timeline (2)	More than a 3session late (0)	More than a 2session late (0.5)	More than a 2session late (1)	More than a 1session late (1.5)	Early or on time (2)
Code design(4)	NA (0)	Very poor code design with no comments and indentation(1)	Poor code design with very comments and indentation (2)	Design with good coding standards (3)	Accurate design with better coding standards (4)
Demo	No system set up was shown(0)	Incomplete System set up was shown.(1)	Partially Complete set up shown with working(2)	Almost Complete set up shown with working(3)	Complete set up shown with working(4)

Marks :

LO5: To report, present and demonstrate an ability to work in teams and manage the conduct of the research study.

Rubrics for the assessment :

Indicator	Very Poor	Poor	Average	Good	Excellent
Timeline (2)	More than a 3session late (0)	More than a 2session late (0.5)	More than a 2session late (1)	More than a 1session late (1.5)	Early or on time (2)
Teamwork and cooperation (4)	The project appears to have been carried out by only minimal (1-2) members for different tasks. (0)	) The project appears to have been carried out by only by 2) members	. The project was carried out by most (3-4) members	The project was carried out by most (3-4) members	The project was carried out by all members.
Formatting andPresentation of Report (4)	Document contains many errors in formatting, punctuation and writing was incoherent. (0)	Document contains many errors in punctuation and formatting. Referencing is not consistent with chosen style guide. Writing style lacks clarity.(1)	Document contains few errors in formatting and punctuation . Style of referencing is generally consistent with chosen style guide. Writing style is coherent(2)	Document contains few errors in formatting and punctuation . Style of referencing is generally consistent with chosen style guide. Writing style is coherent(3)	Document is professionally presented with virtually no errors in punctuation and is in the correct format. The style of referencing is consistent with chosen style guide. Writing style is clear and engaging(4)

Marks**:**

(10)

Chapter 1

Introduction

The **Internet of Things** (**IoT**) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

Internet of Things (IoT) is the networking of physical objects that contain electronics embedded within their architecture in order to communicate and sense interactions amongst each other or with respect to the external environment. In the upcoming years, IoT-based technology will offer advanced levels of services and practically change the way people lead their daily lives. Advancements in medicine, power, gene therapies, agriculture, smart cities, and smart homes are just a very few of the categorical examples where IoT is strongly established.

Applications:

- Factory Digitalization.
- Product flow Monitoring.
- Inventory Management.
- Safety and Security.
- Quality Control.
- Packaging optimization.
- Logistics and Supply Chain Optimization.

Chapter 2
Problem Definition

To detect the temperature and depth of water in a water body (eg. Lake) for analysis and prediction purpose using IOT and to send the data obtained to the cloud where the data can be monitored via a mobile application.

Chapter3

Literature Survey

Nikhil Kedia entitled “Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project.” Published in 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India. This paper highlights theentire water quality monitoring methods, sensors, embedded design, and information dissipation procedure, role of government, network operator and villagers in ensuring proper information dissipation. It also explores the Sensor Cloud domain. While automatically improving the water quality is not feasible at this point, efficient use of technology and economic practices can help improve water quality and awareness among people.[1]

Jayti Bhatt,Jignesh Patoliya entitled “Real Time Water Quality Monitoring System”.This paper describes to ensure the safe supply of drinking water the quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed. In this paper, we present the design of IOT based water quality monitoring system that monitor the quality of water in real time. This system consists some sensors which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature. The measured values from the sensors are processed by microcontroller and this processed values are transmitted remotely to the core controller that is raspberry pi using Zigbee protocol. Finally, sensors data can view on internet browser application using cloud computing.[2]

Michal Lom, Ondrej Pribyl, Miroslav Svitek entitled “Industry 4.0 as a Part of Smart Cities”. This paper describes the conjunction of the Smart City Initiative and the concept of Industry 4.0. The term smart city has been a phenomenon of the last years, which is very inflected especially since 2008 when the world was hit by the financial crisis. The main reasons for the emergence of the Smart City Initiative are to create a sustainable model for cities and preserve quality of life of their citizens. The topic of the smart citycannot be seen only as a technical discipline, but different economic, humanitarian or legal aspects must be involved as well. In the concept of Industry 4.0, the Internet of Things (IoT) shall be used for the development of so–called smart products. Subcomponents of the product are equipped with their own intelligence. Added intelligence is used both during the manufacturing of a product as well as during subsequent handling, up to continuous monitoring of the product lifecycle (smart processes). Other important aspects of the Industry 4.0 are Internet of Services (IoS), which includes especially intelligent transport and logistics (smart mobility, smart logistics), as well as Internet of Energy (IoE), which determines how the natural resources are used in proper way (electricity, water, oil, etc.). IoT, IoS, IoP and IoE can be considered as an element that can create a connection of the Smart City Initiative and Industry 4.0 – Industry 4.0 can be seen as a part of smart cities.[3]

Chapter 4

Hardware and Software Components used in Project

These are the hardware components used in our project-Water Monitoring System. These hardware components play a very important role in this project as does the software part. The heart of the hardware components is the Arduino mega 2560 board and Wi-Fi module which helps in transmission of the data. The admin first registers himself to the cloud (LOGIN) then he can login to the cloud. After that the files are uploaded to the cloud where a folder is created then the file is forwarded where the values are stored and then the file is downloaded through the app in the Android phone.The user login to his account then when the user gives a command to acquire values the file is first uploaded to the cloud and then the user can download the file. Finally the users can logout..The app that we have used as the cloud in our project is the Blynk App.

The hardware of the water monitoring system comprises of the following components:

- Waterproof Temperature sensor
- Ultrasonic temperature
- Wi-Fi module- esp8266
- Arduino mega 2560.

Temperature sensor: Water Temperature indicates how water is hot or cold. The range of DS18B20 temperature sensor is -55 to +125 °C. This temperature sensor is digital type which gives accurate reading.

Fig 4.1: Temperature sensor

Ultrasonic sensor: An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

Fig 4.2: Ultrasonic sensor

Wifi module: The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware. The ESP8266 module is an extremely cost effective board with a huge, and ever growing,

Fig 4.3: Wifi Module

Arduino Mega : The Arduino Mega is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. All analog pins can be used as digital I/O pins. Designing of a project using Arduino Mega gives you the flexibility of working with more memory space and processing power that allows you to work with a number of sensors at once. This board is physically larger than other Arduino boards.

Fig 4.4: Arduino Mega

Arduino IDE is an open source SOFTWARE that is mainly used for writing and compiling the code into the Arduino Module. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. BLYNK is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and such, over the Internet. .It can control hardware remotely, it can display sensor data, it can store data, vizualize it, etc. Blynk Server is responsible for all the communications between the smartphone and hardware.

Chapter 5

Project Implementation

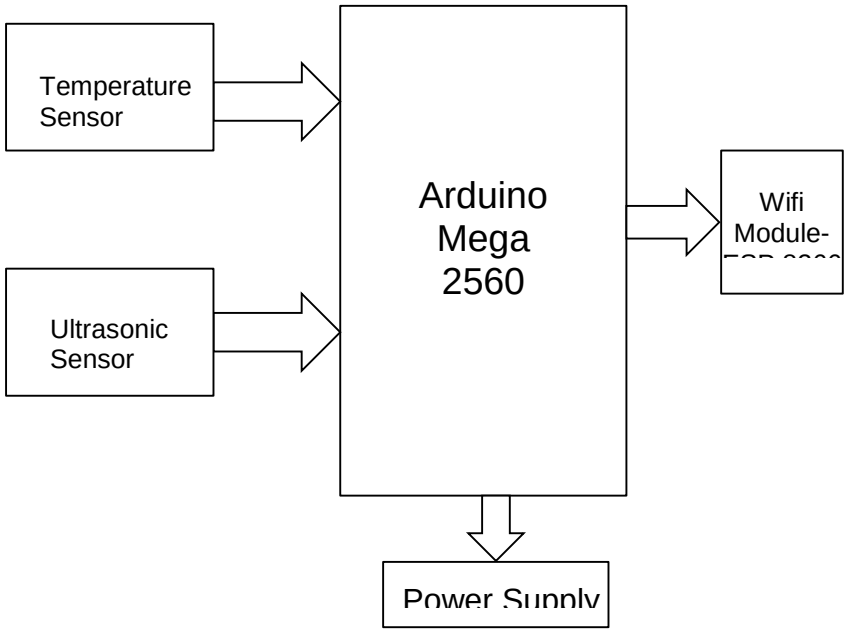


Fig5.1- Block Diagram

- Interfacing Arduino With Wifi Module

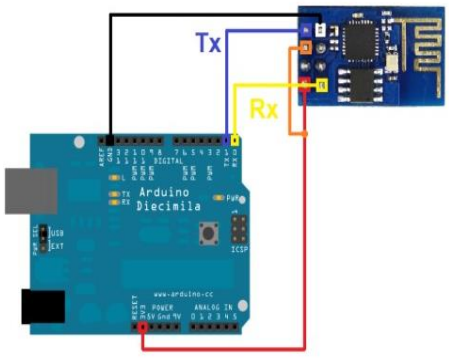
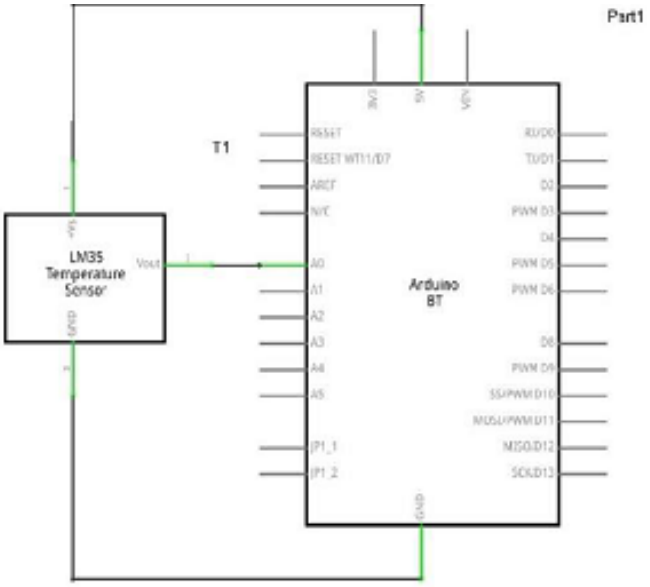


Fig5.2

ESP8266:_____ Arduino MEGA:

- GND ---------- GND
- GP2 ---------- Not connected
- GP0 ---------- Not connected
- RXD ---------- TX
- TXD ---------- RX
- CHPD ---------- 3.3V
- RST ---------- Not connect
- VCC ---------- 3.3V

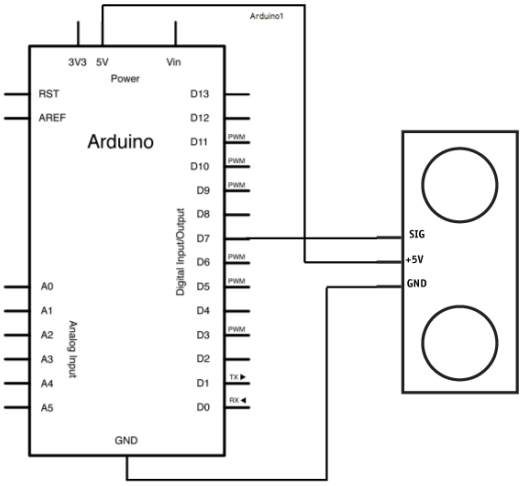
- Interfacing Arduino With Waterproof Temperature Sensor



Pin 1 receives positive DC voltage in order for the IC to work. This, again, is voltage between 2.7-5.5V. Pin 3 is the ground, so it receives the ground or negative terminal of the DC power supply. And Pin 2 is the output of the IC, outputting an analog voltage in proportion to the temperature it measures.

Fig5.3

- Interfacing arduino with ultrasonic sensor



The 5V pin of the SEN136B5B is connected to the 5V pin on the board, the GND pin is connected to the GND pin, and the SIG (signal) pin is connected to digital pin 7 on the board.

Fig5.4

- Project representation

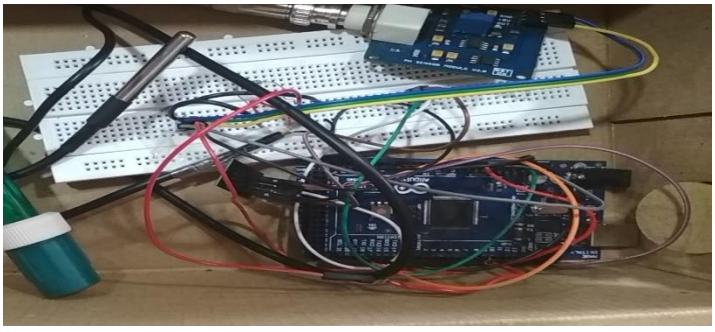


Fig5.5

Chapter 6

Testing&Debugging

Testing esp8266 with Andruino IDE

Connection: Rx-Rx, Tx-Tx, RST-3.3V, GPIO0 & GPIO2 floating.

1. Connect and power up your Arduino board & ESP8266
2. Make sure you Arduino board isn't loaded with other programs. Either reset your Arduino baord, or upload a BareMinimum example program to it
3. Open up Arduino IDE, select Tools > Port > YourConnectedPort
4. Open up Serial Monitor, and listen to baudrate 115200. You may see some messages bump up; those should be from ESP8266. Recognize the ready message at the end. See image in step 7
    - *Try other baudrates if you are seeing random symbols, or seeing nothing*
5. Select Both NL & CR option - it adds \r\n after your input line. Necessary for sending a valid AT command
6. Input AT in your input box and press enter. You should see the response OK from ESP8266

Debugging:

1. Errors: espcomm_open failed

Possible causes: faulty circuit connections, GNDs are not connected.

After inspection it was found that the GND was not connected properly.

2. Temperature sensor was getting overheated

Possible causes: Shorting, Excess voltage supplied.

After inspection, it was realized that the resistor of 3.7kohm was faulty. It was replaced with a new one.

Chapter 7

Results

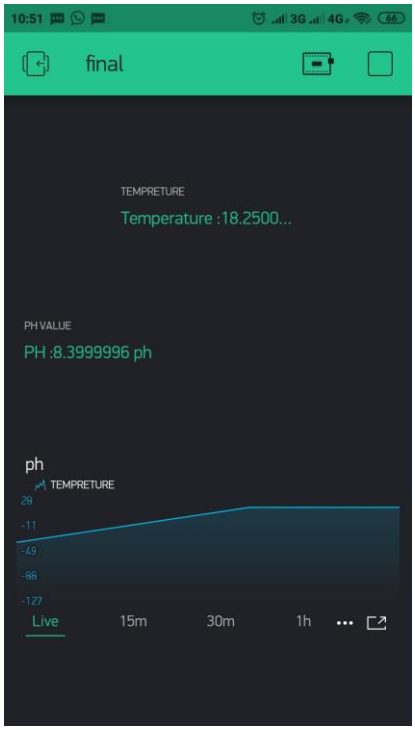


Fig7.1

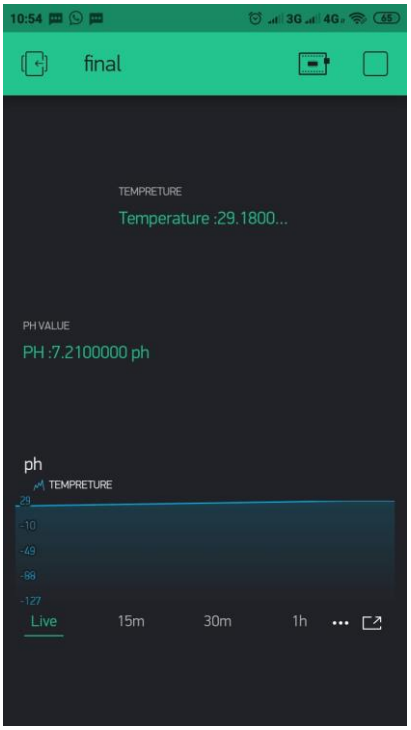


Fig7.2

The system can monitor water automatically, and it is low in cost and does not require people on duty. This system is used to avoid the huge amount of water is being wasted by uncontrolled use of home/offices etc. So the water quality testing is likely to be more economical, convenient and fast. This designed smart water system can be easily applied to home, offices, and schools and at any places where water tanks are used. By placing this system in a smart building, we will be able to collect and analyze the water usage patterns of the residents and save a lot of water from wastage. This is the small contribution from our side to save and supply good quality of water.

Chapter 8

Futurework

In this paper, a prototype water monitoring system using IoT is presented.For this some sensors are used. The collected data from all the sensors are used for analysis purpose for better solution of water problems. The data is sends to the cloud server via Wi-Fi module ESP8266. So this application will be the best challenger in real time monitoring & control system and use to solve all the water related problems.

- In future we use IOT concept in this project
- Detecting more parameters for most secure purpose
- Increase the parameters by addition of multiple sensors
- By interfacing relay we control the supply of water

Chapter 9

Reference

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Appendix

Code

```
#define BLYNK_PRINT Serial

#include <ESP8266_Lib.h>

#include <BlynkSimpleShieldEsp8266.h>

#include <OneWire.h>

#include <DallasTemperature.h>

#define ONE_WIRE_BUS 8

#define trigpin 7

#define echopin 6

#define SensorPin 0          // the pH meter Analog output is connected with the Arduino’s Analog

unsigned long int avgValue;  //Store the average value of the sensor feedback

float b;

int buf[10],temp;

// You should get Auth Token in the Blynk App.

// Go to the Project Settings (nut icon).

char auth[] = "FTxFc7wOgM_PPzvgN71cOu6DC4ucidZf";

// Your WiFi credentials.

// Set password to "" for open networks.

char ssid[] = "redm";

char pass[] = "";

// Hardware Serial on Mega, Leonardo, Micro...

#define EspSerial Serial1

// or Software Serial on Uno, Nano...

//#include <SoftwareSerial.h>

//SoftwareSerial EspSerial(2, 3); // RX, TX

// Your ESP8266 baud rate:
```

```
#define ESP8266_BAUD 115200
OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);
float Celsius = 0;
float Fahrenheit = 0;
ESP8266 wifi(&EspSerial);
void setup()
{
  // Debug console
  Serial.begin(9600);
 pinMode(13,OUTPUT);
  // Set ESP8266 baud rate
  EspSerial.begin(ESP8266_BAUD);
  delay(10);
  Blynk.begin(auth, wifi, ssid, pass);
  // You can also specify server:

//Blynk.begin(auth, wifi, ssid, pass, "blynk-cloud.com", 80);
//Blynk.begin(auth, wifi, ssid, pass, IPAddress(192,168,1,100), 8080);
sensors.begin();
}
void loop()
{
  Blynk.run();
  // You can inject your own code or combine it with other sketches.
  // Check other examples on how to communicate with Blynk. Remember  to avoid delay() function!
```

```
int duration, distance;
digitalWrite(trigpin, HIGH);
delayMicroseconds(1000);
digitalWrite(trigpin, LOW);
duration = pulseIn(echopin,HIGH);
distance = ( duration / 2) / 29.1;
Serial.println("cm:");
Serial.println(distance);
sensors.requestTemperatures();
Celsius = sensors.getTempCByIndex(0);
for(int i=0;i<10;i++)       //Get 10 sample value from the sensor for smooth the value
  {
    buf[i]=analogRead(SensorPin);
    delay(10);
  }
for(int i=0;i<9;i++)        //sort the analog from small to large
  {
    for(int j=i+1;j<10;j++)
    {
      if(buf[i]>buf[j])
      {
        temp=buf[i];
        buf[i]=buf[j];
        buf[j]=temp;
      }
    }
  }
```

```
  avgValue=0;
  for(int i=2;i<8;i++)                    //take the average value of 6 center sample
    avgValue+=buf[i];
float phValue=(float)avgValue*5.0/1024/6; //convert the analog into millivolt
  phValue=3.5*phValue;
// sensorData = analogRead(A0); //reading the sensor on A0
 Blynk.virtualWrite(V5, Celsius); //sending to Blynk
Blynk.virtualWrite(V6,  phValue); //sending to}
```