GUJARAT TECHNOLOGIAL UNIVERSITY
(GTU)

AHEMADABAD- 382424

Vishwakarma Government Engineering College, Chandkheda-382424
(Affiliated with Gujarat Technological University, Ahmedabad)

A
Project report
On

IOT BASED AIR POLLUTION MONITORING SYSTEM

Prepared as a part of the requirement for the subject of
B.E- Semester- VI
(Electronics and Communication Branch)

Submitted by:

Sr. No.	Name	Enrollment No.
1	PANCHAL BHAVIN B	190170111070

Guided by:
Prof. N. P PATEL
Assistant Professor, Electronics & Comm. Engineering, VGEC, Chandkheda

Head of department:

Prof. A.B. Nandurbarkar
Head of the Electronics and Communication Engineering, VGEC, Chandkheda

Academic Year 2022-23

GUJARAT TECHNOLOGICAL UNIVERSITY

CERTIFICATE FOR COMPLETION OF ALL ACTIVITIES AT ONLINE DESIGN PORTAL

SUBJECT : DE2B-2160001

B.E. SEMESTER VI, ACADEMIC YEAR 2022-2023

Date of certificate generation : 29 April 2022 (13:26:38)

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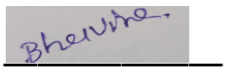
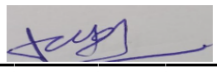
AEIOU & Mind Map Canvas	**Completed**
Empathy Canvas	**Completed**
Ideation Canvas	**Completed**
Product Development Canvas	**Completed**
Prototype	**Completed**
Report	**Completed**

Name of Student : PANCHAL BHAVIN BHARATBHAI

Name of Guide : Mr.PATEL NARESHKUMAR PRAGJIBHAI

Signature of Student : 

*Signature of Guide : 

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ACKNOWLEDGEMENT

With great pleasure, I take this opportunity to express my deep sense of gratitude and indebtedness to my renowned and esteemed guide **Prof. N. P PATEL** Assistant Professor, Department of Electronics And Communication Engineering, Vishwakarma Government Engineering College, Chandkheda for his consummate knowledge, due criticism, invaluable guidance and encouragement which has enabled us to give present shape to this work.

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Finally, I would like to thank our friends and family for their support and patience throughout the year, especially to our parents who without their encouragement and financial support, this would not have been possible.

CONTENTS

1. Introduction

In this era of modernization, technologies are advancing rapidly. Every day we realize some mew technology coming in market to simplify our lives more than ever. Back in time checking the pollution in a particular area was a very tedious task which was not very efficient also.

With the increasing pollution and advancing technology various new methods were introduced to keep an eye on the rapid increase in pollution
More efficiency. Internet of things is one of the latest works that has been done in this path. The increment in use of internet and the interaction of human with machine gave rise to IOT.

It allows exchange of information among various devices like fridge, washing machine, automobile, watches etc. This exchange of information takes place with the help numerous sensors. The account for the success of IOT is its efficiency and makes it a feasible technology at low cost. Air pollution are two main constituents that have the most adverse effect on humans as well as the entire earth. Therefore it is very important to check and control it. traditional methods involves manual work in which data loggers used to visit the site to collect the data , analyze it and perform comparisons to provide the output which was very lengthy and time consuming besides being inefficient .

The pollution monitoring system involves use of sensors (MQ135) which measures the Air pollution concentration and level of harmful gases like benzene, alcohol, smoke, steam, stream which mainly pollutes the air. Comparisons are done automatically using previously stored data in database and output is stored on cloud to make it accessible from remote area. This paper involves description of the system that presents its output to the server thingspeak.com which the user can access it whenever it wherever they want. It can be used for notifying the authorities.

2 CANVASES:

2.1 AEIOU SUMMARY:

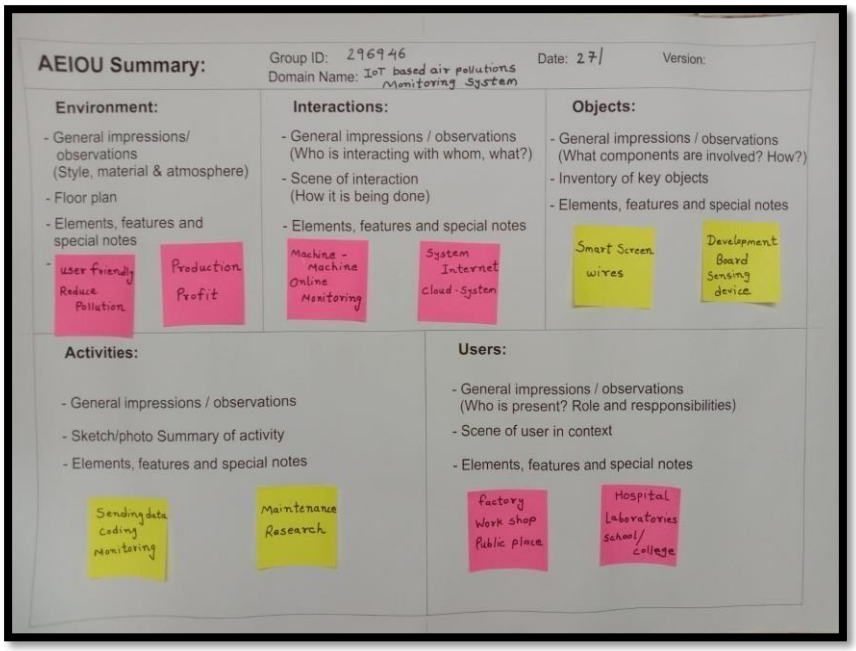
1. ACTIVITY: This section will include the applications of the product such as the sending data, monitoring, maintenance, research, assemble of equipment, measuring data,etc.

2. ENVIRONMENT: This will include the effect of the objects placed in its surroundingssuch as: Vast Area, industry area, production , profit , user friendly

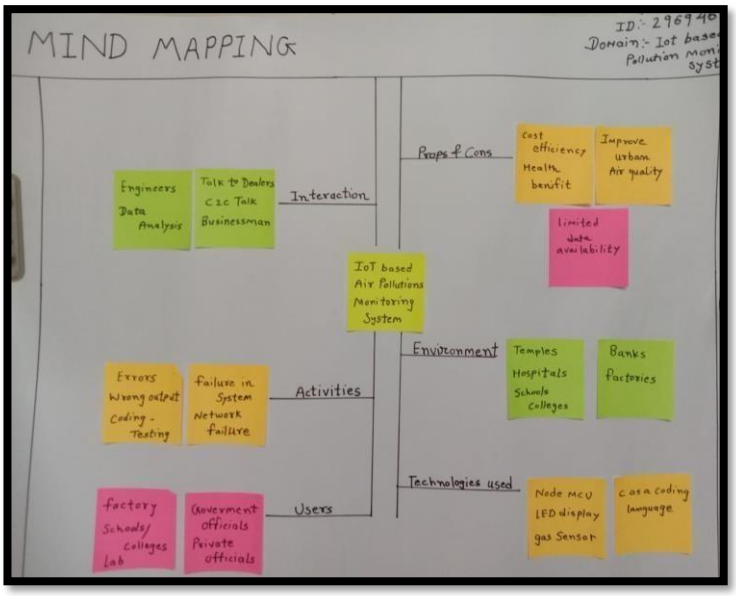
3. INTERACTION: This will include the Stakeholders such as Industries, Power Plants,Schools, Colleges, Farms, etc.

4. OBJECTS: This section of the canvas includes the equipment used for the production such as Arduino , gas sensor, node mcu , lcd ,batteries, etc

5. USERS: As usual it will include the people who are associated with the product like Engineers, Students, Farmers, Domestic Users, and Public Sectors.



2.2 MIND MAPPING:

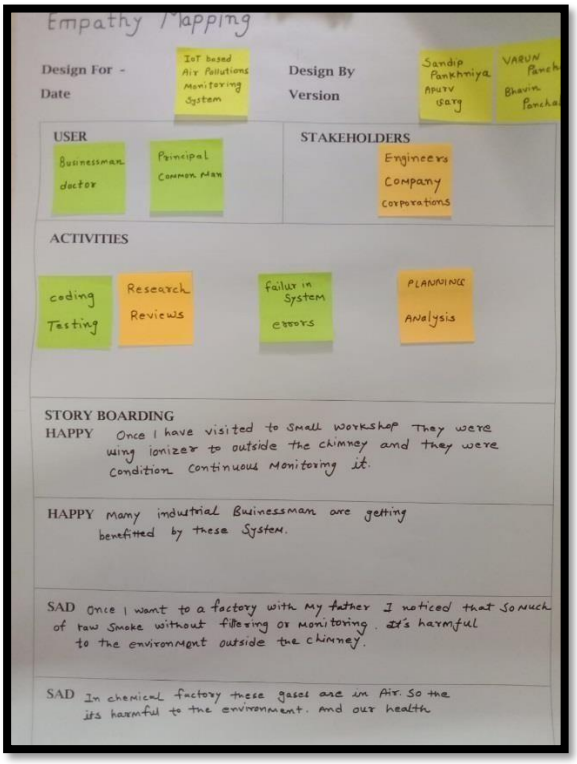


2.3 EMPATHY CANVAS:

This is the first step of the project or a problem. In this canvas, we will find out what is user? Who is a User? What is Stakeholder? Who are they? And what are the broad stories of their activities?

1. **User:**
   - In this stage, we find various users who are directly or indirectly related to our product
   - For Example: Engineers, Students, Professionals, Common People, etc.
2. **Stakeholders:**
   - Stakeholders are people or an organization with an interest.
   - In this stage, we find those users which are directly or indirectly related to the users.
   - For Example: Industries, Power Plants, Colleges, Residences, etc.
3. **Activities:**
   - Activities are directly or indirectly related to the stakeholders.
   - For Example coding, testing, research, error correction and detection , analysis etc.
4. **Story Boarding:**
   - **Happy:** once I have visited to small workshop they were using ionizer to outside the chimney and were condition continuous monitoring it.

- **Sad:** once I want to a factory with my father I noticed that so much of raw smoke without filtering or monitoring .its harmful to the environment outside the chimney.



2.4 Ideation canvas

This canvas consists of the ideology behind the user, so in this canvas some brief ideas are expressed. People section consists of persons related to user technically and similar persons may relate to user. Then we divided activities in social & technical and try to find out the importance of each activity and situations & location regarding are find out related to each.

PEOPLE:

- Engineers
- Students
- Society
- Transportation user
- Domestic Users

ACTIVITIES:

- Measuring gases in air
- Display interfacing
- Output on server

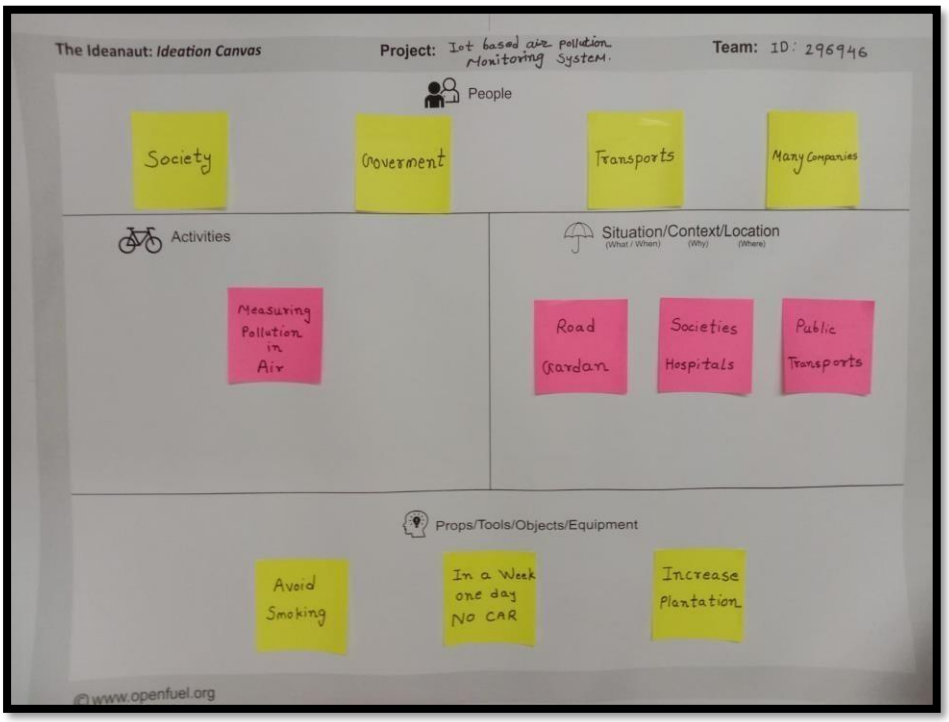
LOCATION:

- Industries

- Power Plants
- Colleges
- Public Sector
- Residential Areas
- Hospitals

PROPS:

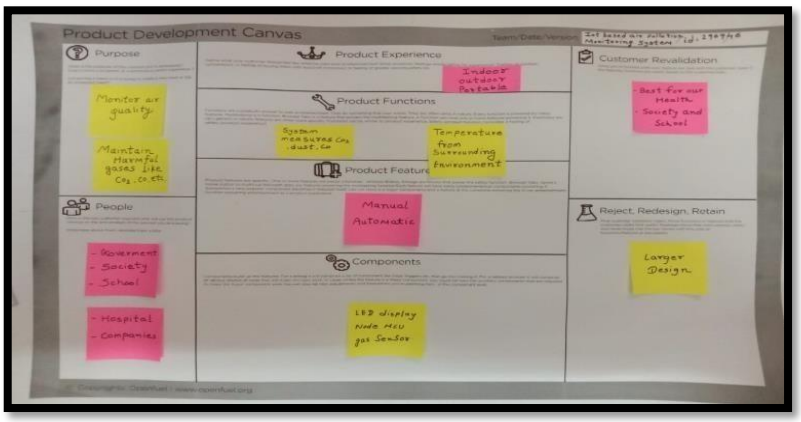
- Avoid smoking
- In a week one day no car
- Increase plantation



2.5 product development canvas:

PURPOSE:

The most important and the most needed purpose of such products using air pollution monitoring system is **TO MAINTAIN HARMFUL GASES**



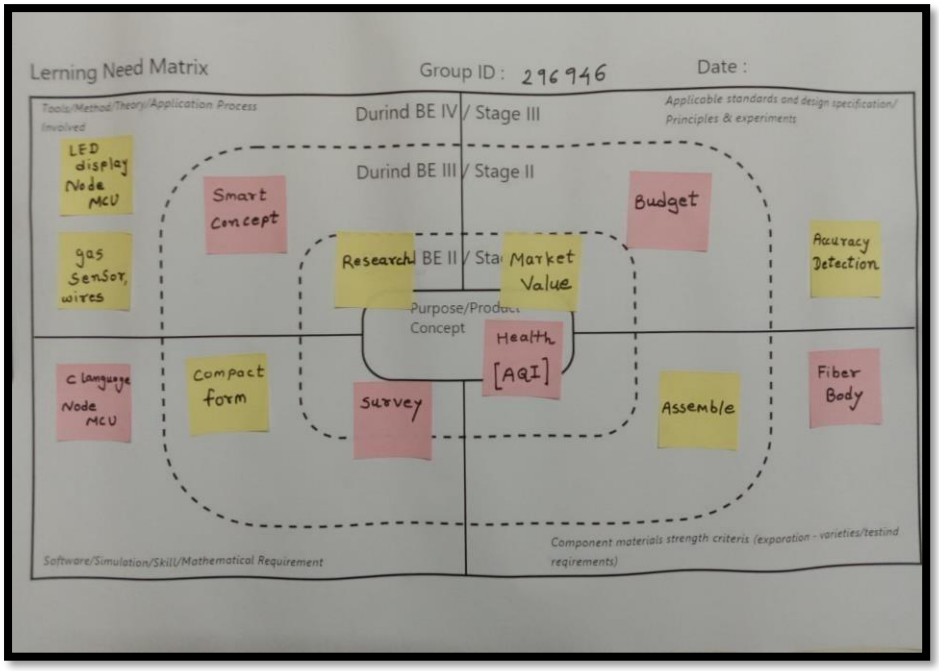
PEOPLE:

The most basic users of such kind of products are Engineers, bussiman,doctors.

PRODUCT FUNCTIONS:

- The three most important and basic functions of these products are:
    1. Measuring gases
    2. Detect harmful gases

2.6 LEARNING NEED MATRIX



3. Literature Survey

The motive of thinking a smart city can be fulfilled by using technology, thus making the life better and also enhancing the quality of services, therefore meeting every individual's needs.

With modern technology in fields of information and communication, it has become easy to interact with the authorized people of city to tell them where about of area or city, how well city is developing and how to make it possible to achieve a better life quality.

In this system, an application was created to make one more step in the fulfilment of the goal. An area is analyzed for evaluating how much pollution is affecting the area. The components of gases and their amounts are calculated and checked.

If the amount is higher than the officials are reported about it. After that the people are made to clear the area and taken to a safe place. The combined network architecture and the interconnecting mechanisms for the accurate estimation of parameters by sensors are being explained and delivery of data through internet is presented.

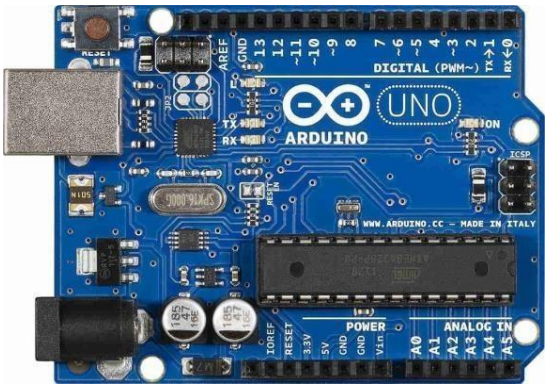
Some of the research work made for monitoring the pollution parameters in a particular location in order to make the environment safe and that area smart. Different methods were used in the past and are described in this section.

First is smart environment monitoring using wireless sensor networks in which the main focus was on th developing an environment free of pollution by making it smart. Wireless sensors are fitted all over the city and in public transports.

By monitoring all the sensor networks, all the environment happenings can be gathered as a streaming database to analyze the environment position.

3.1 Explanation of blocks:

1) Arduino UNO as microcontroller: Arduino Uno is a microcontroller board based on the ATmega328P. it has 14 digital input/output pins 6 analog inputs, a 16 MHZ quartz crystal, a USB connection ,power jack, an ICSP header and a reset button as shown in figure :



Arduino UNO:

Microcontroller	Atmega 328p-8bit AVR family
Operating voltage	5V
Recommended input vol.	7-12V
Input voltage limits	6-20V
Analog input pins	6(A0-A5)
Digital i/o pins	14
Dc current on i/o pins	40mA
Dc current on 3.3v pin	50mA
Flash memory	32KB
SRAM	2KB
EEPROM	1KB
Frequency (clock speed)	16 MHZ

2)Node mcu: NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module.

3 Node mcu

- Microcontroller: Ten silica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz

3) MQ135 sensor as gas sensor: The MQ135 sensor can sense NH3, NOx , Alcohol, Benzene, smoke ,CO2 and some other gases. It gives the output in form of voltage levels. Figure shows the sensor MQ135.

MQ135 Gas sensor:

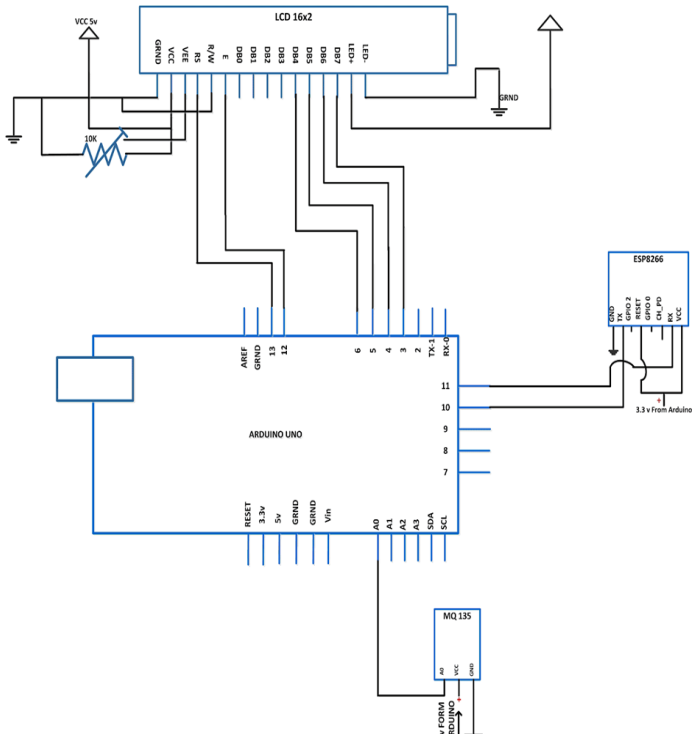
- Wide detecting scope
- Fast response and high sensitivity
- Stable and long life
- operating voltage is +5V
- detect NH3, NOx, alcohol, Benzene, smoke, CO2
- Analog output voltage:0V to 5V
- digital output voltage :0V to 5V
- preheat duration 20 seconds
- can be used as a digital sensor
- the sensitivity of digital pin can be varied using the potentiometer

4) 16x2 LCD: as display this is basic (16x2) 16 character by 2 line display. Black text on green background. It is used to indicate the Air and humidity in PPM. Figure:

16x2 LCD

- operating voltage is 7.4V to 5.3V
- Current consumption is 1mA
- consists of two rows and each row can print 16 characters.
- each character is built by a 5x8 pixel box
- available in green and blue light
- it can also display any custom generated characters

3.2 Circuit diagram



Working Of Circuit:

First applying 5V to the Arduino board will start executing program uploaded on chip. As per program first it will be try connect to the router through Wi-Fi module it will search for SSID and password match entered in a program if SSID and password will match that will be connect else it will show Wi-Fi connect error.

Microcontroller LCD display will be show the welcome note and all that written in code, controller will read values coming from gas sensor and display on LCD, values coming from analog pin will display as fresh air or poor air. The range of fresh air is between 0 to 300 PPM above this value air will be considered as poor air.

Microcontroller will send the values on 16 seconds delay of each value to the Wi-Fi module which is connected to the internet through the router.

Now , Wi-Fi module will send data to the thingspeak server through a special key called API key which specifies our channel and field for plotting graph of our sensors values.

For that first Wi-Fi module will request to server for providing services. This will establish TCP connection on “api.thingspeak.com” at port no.80 through at commands.

After establishing TCP connection this start sending data through a data frame this frame contains start bit, stop bit, guard bit and tail bit .through at commands data will be sending to the server on desired API key. After every delay values will be updated through microcontroller.

Thingspeak is free server for storing data it provides collect data analyze data and act on data. Thingspeak will collect data on 16 seconds delay of each value which is default for this server for analyze the data and plotting graph.

This will collect our sensor data and analyze it for visualization on graph, after analyze data it will show the graph on your monitor.

Connection description:

LCD to Arduino:

GND	GND
VCC	GND COMMON
VEE	05 V
RS	12
R/W	5 V
ENABLE	12
DB4	5
DB5	4
DB6	3
DB7	2
LED+	GND
LED-	5 V

mq135 to Arduino:

VCC	Vin
GND	GND
AO	A0 common

Pot connection:

Output pin of pot must connect to 3rd pin (VEE) of LCD.

Other two remaining pins connect to 5v and ground.

Cost:

750/- Uno

200/- node mcu

150/- mq135 gas sensor

135/- display 16x2

65/- breadboard

100/- cable uno and jumper

Total cost is around 1400/-

4 Software development

Output of sensor mq 135 will be form of different voltage levels. This is sensation of alcohol, smoke, and benzene gases. Different voltage levels will convert further in digital from 0 to 1024 in microcontroller.

Controller will calculate the average value of gases. And it will represent it in form of PPM. This data is PPM is only the average value of alcohol, smoke and benzene. Now that data in PPM will go to the server through one desired special API key to that exact channel of us and from values of sensor graph will automatically plotted by thingspeak.

SERVER:

Here, for sending data of sensor on internet, we are using thingspeak server which can collect analyses data and can also act as per given conditions of different data values.

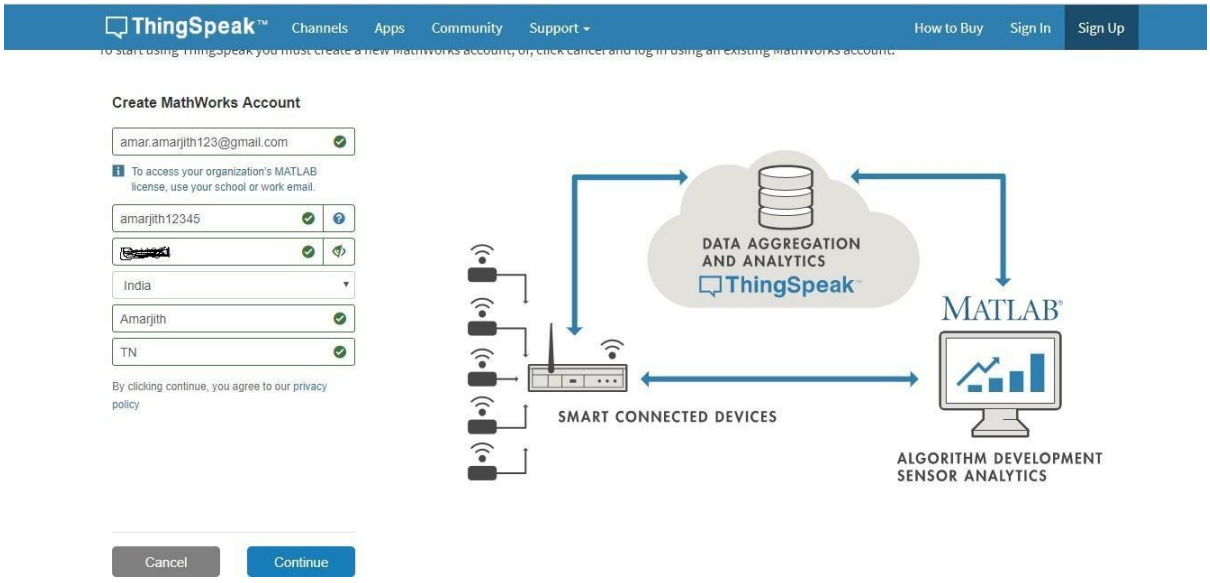
Thingspeak shows graph on their server of our channel, for that we have to sign up on thingspeak .com and have to create our channel .process in this figure

Step: 1 sign up things speak

https://thingspeak.com/users/sign_up

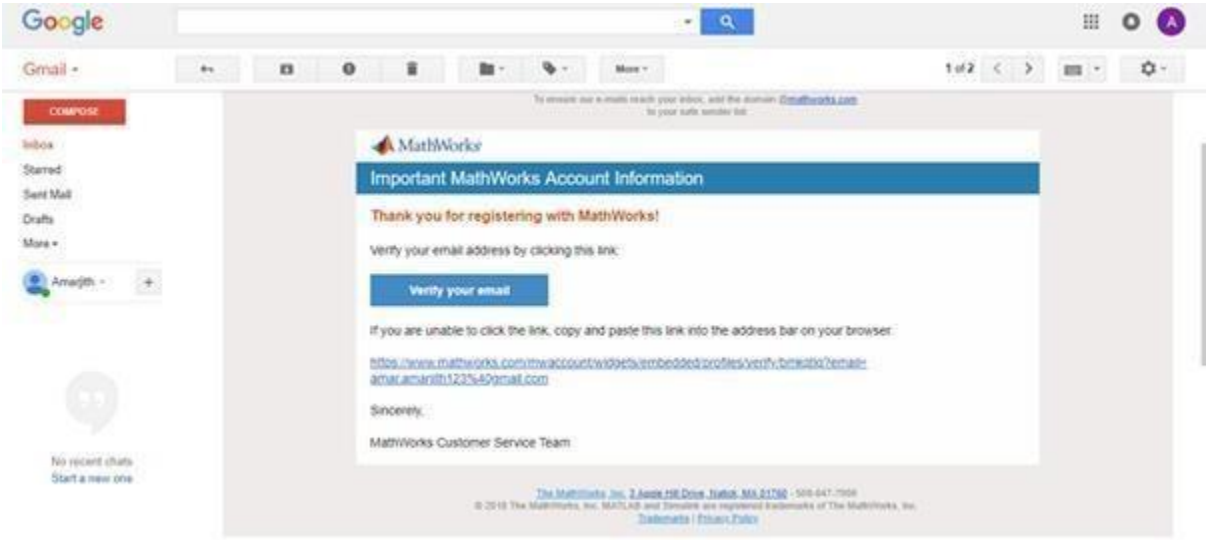
Step: 2

Fill out all fields



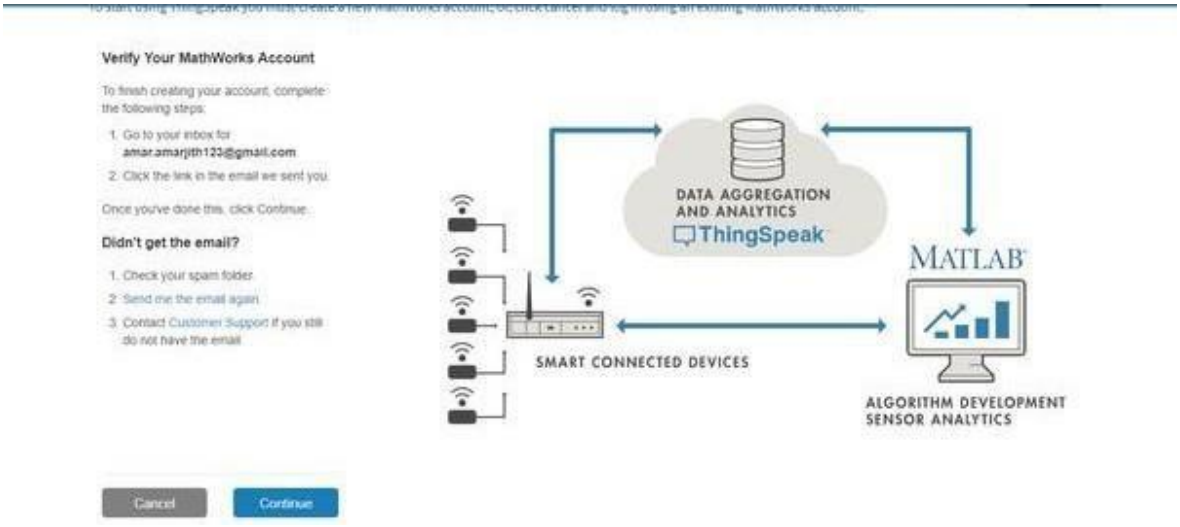
Step: 3

Verify email account



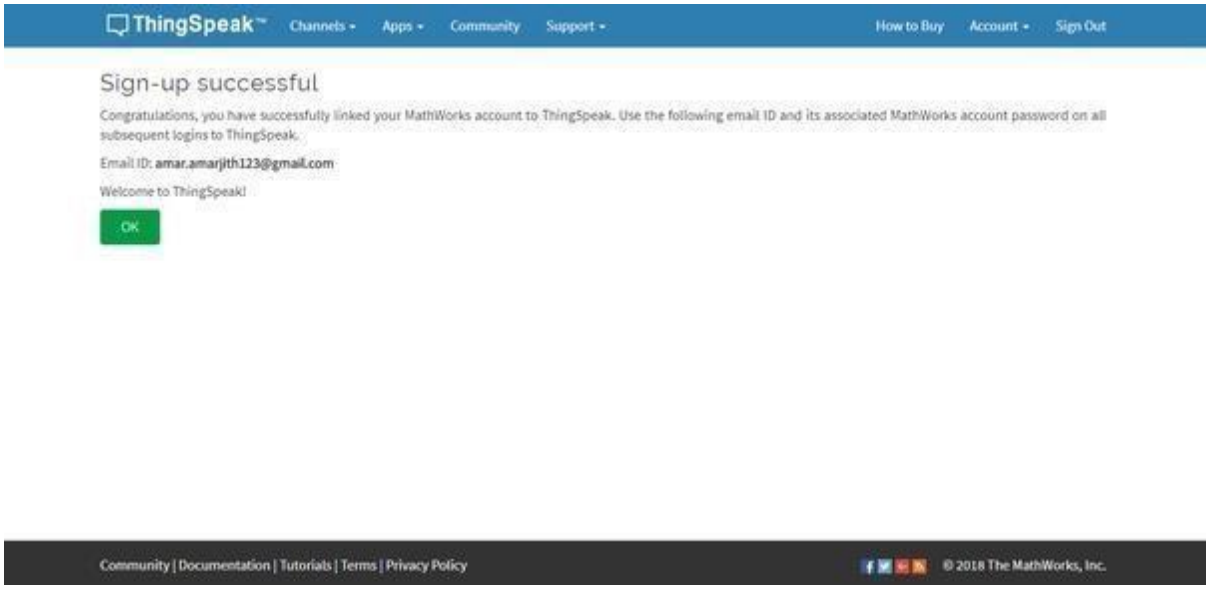
Step:4

After verification, click on continue



Step:5

OK

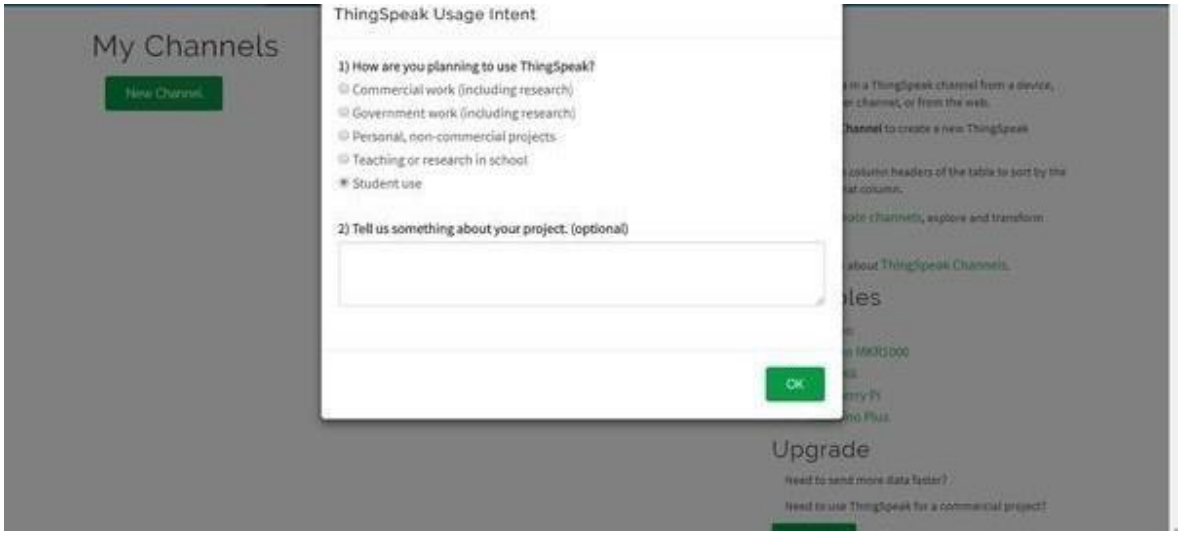


Step:6

Agree to terms

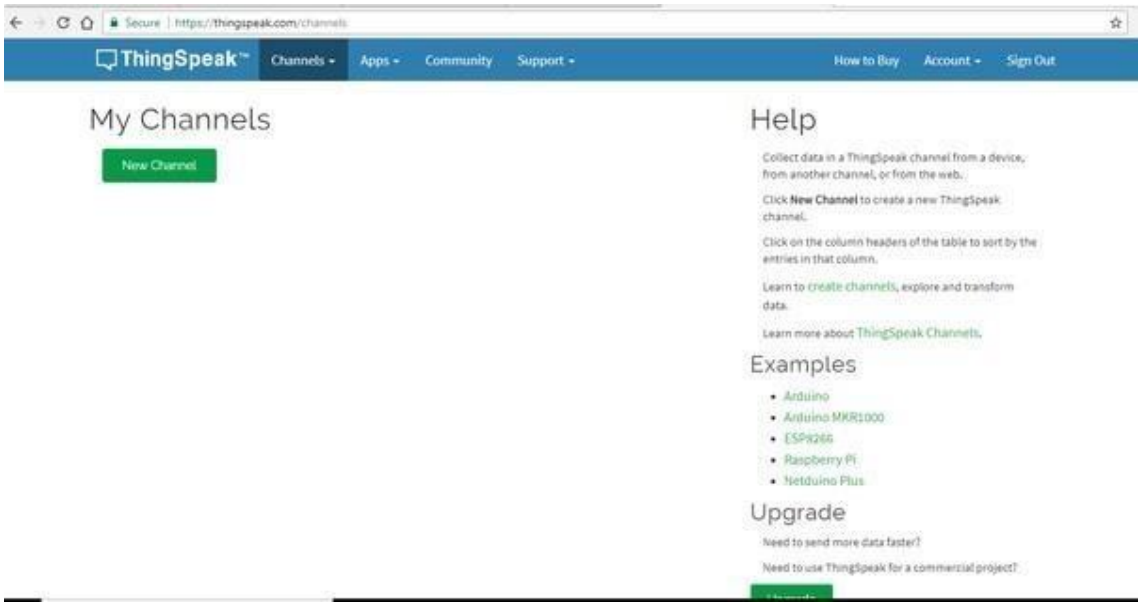
Step: 7

Select Student Use



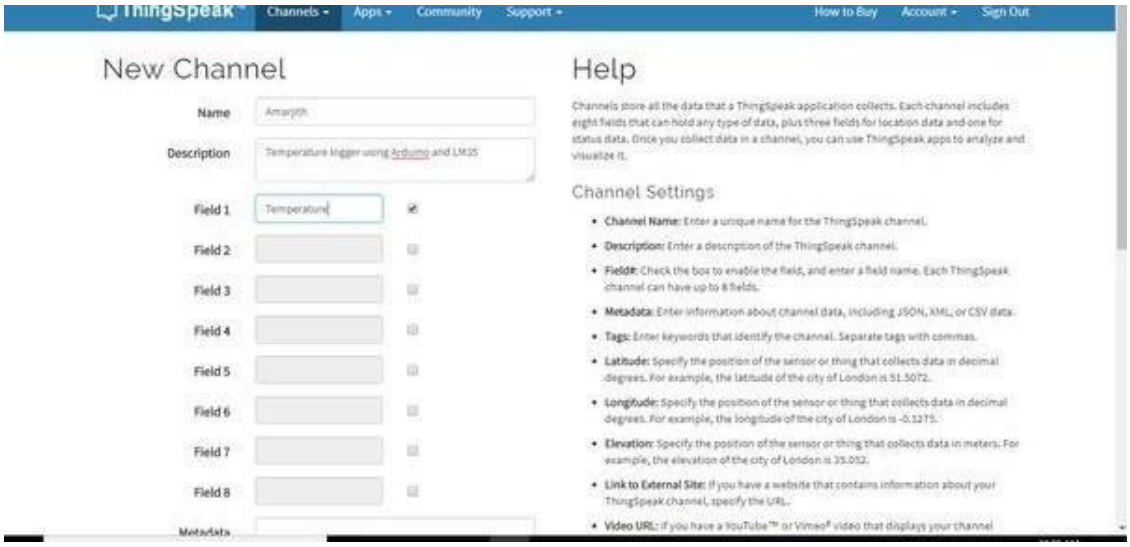
Step : 8

Wait for this window



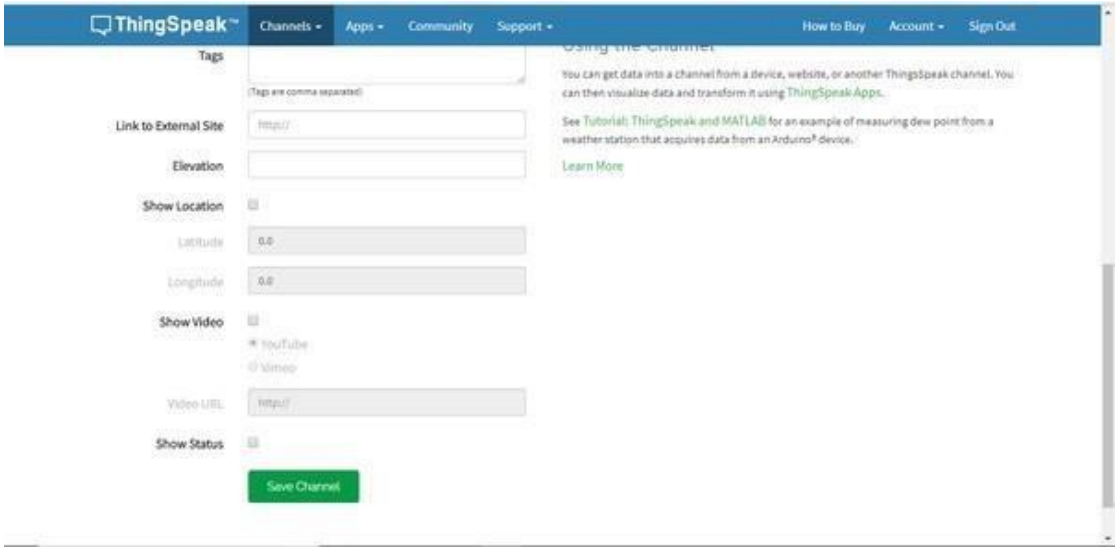
Step:9

Create new channel



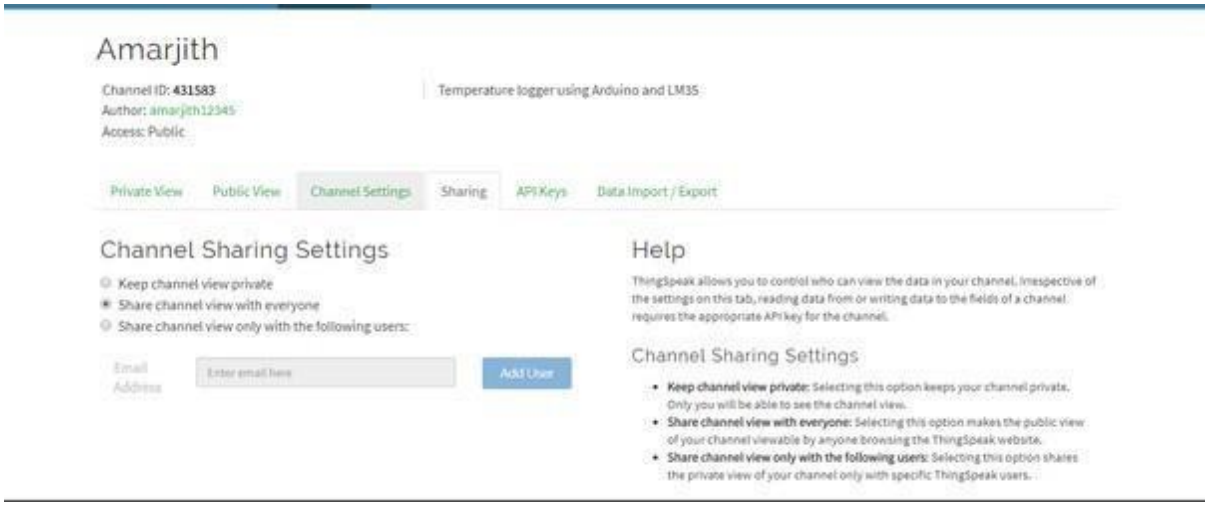
Step:10

Save channel



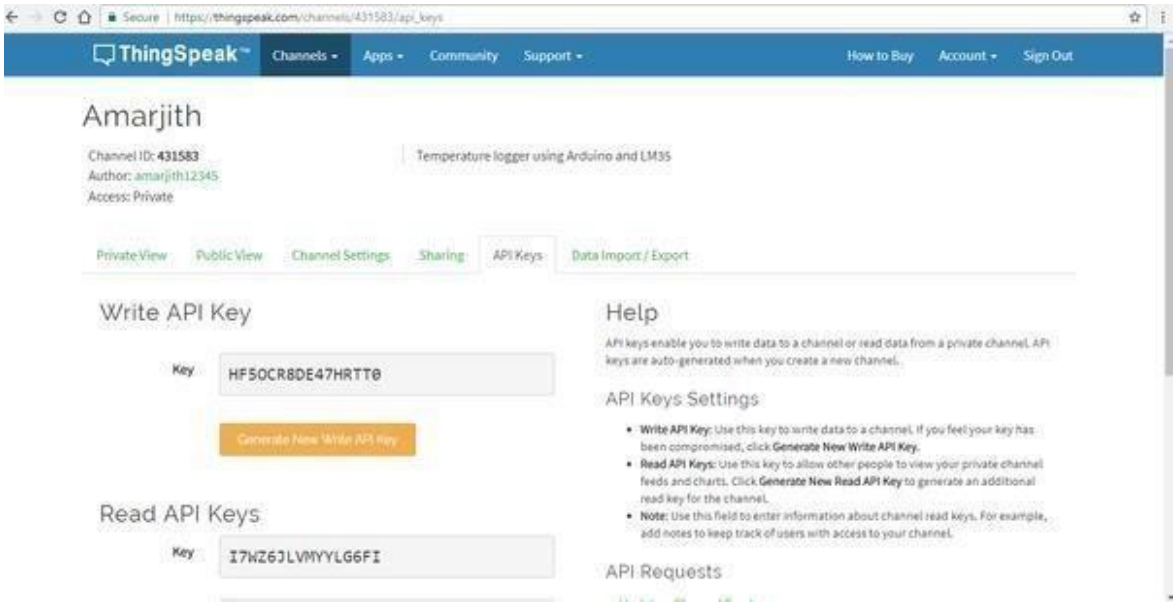
Step:11

Make channel public



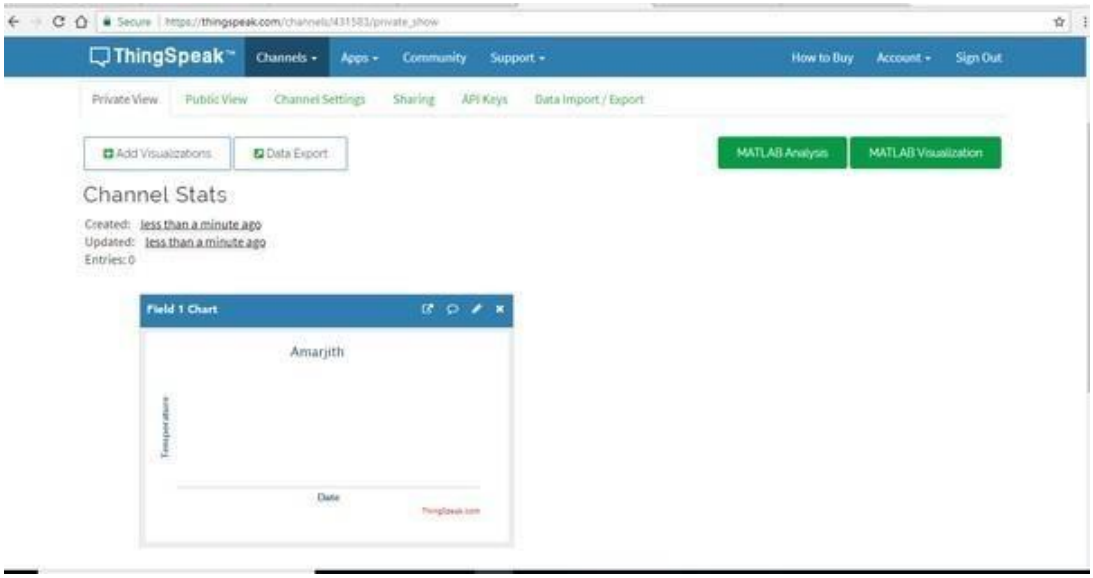
Step:12

Copy “write apikey” and then paste it in your program (later)

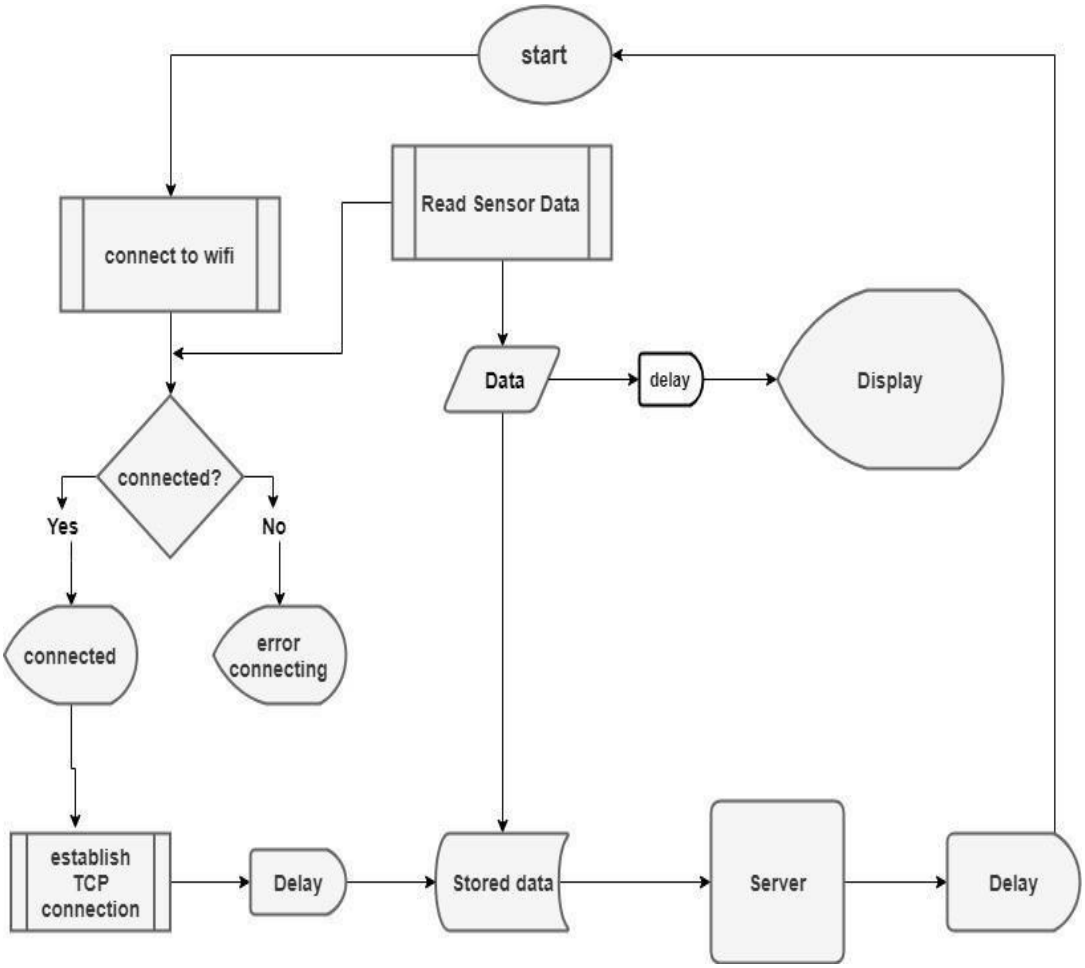


Step:13

Open private view

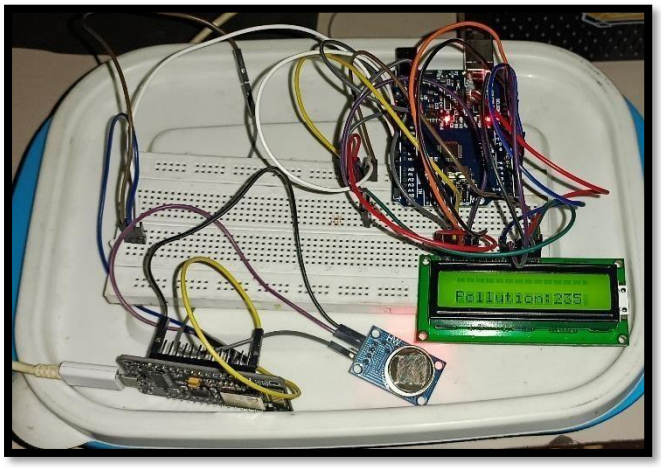


Flow chart:

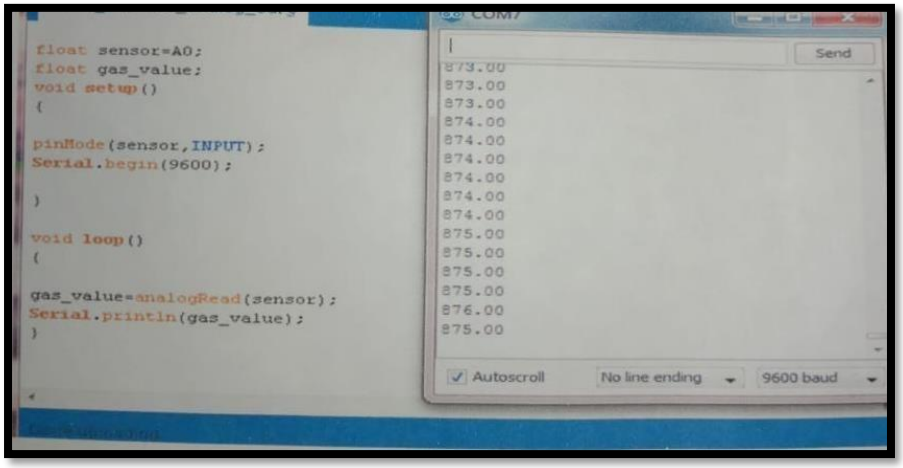

start
connect to wifi
Read Sensor Data
Data
delay
Display
connected?
Yes
No
connected
error connecting
establish TCP connection
Delay
Stored data
Server
Delay

5. Project outcomes and Applications:

Outcomes:



Outout of Arduino to gas sensor interfacing



Graph:

Applications:

In hospitals and pollution affected areas

Air pollution control for coating industry

Measurement of methane and non-methane hydrocarbons for environmental air quality

Ambient air quality monitoring for government.

Continues emissions monitoring for CO2 capture.

For tunnel monitoring.

6. Future Expansions

This System is IOT based means this system can access the internet. You can monitor your home, office, and factory pollution continuously. In the future, making the system more advanced, we can add an air purifier or air ionizer relay through the system.

This means we can switch on or off our purifier on some conditions like, if pollution increases from some PPM then on the relay that enables purifier and in else off the relay.

In the next step we can use node MCU instead of Arduino. It decreases cost, size and power also because node MCU takes only 3.3V dc for running it.

In addition, we can put Raspberry pi and we can control the system through voice commands from anywhere on the earth. We can interface more sensors in that system to cause different pollution levels measurement in different departments of my office or factory.

This system can be used after making it powerful and reliable in corporate offices and manufacturing.

7. References

1. www.engineersgarage.com/contribution/arduino-based-air-quality-monitoring-iot-project

2. www.instructables.com/id__Air-Qualiy-Monitoring/

3. http://www.components101.com/sensors/mq135-gas-sensor-for-air-quality

4. create.arduino.cc/projecthub/ruchir1674/air-quality-monitoring-7c5bae?ref=search&ref_id=air%20 quality&offset=3