SMART SENSOR BASED SEWER PIPELINE GAS MONITORING AND DETECTION

A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this mini project report **"SMART SENSOR BASED SEWER PIPELINE GAS MONITORING AND DETECTION"** is the bonafide work of "**BINO BENSE J, MADHANIKA S, PREM J** and **THIVYA B"** who carried out the mini project work under my supervision.

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ABSTRACT

In this project, we have proposed a novel sewer pipeline gas leakage detection using IoT enabled smart sensors which detects the toxic level. The primary objective of this project is to recognize the dangerous gases present inside sewer-pipeline to offer protected access to sewer-pipeline repair and maintainance here with the goal to avoid human fatalities, which can happen due to presence of toxic gases . Sewer gases cause health issues and fatal death to the labors .We have used a set of sensors such as **MQ-4** and **MQ-135** were integrated with ESP8266 (Node MCU) microcontroller unit process to process the data and analyse the level of toxic gases .In case of any breach in optimal condition, emergency is notified. In order to overcome the disasterous events, we have proposed a smart sensor system to sense, log, communicate the toxic level ubiquitously. We have used a buzzer to signal the labours in case of sudden eruption of gases during work. The collected data is monitored in real time through a dedicated wed server, which displays the toxic gas level. This project will also predict the composition of gases present in the sewer pipeline and display the values for the better understanding of scenario in real time before deploying workers using IoT enabled smart sensors device.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In this paper we talk about formulating an answer to this critical problem for humans using latest technological advancement, to avoid many human fatalities due to manual scavenging. The technology used for this should be easily usable by the workers.In this paper, we have tackled a unresolved problem related sewer-pipeline environment nature, where sewer-pipeline safe environment detection and identification (in terms of non-toxic environment) was required to allow maintenance and cleaning of the pipeline. The detection of these gases is very complex and ambitious because of many different factors such as presence of mixture of several toxic gases, and there is no single gas sensor which will offer reliable result alone,we need to make use of multiple sensors to achieve desired results. Therefore, we observe the behaviour of the complex mixture of gases. The primary goal of this work is to offer a mechanism with high efficiency and accuracy to differentiate the toxic gases in a simple and straightforward way such that the end result is as simple as ”safe or not safe”.Sewer-pipeline are usually not opened for a long time due to which sunlight does not to enter the pipelines. This leads to generation of toxic gases from the organic waste present inside these pipelines. Sewer-pipeline contains a composite toxic gases such as Methane(CH4), Ammonia(NH3), Sulphur(S), Benzene(C6H6), Smoke, Nitrogen oxides (NOx), etc. These gases

occurs because of decomposition of the organic matter in anaerobic decomposition inside the sewer-pipeline. These gases are fatal for humans who come in contact with these gases or get exposure to these gases. Following this, a distressingly high number of human fatalities are occurring each year.

1.2 OBJECTIVE

Quality maintenance of sewerage system consists of the optimum use of labour, equipment, and materials to keep the system in good condition, so that it can accomplish efficiently its intended purpose of collection of sewage. Our main objective is to establish Resident and Urban People assisting features for the helpful aid of their Civilization . The main requisites for these are to establish a connection between the NodeMCU as well as to detect the sign and Flow sensing unit. Also establishing alerting feature for prevention of blockage and Malfunctioning of sewer pipeline. The level of toxic gases present inside sewer pipeline is noted via web server that displays the range of toxic gas concentration.

CHAPTER 2

LITERATURE REVIEW

There are several techniques to analyze the detection of toxic gases in sewer pipeline. Toxic gases can be detected by using smart sensors. When the level of toxic gases exceeds then it gives message to the buzzer.Then the level of toxic gases present inside sewer pipeline is noted via web server that displays the range of toxic gas concentration.

D.Deepak Kumar, N.Idrajith, R.Bhavya, Dr.V.Jayaprakasan 'Urban underground drainage monitoring system using IoT' International Journal Of Advance Research, Ideas And Innovations in Technology(IJARIIT)

This paper describes various methods used for monitoring and control of an underground sewage system for this project. It explains the various uses, such as subsurface drainage, as well as real-time, manhole identification. A number of parameters such as water consumption, and the water level can be controlled updated online by using the Internet of Things. This could be the responsible person will need to take the necessary action against the same person. With the help of this design, we can reduce the cost on the human time and energy in order to check the sewer, and underground drainage pipe and avoid the hazards involved. If the responsible person does not have to have a smartphone in order to access the app blynk or may not be able to check e-mail frequently, we will send you a notification via TEXT message notice, however, we have not yet added to it, the SMS module to the project, Sensory networks are seen as an activator of the words to be the paradigm IOT.

SXDSmart manhole toxic gas identification and alerting system by L.K.Hema, Velmurugan S, Suriya.Pa, R.Indumathi.

In this proposed system, using a set of integrated sensors incorporated with microcontroller unit process and LCD display to quantify toxic gases produced in the system. It recognizes the scale of toxicants and then intimates the workers to acquire the safety precautions before entering into the manholes.

Smart real time manhole monitoring system by Chandraprabha R, Ashwini C.V, Dharani M, Harshitha G, Kruti mohan.

In this system IOT based real time alerts the managing station through an email when any manhole crosses its threshold values. This system reduces the death risk of manual scavengers who clean the underground drainage and also benefits the public.

IOT based smart safety monitoring system for sewage workers with two-way communication by A.Vellingiri, K.Dharni, M.Arunadevi, R.L. Aravind Lal.

The proposed system will gives alert through the LCD Display after reaching the threshold level of each gas sensors then people gets alert. Heart Beat sensor calculates the range of the Pulse rate then output at the abnormal range will give alert through notification through an IOT.

IOT based smart drainage worker safety system by Pushpakumar R,Rajiv

This system will help to identify the gas level inside the drainage manholes so that the worker can get some idea of entering into the manholes. It very helps workers and safety to them before getting down into the manholes and it will sense the level of the gas inside**.**

Wireless sensing system for the welfare of sewer laborer's by V.D Ambeth Kumar, D. Elangovan, G. Gokul, J. Praveen Samuel, V.D. Ashok kumar.

Embedded system is designed using a microcontroller with internet of things, for the purpose of detecting and monitoring the hazardous gas leakage, which aids in the evasion of endangering of human lives.

CHAPTER 3
SYSTEM SPECIFICATION

3.1 HARDWARE REQUIREMENTS

3.1.1 NODE MCU(ESP8266)

Fig 3.1.1 Node MCU

The Node MCU ESP8266 CH340G Wi-Fi Development Board is based on ESP8266 and is one of the easiest ways to get started with ESP8266 and Wi-Fi related projects. This module uses one of the highest used ESP8266-12F, which can be found in many of IoT devices nowadays. The module has Micro USB Interface. It has dual use, for connection with PC, as well as for Input power supply. It has onboard 3.3 V regulator, and therefore can be supplied with up to 14 V DC. Also, NodeMCU is an open-source firmware and Wi-Fi Development Board kit. And it can help anyone in learning and prototyping of IoT and Wi-Fi based products with Lua Script Lines.

- Easy to use, leading, low-cost device for Wi-Fi / IoT product prototyping
- Modern high-level Lua based technology, which is integrated with almost all peripherals onboard, so making it easy to program.
- Internet development Tools such as Node.js can be interfaced with the

device, therefore developers can take advantage of built-in API to easily make your idea in to product.t is based on mature ESP8266 technology, and has abundant resources on web .

- It has onboard Wi-Fi integration with GPIO, PWM, ADC, I2C and 1 wire resources.
- Built in USB to TTL Serial using CH340G.
- Wide input voltage Range: 5 V to 14 V DC.

3.1.2 MQ-4 SENSOR

Fig 3.1.2 MQ-4 Sensor

MQ4 methane gas sensor is a MOS (metal oxide semiconductor) type sensor,used to detect the methane gas concentration within the air at either home or industries & generates output like analog voltage by reading it. Here, the range of concentration for sensing ranges from 300 pm – 10,000 ppm which is appropriate for the detection of a leak.

This gas sensor mainly includes a detecting element like ceramic based on aluminum-oxide (Al_2O_3), coated with Tin dioxide (SnO2) and arranged within a stainless-steel mesh. When methane gas and detecting elements get in contact with each other then the resistivity of the detecting element will be changed. After that, the change is measured to get the methane gas concentration. The ignition of Methane gas is extremely exothermal which means it generates a huge amount of heat once ignited.

SPECIFICATIONS

- Sensor Type Semiconductor.
- Power requirements: VCC - 5V±0.1.
- DO output: TTL digital 0 and 1 (0.1 and 5V).
- AO output: 0.1-0 .3 V (relative to pollution), the maximum concentration of a voltage of about 4V.
- Detection Gas: Natural gas/Methane.
- Detection Concentration: 200-10000ppm (Natural gas / Methane).
- Interface: 1 TTL compatible input (HSW), 1 TTL compatible output (ALR).

3.1.3 MQ-135 SENSOR

Fig 3.1.3 MQ-135 Sensor

MQ gas sensors are a family of sensors which are used to detect a wide variety of gases like alcohol, smoke, methane, LPG, hydrogen, NH3, Benzene, Propane etc. These sensors are made up of electrode which is coated with a sensing material, and it is heated to make it more reactive and sensitive

The MQ-135 Gas sensor can detect gases like Ammonia (NH3), sulfur (S), Benzene (C6H6), CO2, and other harmful gases and smoke. Similar to other MQ series gas sensor, this sensor also has a digital and analog output pin. When the level of these gases goes beyond a+ threshold limit in the air the digital pin goes high.

Description: Air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2. Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benzes steam, also sensitive to smoke and other harmful gases.

Range of CO2 sensor

10 To 1000 Ppm

MQ135 Air Quality Gas Sensor Module, Measuring Range: 10 To 1000 Ppm.

This is how an MQ-135 sensor can be used to measure accurate CO2 in the air. The complete MQ135 Air Quality Sensor Arduino Code and working video are given below.

3.2 SOFTWARE REQUIREMENTS

3.2.1 ARDUINO SOFTWARE

Founders. Massimo Banzi is an interaction designer, educator, open-source hardware pioneer, and TED speaker. His background is in electrical engineering, but he spent most of his early career working as a software architect before spending four years at the Interaction Design Institute Ivrea as an Associate Professor.

The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low-cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics.

Arduino is programmed with a c/c++ 'dialect'. Most c/c++ will work but much of the standard libraries will not work. Many of the restrictions is made because of the little available RAM on the Arduino hardware.

Step 1 − First you must have your Arduino board (you can choose your favorite board) and a USB cable. In case you use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, you will need a standard USB cable (A plug to B plug), the kind you would connect to a USB printer as shown in the following image.

Step 2 − Download Arduino IDE Software.

You can get different versions of Arduino IDE from the Download page on the Arduino Official website. You must select your software, which is compatible with your operating system (Windows, IOS, or Linux). After your file download is complete, unzip the file .

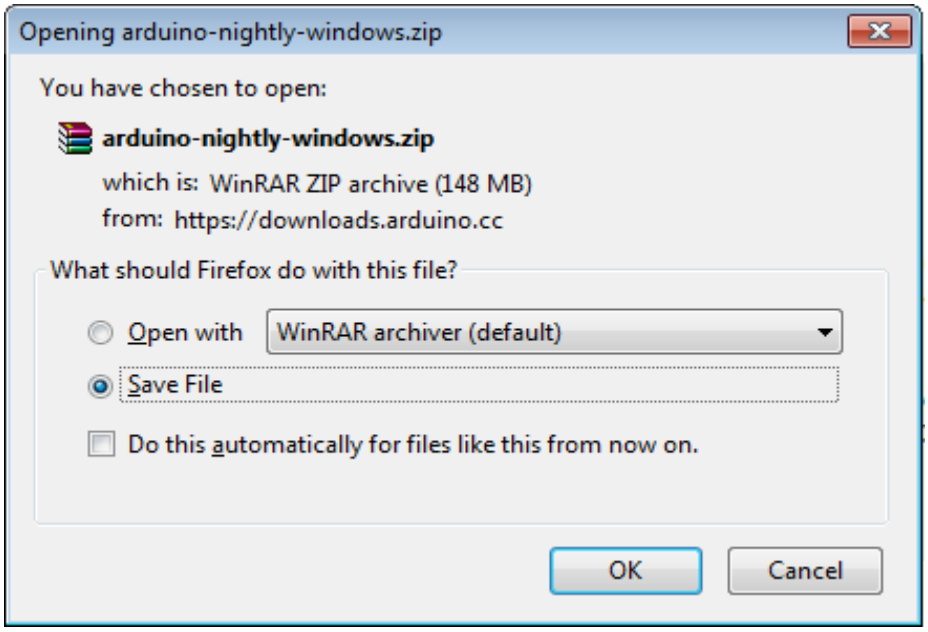

Fig 3.2.1 Download Arduino IDE Software

Step 3 − Power up your board.

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either, the USB connection to the computer or an external power supply. If you are using an Arduino Diecimila, you have to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it is on the two pins closest to the USB port.

Connect the Arduino board to your computer using the USB cable. The green power LED (labeled PWR) should glow.

Step 4 − Open your first project

Once the software starts, you have two options −

- Create a new project.
- Open an existing project example.

To create a new project, select File → **New**.

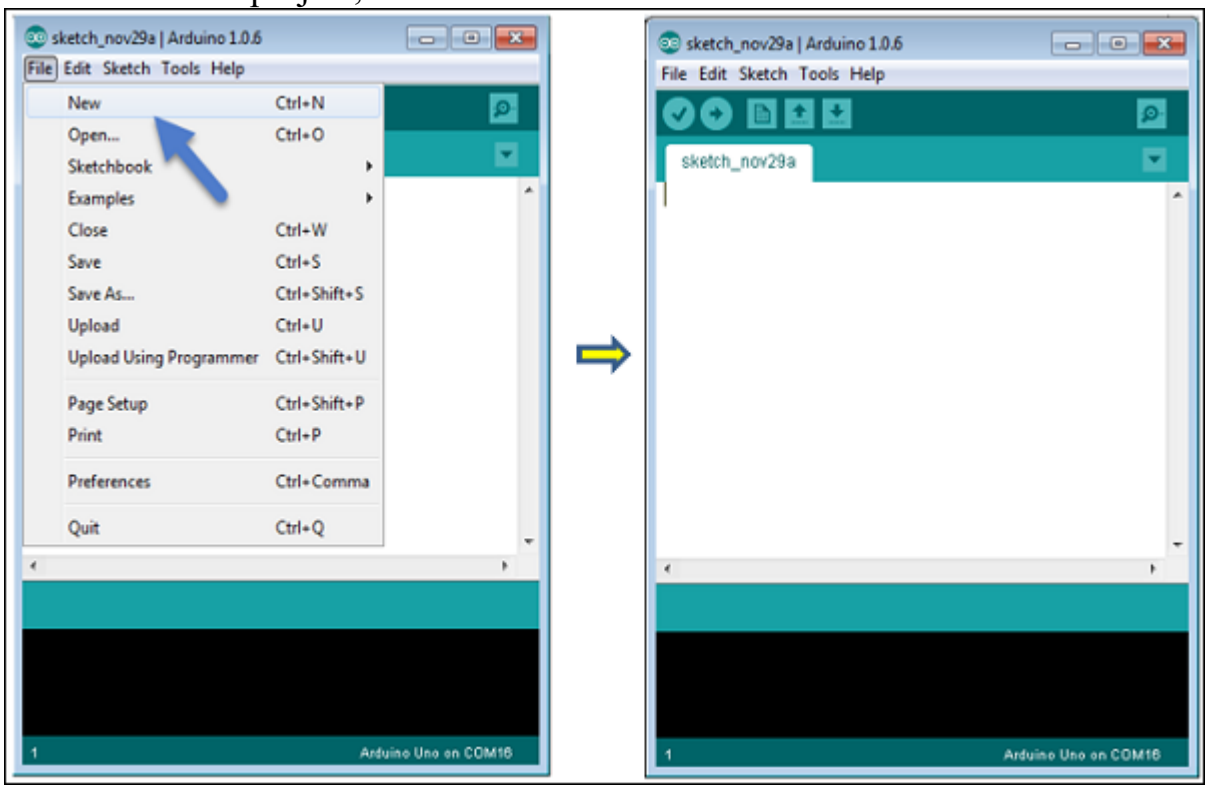

Fig 3.2.2 Opening first project.

To open an existing project example, select File → Example → Basics → Blink.

Here, we are selecting just one of the examples with the name **Blink**. It turns the LED on and off with some time delay. You can select any other example from the list

Step 5− Select your Arduino board.

To avoid any error while uploading your program to the board, you must select the correct Arduino board name, which matches with the board connected to your computer.

Go to Tools → Board and select your board.

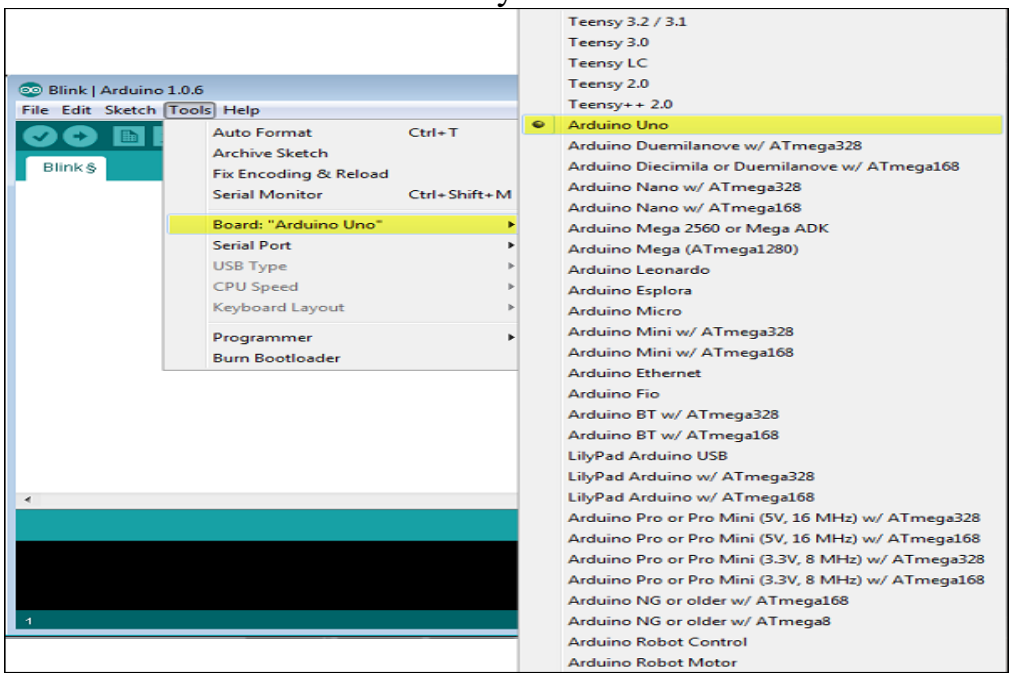

Fig 3.2.3 Select your Arduino board.

Step 6: Select your serial port

Select the serial device of the Arduino board. Go to **Tools → Serial port menu.** This is likely to be COM3 or higher .To find out, you can disconnect your Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select the serial port.

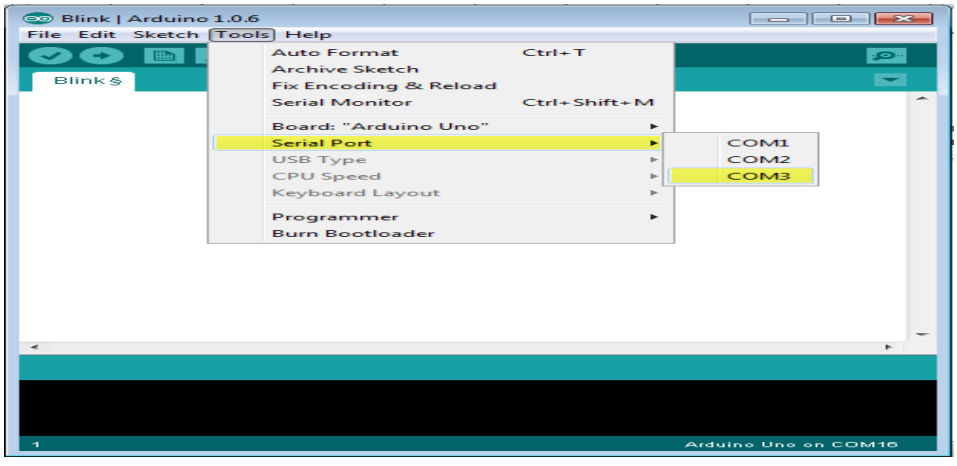

Fig 3.2.4 Select your serial port

Step 7: choose library

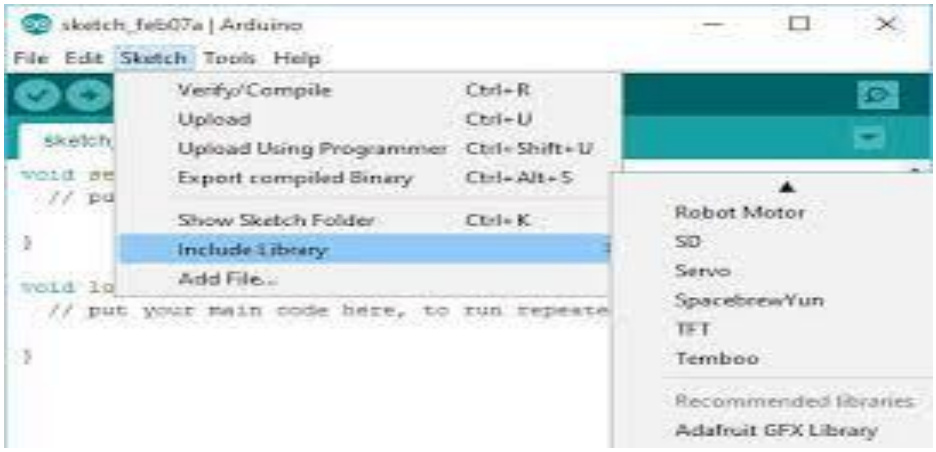

Fig 3.2.5 choose library

Step 8: Upload the program to your board.

Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.

3.2.6 upload the program

A − Used to check if there is any compilation error.

B − Used to upload a program to the Arduino board.

C − Shortcut used to create a new sketch.

D − Used to directly open one of the example sketch.

E − Used to save your sketch.

F − Serial monitor used to receive serial data from the board and send the serial data to the board.

Step 9: Output

Fig 3.2.7 output

3.2.2 WEB SERVER

Web server is a program that uses HTTP (Hypertext Transfer Protocol) to serve the files that form Web pages to users, in response to their requests, which are forwarded by their computers' HTTP clients.

To implement web server on ESP, there are two ways to make your first web server first connect to your WiFi router or make ESP as access point**.**

DISPLAYING THE HTML WEB PAGE

The first thing you need to do, is creating the web page. The ESP32 will be sending a response to your browser with some HTML code to build the web page.

The web page is sent to the client using this expressing client.println(). You should enter what you want to send to the client as an argument.

The first thing we should send is always the following line, that indicates that we are sending HTML.

```
<!DOCTYPE HTML><html>
```

Then, the following line makes the web page responsive in any web browser.

```
client.println("<head><meta                    name=\"viewport\"
content=\"width=device-width, initial-scale=1\">");
```

And the following is used to prevent requests on the favicon. – You don't need to worry about this line.

```
client.println("<link rel=\"icon\" href=\"data:,\">");
```

To access the web server, open your browser, paste the ESP32 IP address, and you'll see the following page. In our case it is **192.168.1.135**.If you take a look at the Serial Monitor, you can see what's happening on the background. The ESP receives an HTTP request from a new client (in this case, your browser). You can also see other information about the HTTP request.

STYLING THE WEB PAGE

Next, we have some CSS text to style the buttons and the web page appearance. We choose the Helvetica font, define the content to be displayed as a block and aligned at the center.

```
client.println("<style>html { font-family: Helvetica;
display: inline-block; margin: 0px auto; text-align:
center;}");
```

We style our buttons with the #4CAF50 color, without border, text in white color, and with this padding: 16px 40px. We also set the text-decoration to none, define the font size, the margin, and the cursor to a pointer.

```
client.println(".button { background-color: #4CAF50; border:
none; color: white; padding: 16px 40px;");
client.println("text-decoration: none; font-size: 30px;
margin: 2px; cursor: pointer;}");
```

CHAPTER 4

PROPOSED METHODOLOGY

Our main objective is to establish Resident and Urban People assisting features for the helpful aid of their Civilization . The main requisites for these are to establish a connection between the Node MCU as well as to detect the sign and Flow sensing unit in sewer pipeline. Also establishing alerting feature of gas leakage detection in sewer pipeline using buzzer alarm and continual real time monitoring using web server.

4.1 BLOCK DIAGRAM

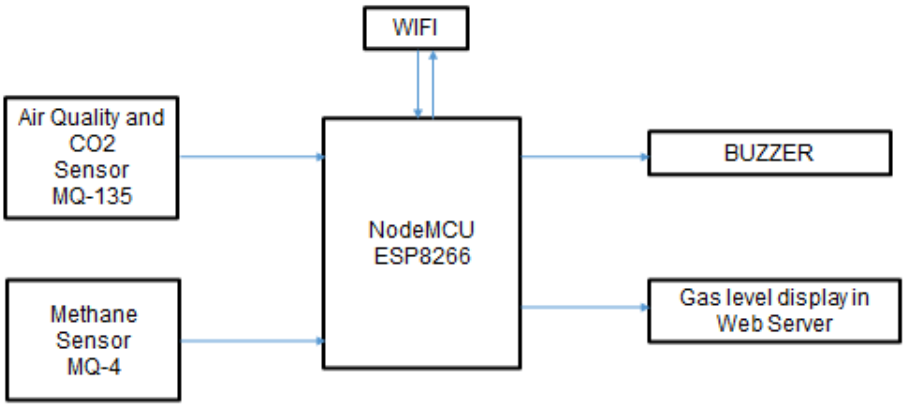

Fig 4.1 Block Diagram

The proposed system helps in avoiding the sudden toxic gas accidents of sewer pipeline workers. It also introduces a smart approach to measure the concentration level of hazradous gases.Our proposed system monitors main toxic gases like methane(CH4),Ammonia(NH3) and Sulphide using MQ-4, MQ-135 sensors and these values are processed and analyzed by ESP8266(NodeMCU).The device sends out alerts at regular interval so the

unit ,anagers can be timely notified of the issues whenever the parameters breaches set threshold values.If there is any abnormalities (i.e)if methane level increases ,MQ-4 sensor detects anywhere from 200 to 10,000 ppm and MQ-135 sensor detects ammonia gas from 10 to 1000 ppm and it will provide alert by using buzzer.We will also display the toxic gas level in web server at regular intervals.A fully automated project reducing the reliance on a tedious manual process to record data.

4.2 SCHEMATIC DIAGRAM

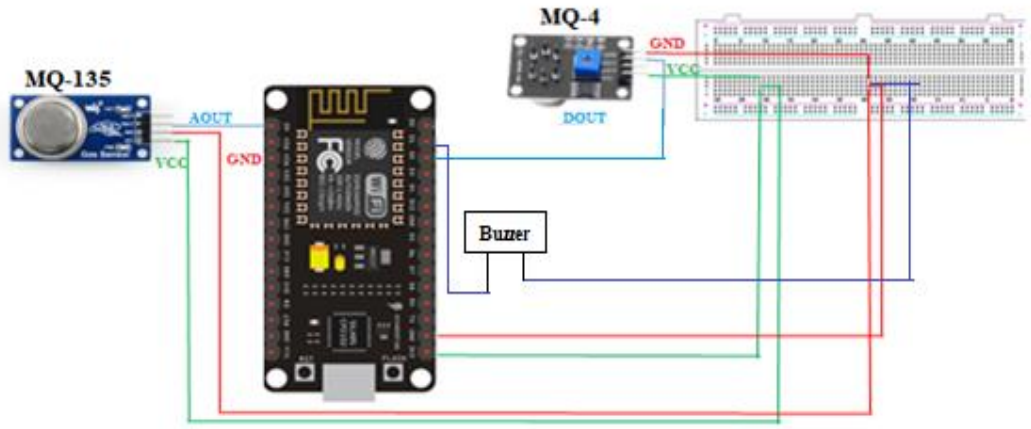

Fig 4.2 Schematic Diagram

CIRCUIT CONNECTIONS

- MQ-4 D0 Pin is connected to D2 of Node MCU.
- MQ-135 A0 pin is connected to A0 of Node MCU.
- All Vcc and Gnd pins are connected in the same alignment in bread board.

4.3 FLOW DIAGRAM

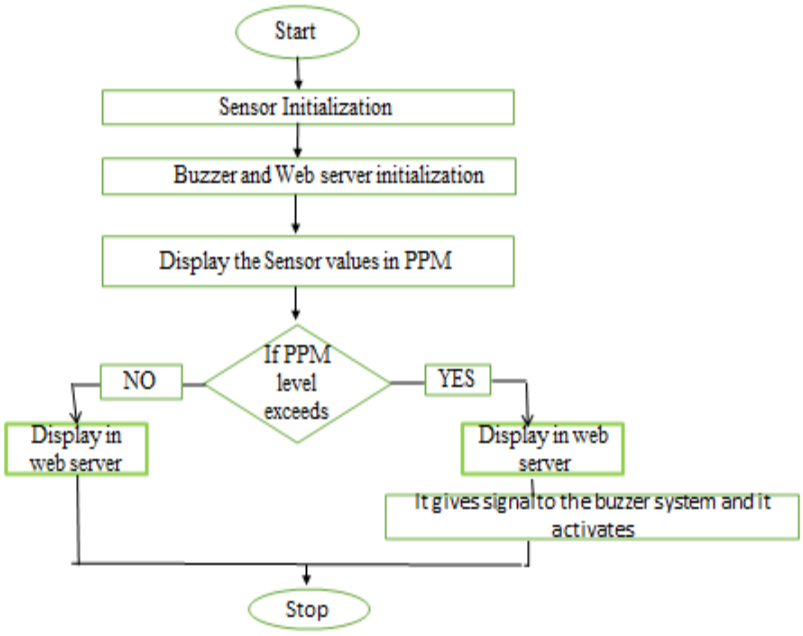

Fig 4.3 Flow Diagram

ALGORITHM

- Start the Arduino IDE.
- Then compile the program and upload.
- MQ-135 detects air quality and Mq-4 detects methane gas.
- Output will be displayed in the serial monitor.
- Buzzer system is used for giving alert when the toxic level exceeds.
- WiFi client is used for checking the values in the web server.
- Web server displays the air quality content and methane content.

ADVANTAGES

- Low power consumption and reliable.
- Easy and simple setup.
- It is convenient to use and cost effective
- It provides quick response rate.
- A fully automated solution reducing a reliance on a tedious manual process to record data.

CHAPTER 5

EXPERIMENTAL RESULTS

5.1 PROTOTYPE MODEL

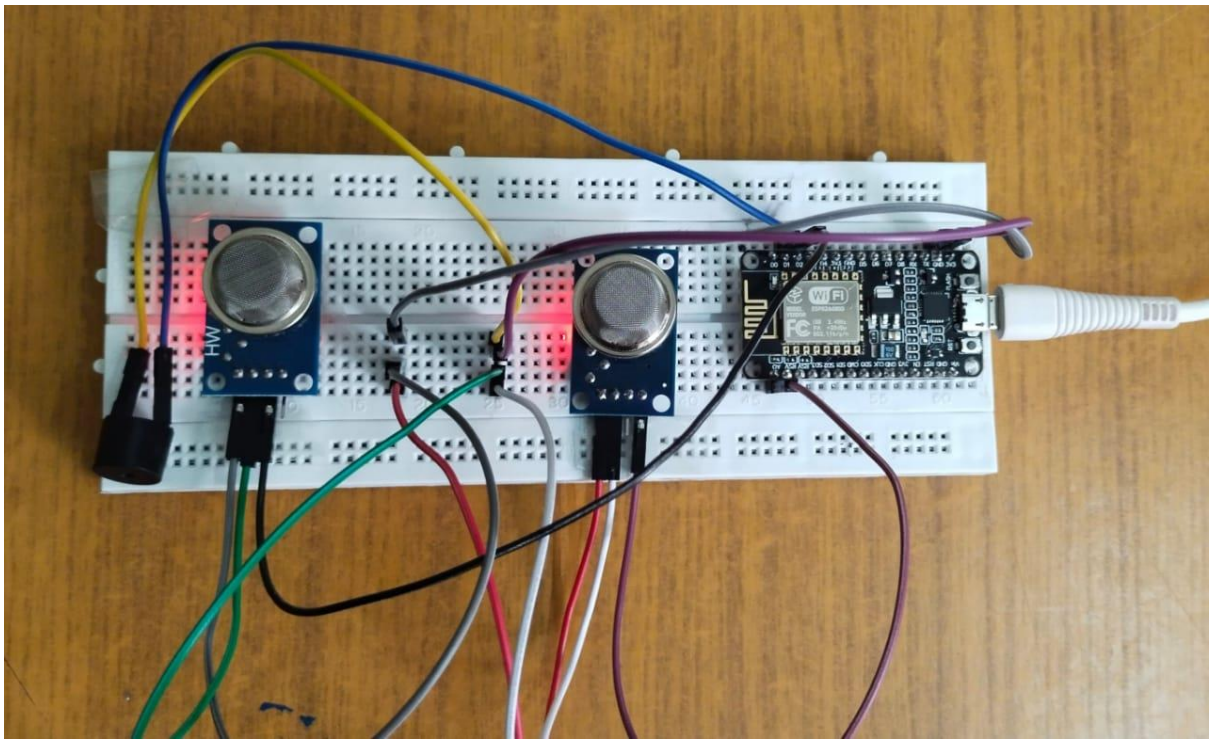

Fig 5.1 Protype model

5.1.1 COMPILATION OF SOURCE CODE

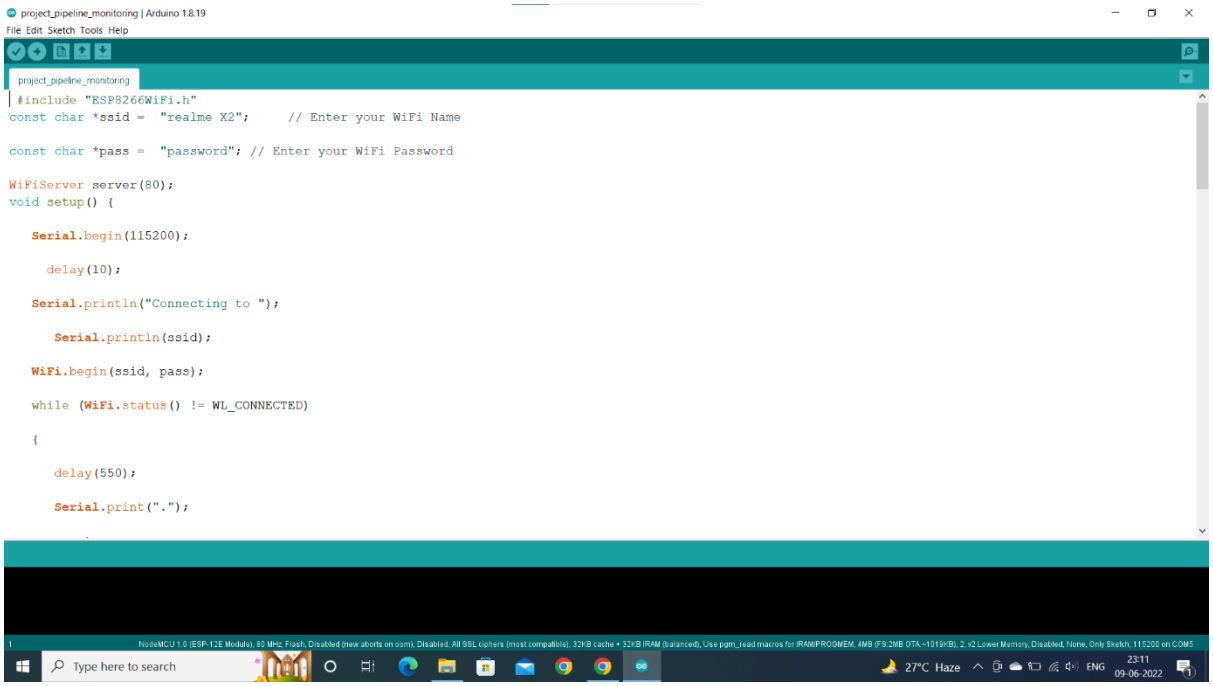

Fig 5.1.1 Compilation of source code

5.1.2 VERIFICATION OF SOURCE CODE

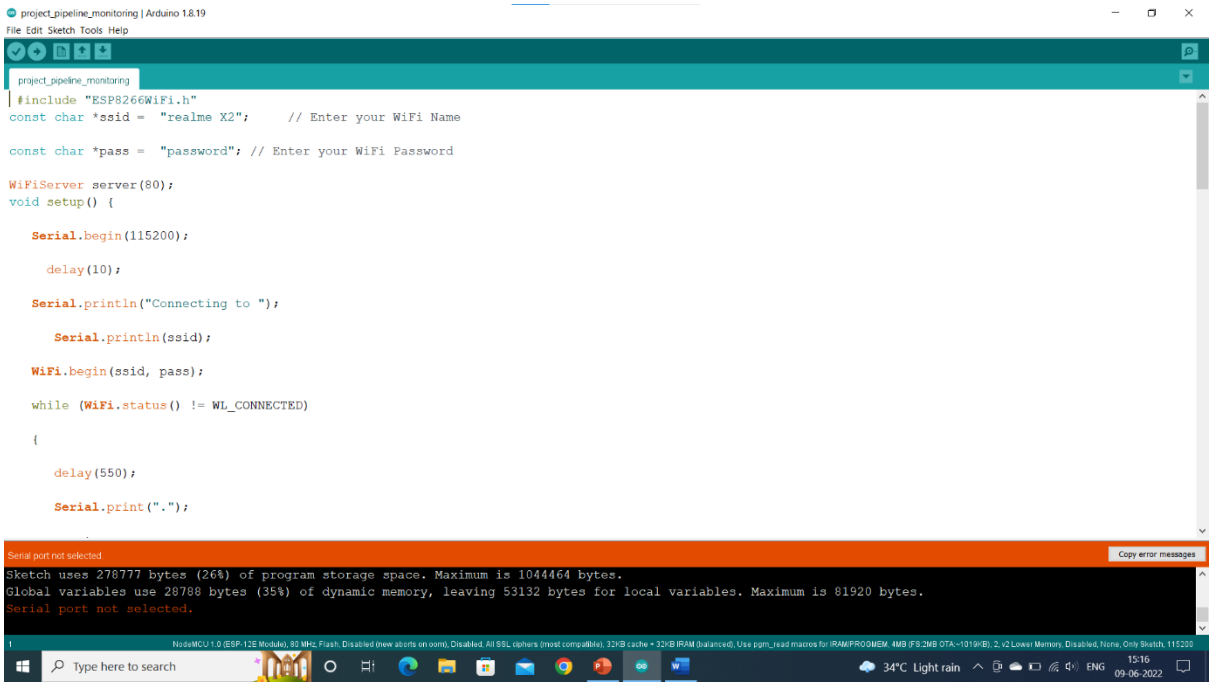

Fig 5.1.2 Verification of source code

5.1.3 SERIAL MONITOR OUTPUT

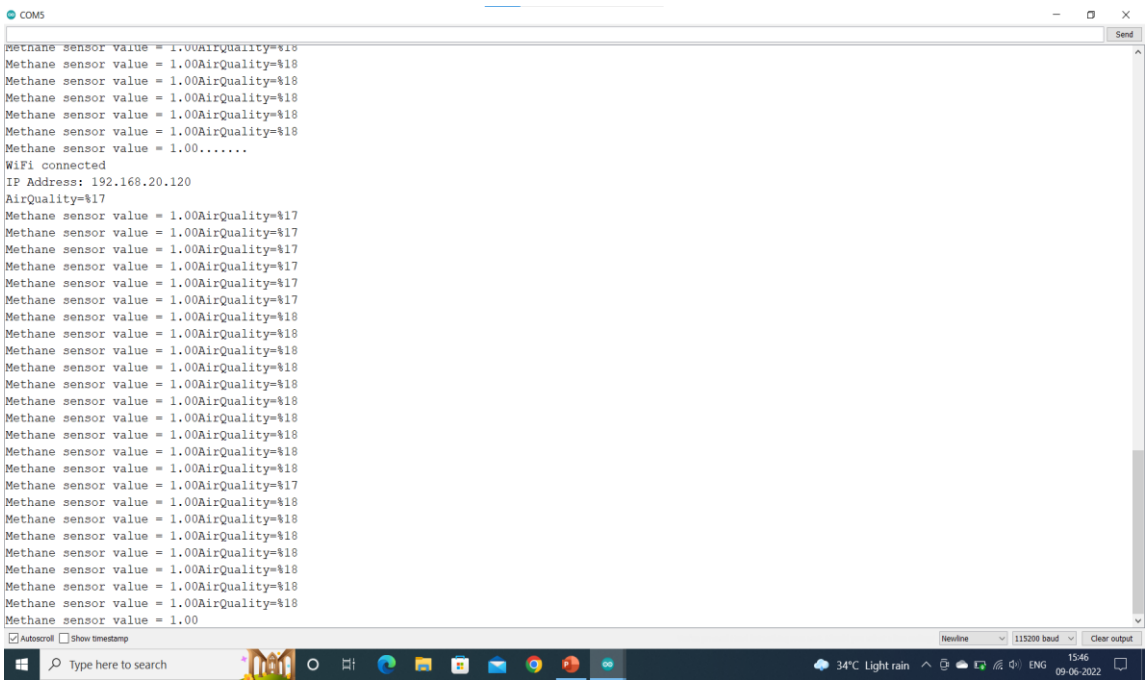

Fig 5.1.3 Serial monitor output

5.1.4 WEB SERVER OUTPUT

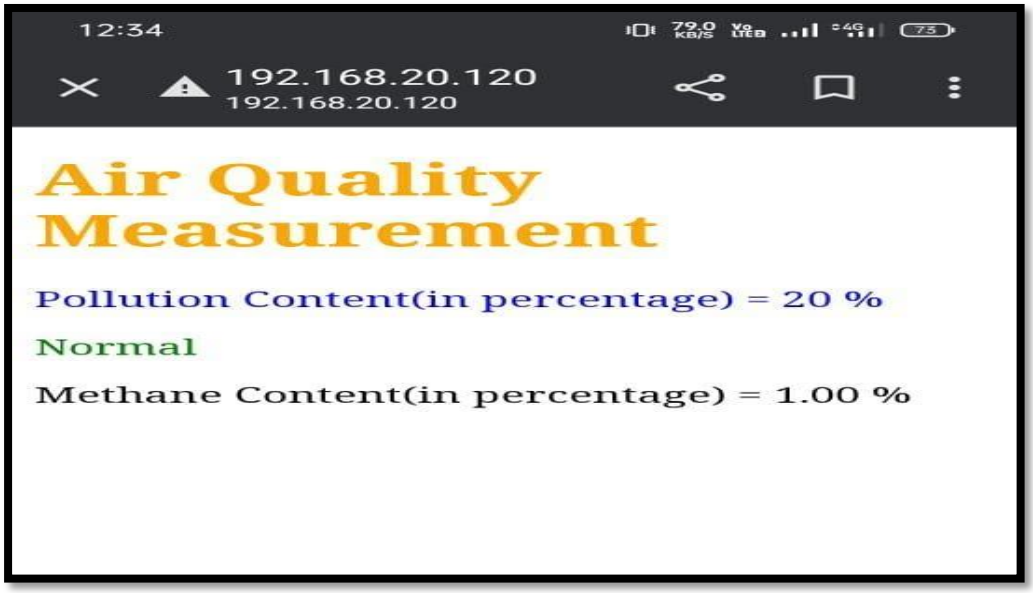

Fig 5.1.4 When air quality is normal

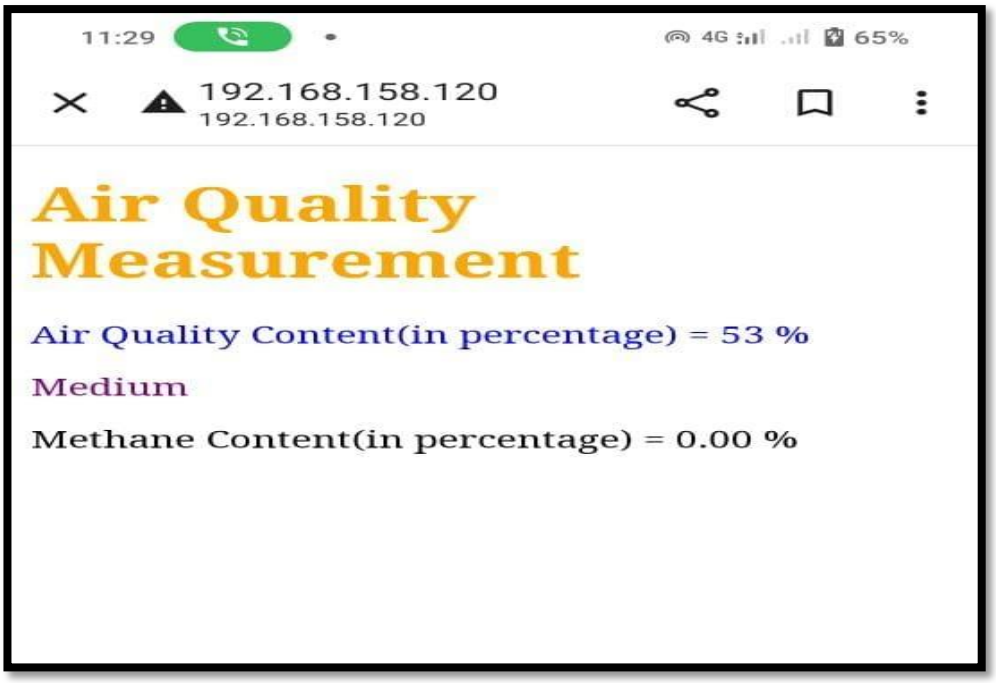

Fig 5.1.4 When air quality is 53% (normal)

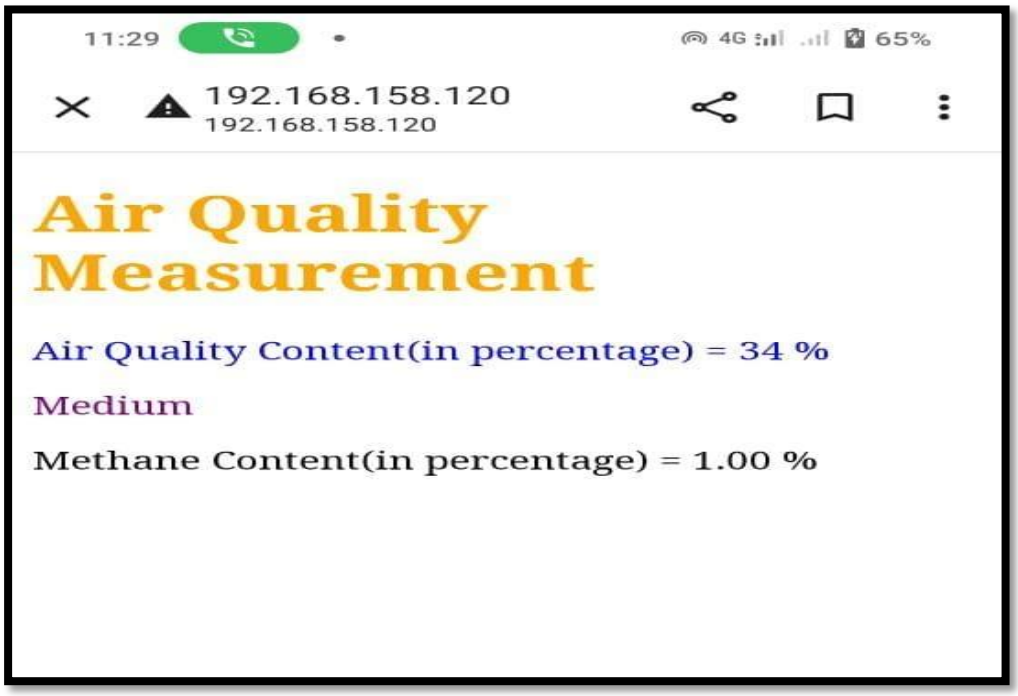

Fig 5.1.4 When air quality is 34% (medium)

CHAPTER 6
CONCLUSION

Monitoring of sewer pipeline is a complex task. Various methods used for monitoring and control of an underground sewer pipeline for this project. By using number of parameters such as smart sensors, toxic levels can be detected online by using the Web server. With the help of this design, we can reduce the cost on the human time and energy in order to check the sewer pipeline and avoid the hazards involved . This article explains all about it an intelligent, real-time, sewer pipeline monitoring system with the help of Arduino software in a large urban area. With a variety of sensors, such as methane gas sensor and air quality sensor , we are able to control the real time problem with the sewer pipeline system. By doing so, we can have some action on the matter, if we are going to receive early warnings of the block, as well as changes. This project may be used to solve the effects of sewer pipeline monitoring system .

CHAPTER 7
FUTURE WORK

The Sensor networks can be considered as a major contributing factor to the development of sewer pipeline system. However, as a result of the increasing range of applications it's getting harder and harder in order to define common requirements for the WSN-locations and platforms. This project aims to solve all automation tasks. As a point of reference for the guide, and then select the program for which you are using the app. Aspects of the sensor network, a platform can be seen as a platform to structure, flexibility and re-usability, the sensor node optimization, communication, connection ,solving of problems and the high availability of the service, in any levels of application, server reliability. This project can be used to provide the service specification, the optimization and development of a sensor-network-platforms-for other kinds of applications.

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