

Design and Implementation of Arduino Based Air Quality Measurement Meter with Digital Dashboard on Smartphone Using Blynk

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Abstract - Air pollution is one such form that refers to the contamination of the air. Due to our unawareness, air is being polluted in many ways. Nowadays air pollution has turned out to be one of the significant issues because of increment in the quantity of Mills, factories, and Vehicles. Mills and factories make air seriously polluted by emitting smoke and poisonous gases. Vehicle burns petrol and diesel. As a result, smoke and fume are produced and they are seriously causing air pollution. Internet of things (IoT) based pollution system is used to detect the current level of hazardous gases in the atmosphere. The IoT based pollution system will help us to fetch the data from any location where the device is installed. All the data we can able to see in the smartphone app. In this project, we have used the Blynk app.

Keywords: Internet of Things (IoT), Gas Sensor, Humidity sensor, PM2.5/PM10 sensor (SDSO11), Arduino Uno, Blynk Software.

1. Introduction

Air is a life giving force. Both, animals and plants inhale oxygen or carbon-dioxide from the air. So if the air is polluted, naturally it makes a great threat to all. That's why air is an important element of our environment. But air is being polluted so severely that this problem has become a global concern at present. One of the main reasons for global warming is carbon dioxide emission into the atmosphere. There are several traditional methods espoused for monitoring the emissions^[1]. Air pollution has turned out to be one of the major issues. It causes such a large number of unfavorable impacts on human wellbeing, atmosphere, and biological community. This paper gives an approach to financially savvy estimation of important natural parameters, in view of sensor exhibit^[2]. Air pollution may causes harm to other living organisms such as animals and food crops and may damage the natural environment. Human activity and natural processes can both generate air pollution. Air is polluted in many ways. But air pollution is more acute in urban areas because vehicles and mills and factories here emit carbon monoxide gases and smokes that pollute our city air seriously. Besides, burning of trash and indiscriminate discharge of human waste in the open air is also the cause of serious air pollution. Harmful gases like nitrogen oxides and sulphur oxides are released into the atmosphere during the burning of fossil fuels. When it

rains, the water droplets combine with these air pollutants becomes acidic and then falls on the ground in the form of acid rain. Acid rain cause great damage to human, animals and crops. Air pollution monitoring with ubiquitous sensor networks is proposed in^[3], where a wasp mote is connected with different gas sensor in a board and the acquired is published through Google maps.

IoT is the system of physical gadget, vehicles, home apparatuses, and different things implanted with hardware, programming, sensors and availability which empowers these articles to associate and trade information. This IoT pollution system is used to monitor air quality on the smartphone using Blynk application and Arduino board. Blynk is an IoT platform to control Arduino, Raspberry pi and the like over the internet. In this project Blynk provides a digital dashboard on the smartphone that displays real-time air quality readings for the immediate surroundings.

2. Hardware Part

2.1 Gas Sensor (MQ 135)

The MQ series of gas sensors utilizes a small heater inside with an electro chemical sensor these sensors are sensitive to a range of gasses are used at room temperature. The

MQ-135 gas sensor senses the gases like ammonia nitrogen, oxygen, alcohols, aromatic compounds, sulfide and smoke. The MQ-135 is used to measure air quality. Sensitive material of MQ135 gas sensor is SnO₂ which with lower conductivity in clean air. The MQ-3 gas sensor has a lower conductivity to clean the air as a gas sensing material. In the atmosphere we can find polluting gases, but the conductivity of gas sensor increase as the concentration of polluting gas increase. MQ-135 gas sensor can be implementation to detect the smoke, benzene, steam and other harmful gases^{[4][5]}.



Fig-1: Gas Sensor (MQ 135)

2.2 Humidity Sensor (DHT 11)

DHT11 Temperature and Humidity Sensor feature a temperature and humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature and humidity sensing technology, it ensure high reliability and excellent long-term stability .It can be used in any microcontroller like Arduino, Raspberry pi, etc. and get rapid result. The DHT11 humidity and temperature sensor consist of 3 main components. It's includes a resistive-type humidity measurement component and NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Humidity sensor has two electrodes with moisture holding substrate between them. As the humidity changes, the conductivity of the substrate changes or resistance between these electrodes changes. This change in resistance is measured and processed by the IC which makes it ready to be read by microcontroller. On the contrary, for measuring temperature these sensors use to NTC temperature sensor or a thermistor^[6].

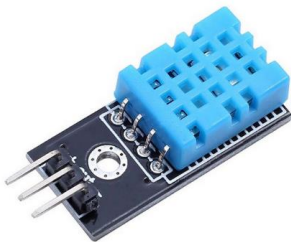


Fig-2: Humidity Sensor (DHT 11)

2.3 PM2.5/PM10 sensor (SDSO11)

The SDS 011 Sensor is a quite recent Air Quality Sensor developed by INOVAFIT, a spin-off from the University of Jinan. It uses the principle of laser scattering in the air, and can detect suspended particulate matter concentration ranging from 0.3 to 10 microns .Data collected by the sensor is stable and reliable.SDSO11 sensor is connected to UART port (TX and RX) of Arduino Uno board^[10].



Fig-3: PM2.5/PM10 sensor (SDSO11)

2.4 Arduino Uno

The Arduino UNO is an open source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Aruino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The Board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable^[7]. Here in more details about Arduino^{[8][9]}.



Fig-4: Arduino Uno

3. Circuit Diagram And Hardware Implementation

Circuit diagram of this project is shown in Fig.-5
 The Circuit Diagram

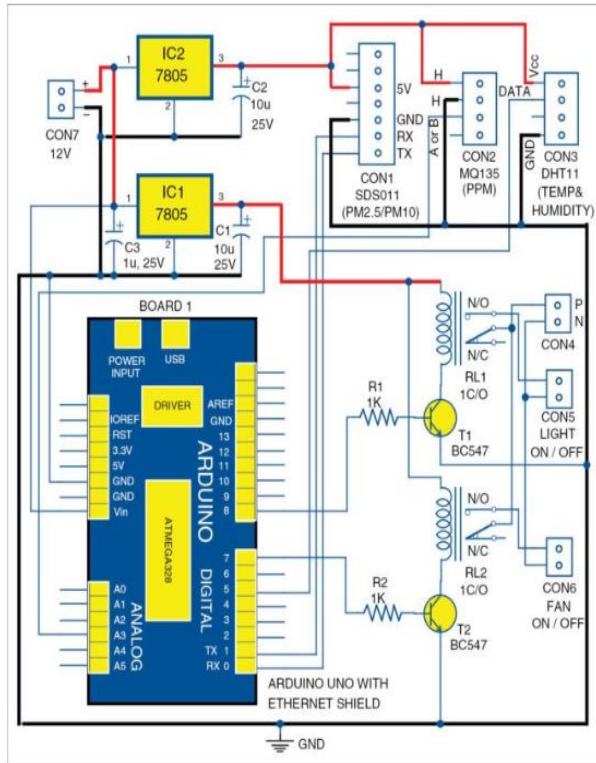


Fig-5: Circuit diagram of the IoT based air pollution monitoring system

At the Heart of the circuit is Arduino Uno board with Arduino shield. Other components use are voltage regulators 7805 (IC1 and IC2), temperature and humidity sensor connected to connector CON3, gas sensor MQ135 connected to connector CON2, PM2.5/PM10 (SDSO11) sensor connected to connector CON1. A 12V battery or supply is connected to connector CON7, which is regulated to 5v using 7805 regulators (IC1 and IC2). Here, IC1 and IC2 have been used for driving various parts of the circuit. Output of the gas sensor is connected to analog input pin A3 of Arduino Uno board through connector CON2, PM2.5/PM10 sensor (SDSO11) is connected to digital input pin (0,1) of Arduino Uno board through connector CON1, Humidity Sensor (DHT 11) is connected to digital input pin 5 of Arduino Uno board through connector CON2.

4. Software Part

4.1 Blynk

Blynk is a platform with iOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where we can build a graphic interface for ours project by simply dragging and dropping widgets. Blynk can control hardware remotely. It can display sensor

data, store and visualize it, among other cool things. Blynk server is responsible for all communication between the smartphone and hardware. We can use Blynk Cloud or run our private Blynk server locally. It is open source, and can handle thousands of devices. Blynk Libraries are available for all popular hardware platforms. The libraries help to communication with the server, and process all incoming and outgoing commands. When we press a button on Blynk app on the phone, the signal travels to the Blynk Cloud, where it finds its way to hardware. It works the same way in the opposite direction, and everything happens in a blink of an eye.

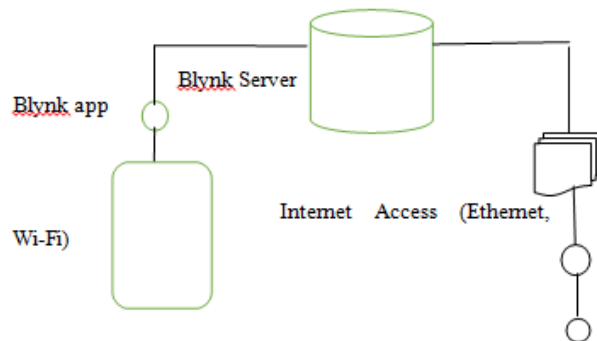


Fig-6: Blynk Software

4.2 Block diagram

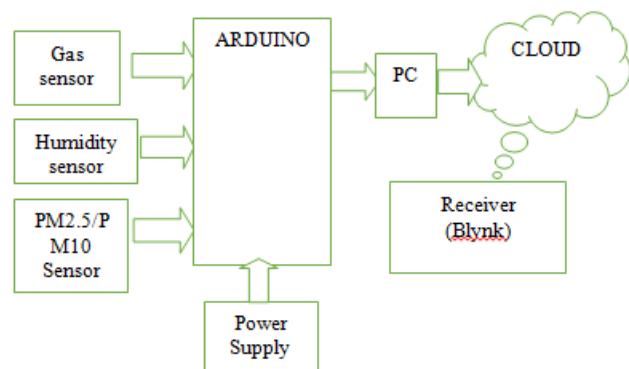


Fig-7: Block diagram of our project

5. Digital Dashboard Setup

Step1. Mount Ethernet shield on Arduino Uno and connect Board to PC using a USB cable.

Step2. Change the IP address in IP Address IP (your IP address) in Arduino sketch ethernetclient.ino.

Compile and upload the code into Arduino Uno from Arduino IDE. This code shows you how to make an HTTP request using an Ethernet shield. It returns a Google search for the word Arduino. Results of this search are viewable as HTML through Arduino's serial window.

Step3. Compile ethernetserver.ino sketch and upload it to Arduino Uno board. Change your IP address in IPAddress IP (your IP address) in the sketch. In this example, use your Ethernet shield and Arduino board to create a simple Web server. Using the Ethernet library, your device will be able to answer an HTTP request with the Ethernet shield.

After navigating to the Ethernet shield’s IP address, Arduino will respond through HTML browser and will be ready to accept input values from analogue pins (A0 through A5) of Board1.

Step4. Connect your mobile with Wi-Fi. Download and install Blynk app from Google Play store. Then, create a new Blynk account (Fig-8). This account is separate from the accounts used for Blynk Forums, in case you already have one.

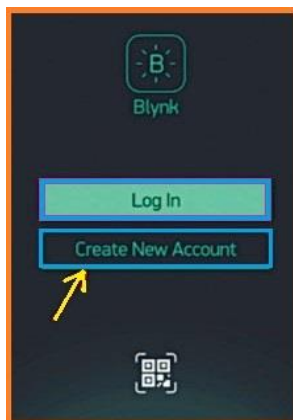


Fig-8 Log in System

An account is needed to save your projects and have access to these from multiple devices anywhere in the world. It is also a security measure. We recommend using a real email address because it will simplify things later.

Step5. After you have successfully logged into your account, start by creating a new project (Fig-9), and give it a name.

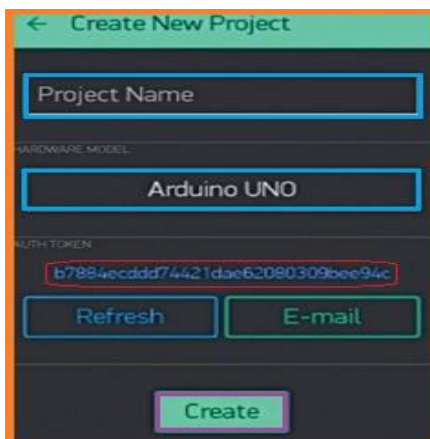


Fig-9 Creating New Project

Step6. Select the hardware model you intend to use. In this case it is Arduino Uno (Fig-10).



Fig-10 Selecting Arduino

Step7. Authorisation (or Auth) token is a unique identifier that is needed to connect the hardware to your smartphone. Every new project you create will have its own Auth token (Fig-11). Click email button and the token will be sent to the email address you used for registration. Use this token in auth[] = “your token” in pollution.ino file.

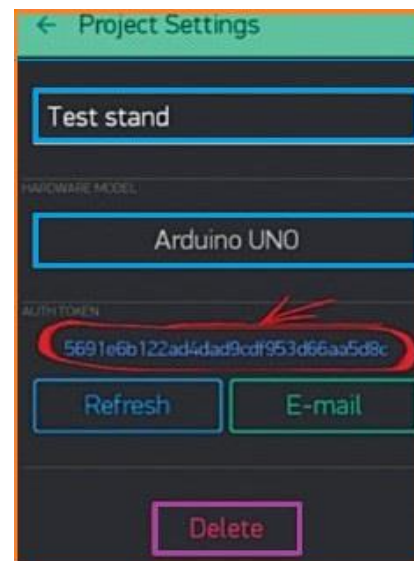


Fig-11 Auth token

Step8. Press Create (Fig-12).

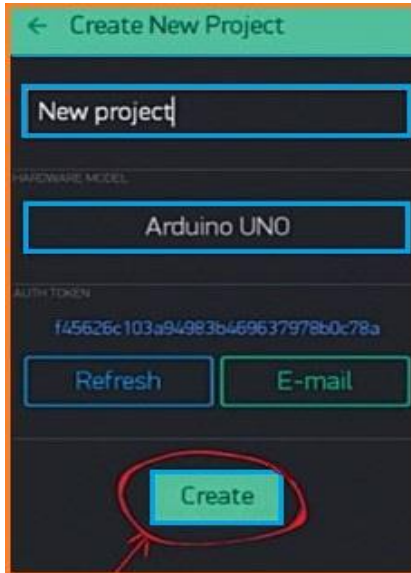


Fig-12 Final stage of creating new project

Step9. Your project canvas is empty at the moment. Tap anywhere on the canvas to open the widget box; all available widgets are located here. Add widgets (Fig-13).



Fig-13 Widgets Box

Add the following widgets in the settings and make the screen look like a digital dashboard as shown in Fig-14 .This includes adding the LCD, LED, on/off switch, pushbuttons and RTC widgets.

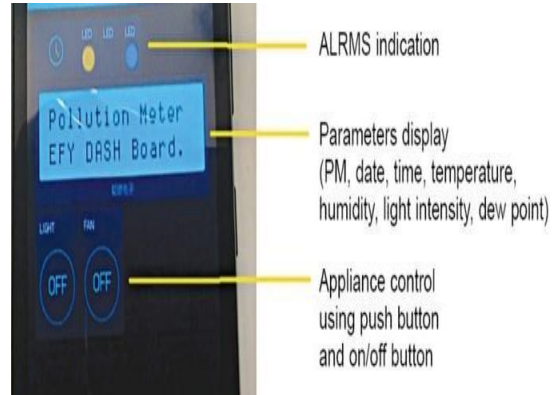


Fig-14 Adding Widgets

Final Execution

Run the project. When you are done with the settings, press Play (Fig-16). This will switch the display from edit to play mode where you can interact with the hardware. While in play mode, you will not be able to drag or set up new widgets. Press Stop and get back to edit mode. In play mode, you will find the screen shown in figure.

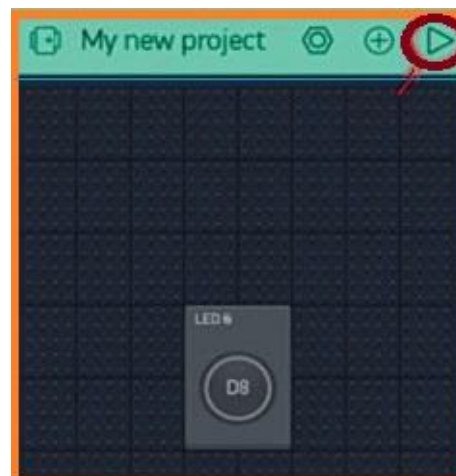




Fig-16 Running the Project

6. Conclusion

The proposed IoT based air quality measurement system is a good device to measure the air quality in outdoors and indoors. This device can be useful to measure the level of gases in a highly dense area like markets, bus stand, railway station etc. from the remote-control room. If data is stored, we can use the data for further experiments which can conclude a significant result. This system is IoT based so it can be used in the smart home for the purpose of cooling, ventilation and other purposes. IoT will enhance the artificial intelligence in the world, so the system can be used in automated systems in factories and industries. The system to monitor the air of environment using Arduino microcontroller, IoT Technology is proposed to improve quality of air. With the use of IoT technology enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed. Here using of MQ135 gas sensor gives the sense of different type of dangerous gas and Arduino is the heart of this project which controls the entire process. Wi-Fi module connects the whole process to internet and LCD is used for the visual Output.

Acknowledgement

Firstly, we are all the members of this project thankful to each other for their co-operation to the success of this project. Around six months ago we had done a class project with the same members. Then we started to discuss to do something for our publication and we decided to implement this project of air quality measurement meter. At the beginning, it was too challenging for us to find out

the starting point of this project however we were able to overcome this by the help of our one of the eldest brothers Md Nasir Uddin who has done some others projects related to IoT. After getting that point of view, we began the project. We divided our works into different parts. It's true that we faced a lot of difficulties and discussed with the team members on a fixed date and solve that. Though it was the first time we have done such work however it was an excellent experience for all of us and we are really delighted to complete this project as our demands eventually outweigh any negative aspects.

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