PROJECT REPORT ON AIR QUALITY MEASUREMENT SYSTEM

NAME OF THE PARTICIPANTS

- NOWAZ SHARIF (17101105060)
- SALEM BASUMATA (18101105096)
- KOSTAV SARKAR (18101105081)
- JAYANTA MANDAL (18101105097)
- SIKANDAR KHAN (18101105099)

UNDER THE GUIDANCE OF:

Prof. SAYANTAN BISWAS

Prof. OF DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE

ACKNOWLEDGMENT

First of all, we would like to take this opportunity to thank my supervisor Prof. Sayantan Biswas without whose effort this project would not have been possible. We're so grateful to him for working tirelessly after us, answering our doubts whenever and wherever possible. We are most grateful to sir for providing us this opportunity to work in this project in Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal 735102, India.

INDEX

ABSTRACT

air pollution has been consistently ranked by the US Environmental Protection Agency (EPA) and its Science Advisory Board to be among the top five environmental public health risks. Average person spends an estimated 90% of their time indoors so that poor indoor air quality (IAQ) poses a substantial risk to public health. Poor air quality may cause increased short-term health problems such as fatigue and nausea as well as chronic respiratory diseases, heart disease, and lung cancer. This project proposes an air pollution monitoring system. The system was developed using the Arduino microcontroller. The air pollution monitoring system was designed to monitor and analyse air quality in real-time and log data to a remote server, keeping the data updated over the internet. Air quality measurements were taken based on the Parts per Million (PPM) metrics. The result was displayed on the designed hardware's display interface and could be accessed via the cloud on any smart mobile device.

KEYWORDS:

Internet of Things, Pollution, Air, Parts per Million, Quality and Metrics.

INTRODUCTION:

Air is one of the essential elements of man's surroundings. The earth's atmosphere is full of air which contains gases such as Nitrogen, Oxygen, Carbon Monoxide and traces of some rare elements. Humans need an atmosphere of air that is free from contaminants. This is very crucial for human life and health. Any change in the natural composition of air may cause grave harm to life forms on earth. Air pollution is the presence of one or more contaminants in the atmosphere such as gases in a quantity that can harm humans, animals and plant. Air pollutants are measured in Parts per Million (ppm) or ug/m3. Primary pollutants are released directly into the atmosphere. Air quality affects public health. effect of air pollution ranges from difficulty in breathing, coughing, aggravation of asthma and emphysema.

EPA is a science leader in the development and improvement of instruments, methods, techniques and other tools to measure and monitor air quality and evaluate air emissions to protect public health and the environment from air pollution. High quality air pollution data is needed by air regulators and managers to implement the National Ambient Air Quality Standards and develop effective preventive and mitigation strategies to protect air quality. Understanding what is in the air near sources of pollution such as industrial applications, oil and gas production facilities, coal-fired power plants and highways is critical to safeguard public health and the environment from six common air pollutants and other hazardous air pollutants regulated by EPA.

Air Quality Measurement Methods

EPA researchers develop new methods and make improvements to existing methods that are used to collect data on air quality.

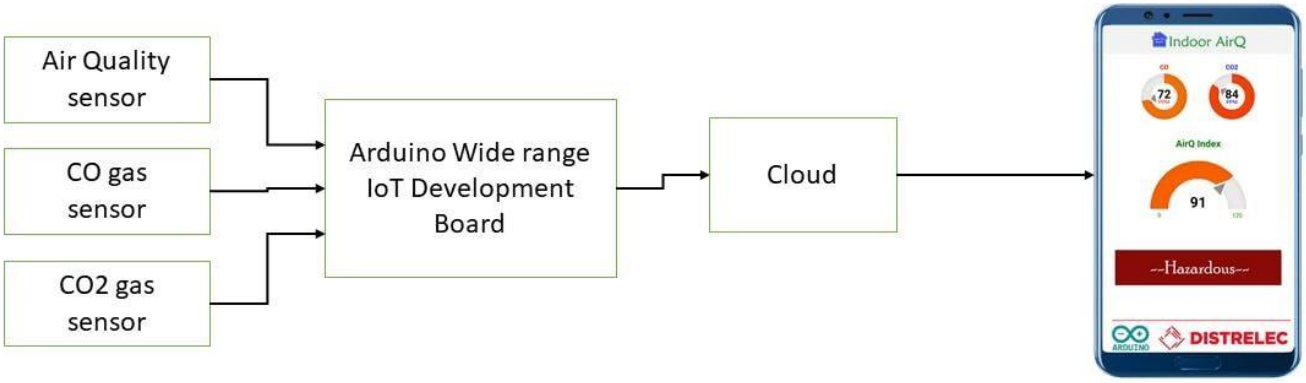
- **Federal Reference and Equivalency Methods**
- **Aircraft Emission Methods**
- **Stationary Source Emissions Methods and Instruments**

Air Quality Index (AQI) Values)	Levels of Health Concern	Colors
When the AQI is in this range:	*...air quality conditions are:*	*..as symbolized by this color:*
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Fig -Standards pollution level by EPA

AIM OF THE PROJECT

This paper focuses on the design and implementation of a smart air pollutant monitoring system. It discusses how the level of pollutants in the air can be monitored using a gas sensor, Arduino microcontroller and a Wi-Fi module. Our system is connected to the Internet, and as a result, anyone can remotely visualize the air quality index form anywhere.



Possible Application Domain of This System:

- Homes and offices
- Industries
- Remote sensing for firefighters
- Research and agriculture
- Hospital and clinic
- ICU unit

Required Components:

- Wide range of IoT boards with Wi-Fi
- Gas sensors (MQ-2, 3, 7)
- Air quality sensor (MQ-135)
- Breadboard
- Android device
- Connecting wires
- Arduino IDE/Arduino Web IDE
- Adafruit IO

DETAILS OF COMPONENTS:

Wide range of IoT boards with Wi-Fi :

The Internet of Things is developing at a rapid pace, thanks in part to an explosion in the availability of small, inexpensive computing hardware. They come in nearly infinite configurations, from tiny battery-powered chips that chirp intermittently over Bluetooth to credit card-sized computers with USB power supplies and high-bandwidth
Wi-Fi radios.

Gas sensors (MQ-2, 3, 7):

The Grove - Gas Sensor(MQ2) module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer.

Sensor	Gas Type
MQ2	Combustible Gas, Smoke
MQ3	Alcohol Vapor
MQ5	LPG, Natural Gas, Town Gas
MQ9	Carbon Monoxide, Coal Gas, Liquefied Gas

Air quality sensor (MQ-135) :

When it comes to measuring or detecting a particular Gas the MQ series Gas sensors are the most inexpensive and commonly used ones. **MQ135** is available as a module or as just the sensor alone. the presence of a gas then you can buy it as a module since it comes with an op-amp comparator and a digital output pin. But if you planning to measure the PPM of a gas it is recommend buying the sensor alone without module.

Breadboard:

A breadboard is a solder less device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate.	

Android device:

We will use our android mobile phone to display the measured output through internet connectivity.	

Connecting wires:

It used as connector or assemble the circuit.	

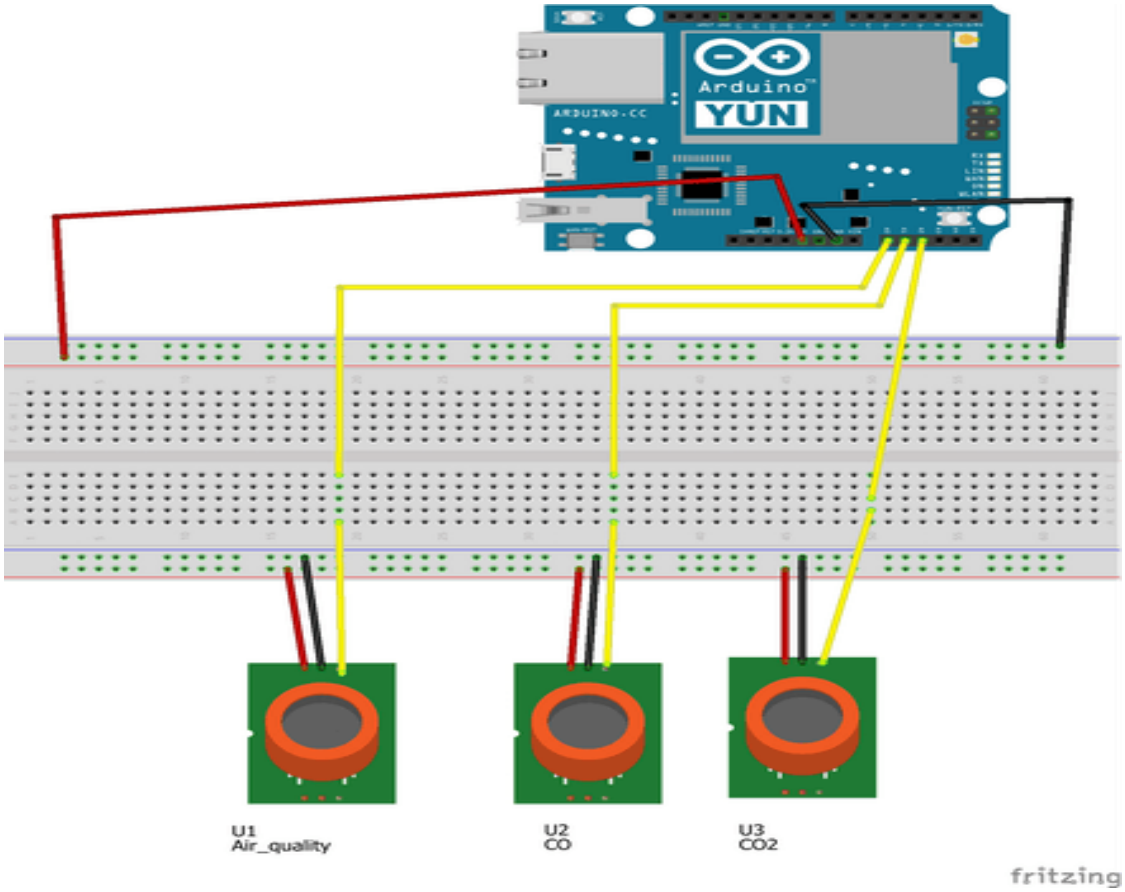
Arduino IDE :

The Arduino integrated development environment (IDE) is a cross platform application (for Windows, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program argument to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

Adafruit IO:

Adafruit IO is a system that makes data useful. Our focus is on ease of use and allowing simple data connections with little programming required. IO includes client libraries that wrap our REST and MQTT APIs, MQTT or message queue telemetry transport is a protocol for device communication that Adafruit IO supports. Using a MQTT library or client one can publish and subscribe to a feed to send and receive feed data.

Circuit Diagram:



Air Quality Sensor

- VCC to 5V pin of Arduino
- GND to GND pin of Arduino
- SIG to A3 pin of Arduino

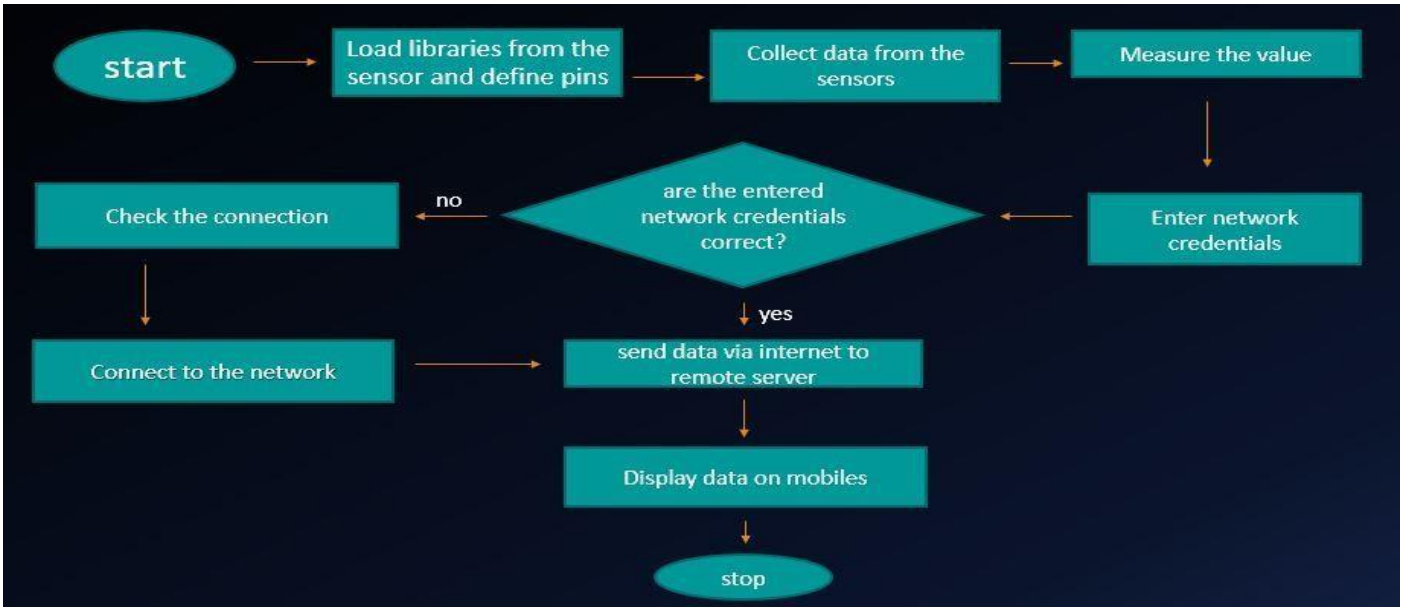
MQ-2 gas sensor

- VCC to 5V pin of Arduino
- GND to GND pin of Arduino
- SIG to A2 pin of Arduino

MQ-3 gas sensor

- VCC to 5V pin of Arduino
- GND to GND pin of Arduino
- SIG to A1 pin of Arduino

Flow chart of writing the source code



Mathematical Analysis of Proposed Model:

The level concentration of pollutants in the air is measured in parts per million (ppm) or percentage.

Conversion factors include the following:

1 ppm = 1.145 mg/m3

1 mg/m3 = 0.873 ppm

1% = 1/100

1 ppm = 1/1000000

1 ppm = 0.0001%

Table 2 shows PPM to percentage conversion.

Table 2 PPM to Percentage conversion

Parts per Million (ppm)	Percent (%)
0	0
5	0.005
50	0.005
500	0.05
1000	0.1

Scope of improvement

- Add humidity and temperature measurements features.
- Compile period of data for analysis by using column chart.

PROGRAMME CODE:

```
#include <YunClient.h>
#include <ThingerYun.h>

#define USERNAME "__________YOUR_____USER____NAME____"
#define DEVICE_ID "__________YOUR DEVICE_____ID_____"
#define DEVICE_CREDENTIAL "_____YOUR___CREDENTIAL_____"

ThingerYun thing(USERNAME, DEVICE_ID, DEVICE_CREDENTIAL);

void setup(){
pinMode(A0, INPUT);
pinMode(A1, INPUT);
pinMode(A2, INPUT);
pinMode(A3, INPUT);

// initialize bridge
Bridge.begin();

// resource output example (i.e. reading a sensor value, a variable, etc)
thing["LPG"] >> outputValue(analogRead(A0)); // optional
thing["CO2"] >> outputValue(analogRead(A1));
thing["CO"] >> outputValue(analogRead(A2));
thing["AIRQ"] >> outputValue(analogRead(A3));

// more details at http://docs.thinger.io/arduino/
}

void loop() {
thing.handle();
}
```

CONCLUSION:

This research proposed a smart air pollution measurement system that constantly keeps track of air quality in an area and displays the air quality measured on a mobile device. It also sends data measured to the “Thing speak” platform. The system helps to create awareness of the quality of air that one breathes daily. This monitoring device can deliver real-time measurements of air quality.

REFERENCES:

- US Environmental Protection Agency (USEPA). Indoor air quality tools for schools Communications guide. Available at http://www.epa.gov.
- J.-J. Kim, S.K. Jung, and J.T. Kim. Wireless monitoring of indoor air quality by a sensor network. Indoor and Built Environment, 19:1:145-150, 2010.
- Arun Raj V., Priya R.M.P., and Meenakshi, V., "Air Pollution Monitoring In Urban Area," International Journal of Electronics and Communication Engineering, 2017.
- Priyanka, V., "Review: Air Quality Monitoring System," International Journal of Advanced Research in Computer and Communication Engineering, 5(6), 2016.
- Programming Arduino by Simon Monk
- Arduino IDE: https://www.arduino.cc/en