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AEROQUAL: Air Quality Monitoring System using IoT

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Abstract: *Humans can be adversely affected by exposure to air pollutants in ambient air. Hence, health-based standards and objectives for some pollutants in the air are set by each country detection and measurement of contents of the atmosphere are becoming increasingly important. Careful planning of measurements is essential. One of the major factors that influence the representativeness of data collected is the location of monitoring stations the planning and setting up of monitoring stations are complex and incurs a huge expenditure. An IoT-based real-time air pollution monitoring system is proposed to monitor the pollution levels of various pollutants. The geographical area is classified as industrial, Residential, and traffic zones this article proposes an IoT system that could be deployed at any location and store the measured values in a cloud database, perform pollution analysis, and display the pollution level at any given location.*

Keywords: College Assistance

I. INTRODUCTION

Increasingly stringent regulatory requirements are making it more difficult for industrial manufacturing facilities to maintain regulatory compliance and optimal process performance. Air quality monitoring and reporting requirements in the U.S., China, India, Europe, and Latin America are shifting and being redefined. Thermo Scientific air pollution monitors provide air quality analysis that meets Indian government regulations & industrial safety standards. Together we can arrive at solutions that make sound business sense.

Air Quality using MQ2 sensor along with Carbon Monoxide CO using MQ2 sensor. Measuring Air Quality is an important element for bringing lot of awareness in the people to take care of the future generations a healthier life. Based on this, Government of India has already taken certain measures to ban 'Single Stroke' and 'Two Stroke' Engine based motorcycles which are emitting high pollutions.

1.1 Objectives of the Project

- Main objective of this project is to get a clean pure air. In this project will be designing a device which can detect air pollution in the environment.
- This IoT devices will be having microcontroller as well as air quality sensor charges mq2 sensor. This IoT device will be continuously monitoring air quality and upload the data to server.
- We will make a air purifier which works on dry air purifier concept. This air purifier will be started once the air quality has been decreased. once the air quality has been restored this air purifier will be switched off.

II. METHODOLOGY

Air pollution can lead to severe health issues. We will create a system which not only detects air quality but also purifiers air when needed. To make the system we will be using Technology such as IOT and Android application. By using IOT Technology we will designer hardware kit which has a microcontroller, air quality sensor, LCD display and air purifier. Whenever there is a rise in air pollution, we will detect that by using air quality sensor.

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Once a pollution has been detected. We will start our air purifier. This air purifier will be built on mechanism of dry air purifier. The air will be forced through a filter such that dust particles and other toxic things will be clear out. This air purifier will be started once the air quality is bad. Once the air quality has been restored to normal again air purifier will be off. This air quality values will be displayed on to a LCD and the data will be uploaded in a server.

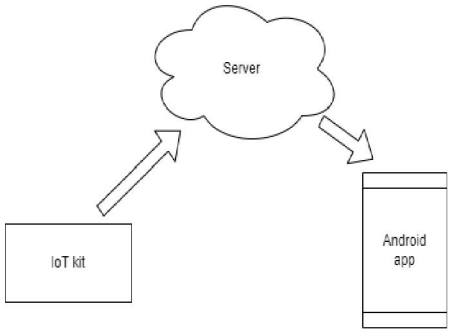

Fig 1: System Architecture Diagram

2.1 Sequence Block Diagram

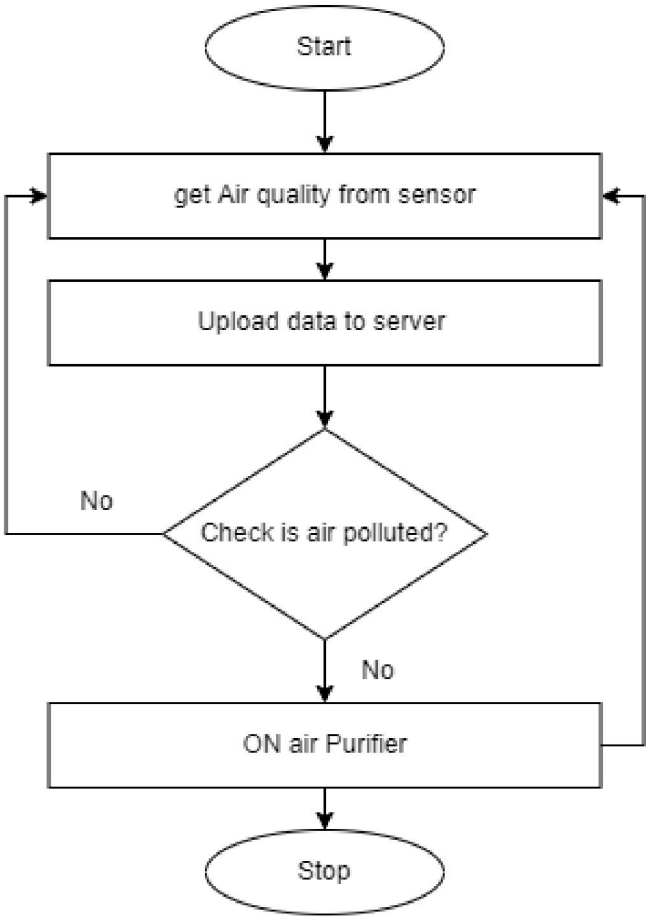

Fig 2: Sequence Block Diagram

In the Sequence block diagram will explain about how the air quality will be sensed from the sensor and upload the same data to the server later check whether the air is contaminated or not. If Yes air purifier will turn on automatically and there is a LCD display which will display the percentage of pollutant, sensed by the MQ2 sensor and Air purifier

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turns on automatically. In this circuit block diagram power is supplied to node MCU which is used to dump data into the server.

2.2 Circuit Block Diagram

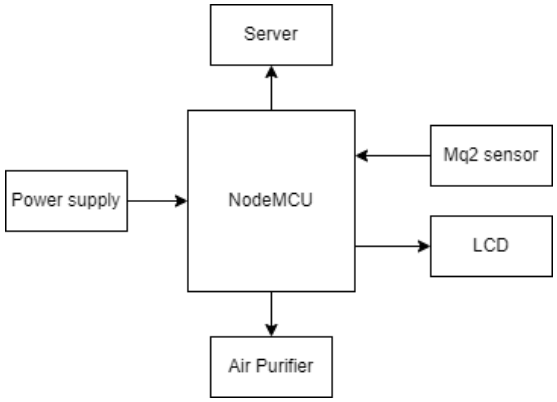

Fig 3: Circuit Block Diagram.

2.3 List of Components Used

A. Software Requirements

- Arduino IDE
- Python
- Flask

2.4 Hardware Requirements

- Node MCU
- MQ2 sensor
- 16x2 LCD display
- Air Purifier

A. Arduino IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. Projects made using the Arduino are called sketches, and such sketches are usually written in a cut-down version of C++ (a number of C++ features are not included). Because programming a microcontroller is somewhat different from programming a computer, there are a number of device-specific libraries (e.g., changing pin modes, output data on pins, reading analog values, and timers).

B. Python

Python is a dynamic, high level, free open source and interpreted programming language. It supports object-oriented programming as well as procedural oriented programming. In Python, we don't need to declare the type of variable because it is a dynamically typed language. For example, x = 10 Here, x can be anything such as String, int, etc.

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C. Python Features and Advantages

- Easy to Code. Python is a very high- level programming language, yet it is effortless to learn.
- Easy to Read. Python code looks like simple English words.
- Free and Open-Source.
- Robust Standard Library.
- Interpreted.
- Portable.
- Object-Oriented and Procedure- Oriented.
- Extensible.

D. Applications

- Web Development
- Game Development.
- Machine Learning and Artificial Intelligence.
- Data Science and Data Visualization.
- Desktop GUI.
- Web Scraping Applications.
- Business Applications. CAD Applications.

E. Flask

Flask is a web application framework written in Python. It was developed by Armin Ronacher, who led a team of international Python enthusiasts called Poocco. Flask is based on the Werkzeg WSGI toolkit and the Jinja2 template engine. Both are Pocco projects Components The microframework Flask is part of the Pallets Projects (formerly Pocoo), and based on several others of them, all under a BSD license.

F. Werkzeug

Werkzeug (German for "tool") is a utility library for the Python programming language for Web Server Gateway Interface (WSGI) applications. Werkzeug can instantiate objects for request, response, and utility functions. It can be used as the basis for a custom software framework and supports Python 2.7 and 3.5 and later.

G. Jinja

Jinja, also by Ronacher, is a template engine for the Python programming language. Similar to the Django web framework, it handles templates in a sandbox.

H. Markup Safe

MarkupSafe is a string handling library for the Python programming language. The eponymous MarkupSafe type extends the Python string type and marks its contents as "safe"; combining MarkupSafe with regular strings automatically escapes the unmarked strings, while avoiding double escaping of already marked strings.

I. Its Dangerous

ItsDangerous is a safe data serialization library for the Python programming language. It is used to store the session of a Flask application in a cookie without allowing users to tamper with the session contents.

J. Android Studio

Android Studio is the official integrated development environment (IDE) is developed for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems. It is a replacement for the Eclipse Android Development Tools (E- ADT) as the primary IDE for native Android application development.

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H. Features

The following features are provided in the current stable version:

- Gradle-based build support
- Android-specific refactoring anquick fixes
- Lint tools to catch performance, usability, version compatibility and other problems
- ProGuard integration and app-signing capabilities
- Template-based wizards to create common Android designs and components
- A rich layout editor that allows users to drag-and-drop UI components, option to preview layouts on multiple screen configurations.
- Support for building Android Wear apps
- Built-in support for Google Cloud Platform, enabling integration with Firebase Cloud Messaging.

I. MQ2 Gas Sensor

Fig 4: MQ2 Gas Sensor

MQ2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemi resistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected.

MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.

2.5 Working Principle

The MQ2 has an electrochemical sensor, which changes its resistance for different concentrations of varied gasses. The sensor is connected in series with a variable resistor to form a voltage divider circuit (Fig 1), and the variable resistor is used to change sensitivity. When one of the above gaseous elements comes in contact with the sensor after heating, the sensor's resistance change. The change in the resistance changes the voltage across the sensor, and this voltage can be read by a microcontroller. The voltage value can be used to find the resistance of the sensor by knowing the reference voltage and the other resistor's resistance. The sensor has different sensitivity for different types of gasses.

2.6 Applications

These sensors are used to detect the presence of gases in the air such as methane, butane, LPG and smoke but they are unable to distinguish between gases. Thus, they cannot tell which gas it is. Module version of this sensor can be used without interfacing to any microcontroller and is useful when detecting only one particular gas. This can only detect the gas. But if ppm has to be calculated then the sensor should be used without module.

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2.7 Node MCU

Fig 5: 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. Later, support for the ESP32 32-bit MCU was added.

NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit).

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as luacjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications (see related projects).

2.8 16X2 LCD Display

Fig 6: 16X2 LCD Display

In LCD 16×2, the term LCD stands for Liquid Crystal Display that uses a plane panel display technology, used in screens of computer monitors & TVs, smartphones, tablets, mobile devices, etc. Both the displays like LCD & CRTs look the same but their operation is different. Instead of electrons diffraction at a glass display, a liquid crystal display has a backlight that provides light to each pixel that is arranged in a rectangular network.

An electronic device that is used to display data and the message is known as LCD 16×2. As the name suggests, it includes 16 Columns & 2 Rows so it can display 32 characters (16×2=32) in total & every character will be made with 5×8 (40) Pixel Dots. So the total pixels within this LCD can be calculated as 32 x 40 otherwise 1280 pixels.

III. IMPLEMENTATION PHASE

We concluded to use the following programming languages and tools for implementing the proposed system.

- Programming Language Used: Python
- Environment used : Aurdino IDE
- Design Software: Android studio

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- Input: Air Quality Monitoring
- Output : Identifying Pollutant, Purifying through Air purifier

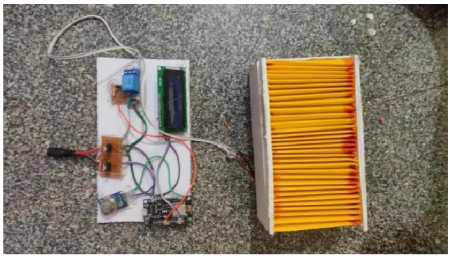

Fig 7: IoT Hardware kit

16 X2 displays mostly depend on multi-segment LEDs. There are different types of displays available in the market with different combinations such as 8×2, 8×1, 16×1, and 10×2, however, the LCD 16×2 is broadly used in devices, DIY circuits, electronic projects due to less cost, programmable friendly & simple to access. Once all these pixels are deactivated, then it will appear black and when all the sub-pixels are activated then it will appear white.

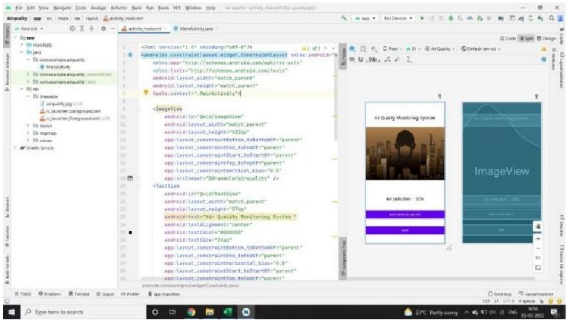

Fig 8: Implementation Code for Android Application

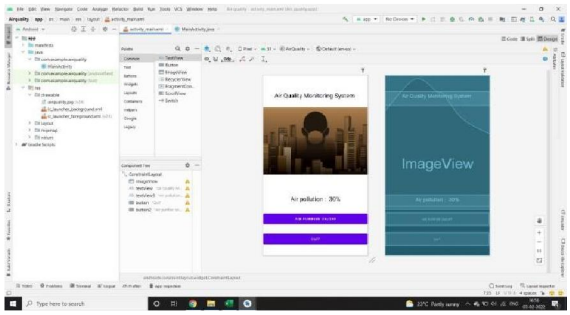

Fig 9: Software Android Application

IV. RESULTS

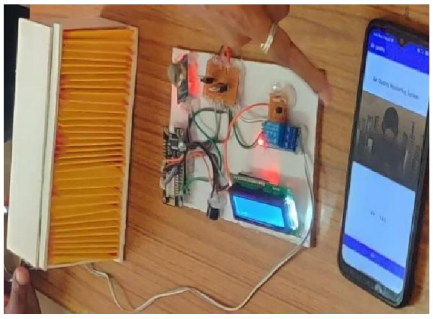

Fig 10: Final model of Aeroqual using IOT

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This is the final model to monitor the air quality, and detect and purify the toxic gases in the surrounding environment by using many hardware components and Notify using android application.

V. FUTURE SCOPE

The future scope is that device which we are having can be done in an compact way by reducing the size of the device For further implementation or the modifications which can be is that detecting the vehicles amount of pollution which can be determined. In future the range can be made increased according to the bandwidth for the high range frequencies.

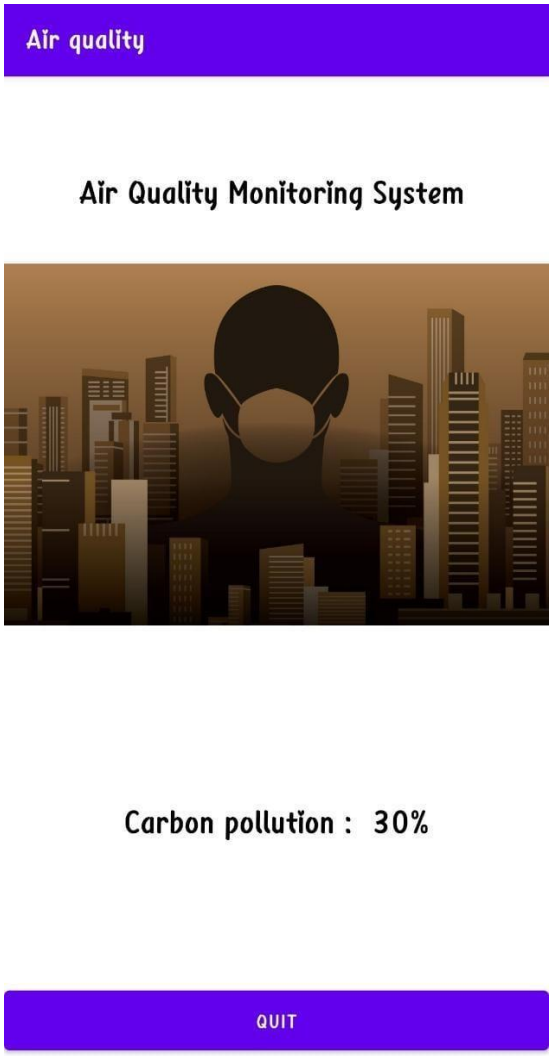

Fig 11:Output of Android Application

Once the pollutant is detected in the surrounding environment this android application is going to display the percentage of pollutant level.

VI. CONCLUSION

This system is used to send gas like benzene, alcohol, smoke, etc. using the MQ2 Gas Sensor to monitor the air of the environment using an Arduino microcontroller, IOT Technology is proposed to improve the quality of air. The use of Io technology enhances the process of monitoring various aspects of the environment such as the air quality monitoring issue proposed in this paper. The system This board has a Wi-Fi module that acts as the internet connector and

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informative access for the air quality. This measures the air quality in real-time using MQ2 Gas Sensor with Node MCU.

Node MCU will send the data to things peak platform which is connected with android application, so whenever the air quality goes below a certain level it will send the android notification, thus warning people in that particular area.

Here the use of the MQ2 gas sensor gives the sense of the different types of dangerous gas and Arduino is the heart of this project which controls the entire process. Wi-Fi module connects the whole process to the internet and LCD is used for the visual Output It supports the new technology and effectively supports the healthy life concept. This system has features for people to monitor the amount of pollution on their mobile phones using the application.

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