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Air Contamination Observing System using Internet of Things

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Abstract: ***The Internet of Things (IoT) is a worldwide network of "smart gadgets" that can interact with people and other systems. It can sense and connect to their surroundings. Air pollution is a significant problem nowadays. The present monitoring techniques have poor accuracy, sensitivity and need for laboratory testing [1]. We have proposed a three-level air pollution monitoring system to address these issues with current regulations. Gas sensors, the Arduino Integrated Development Environment (IDE), and a Wi-Fi module form the foundation of the IoT kit. Gas sensors gather information from their surroundings and send it to the Arduino IDE. It uses the Arduino Wi-Fi module to send IDE data to the cloud. We've also created the Android application IoT-Mobair, which enables users to access the pertinent cloud-based air quality data [3]. When the user arrives at their location, the pollution level is graded throughout the trial, if it is too high an alarm is displayed. Air quality data may also be used to predict future air quality index (AQI) values.***

Keywords: Air Pollution Monitoring System, Air-Pollution Safe Route, Air Quality index, Android, Cloud, Distributed systems, Sensors

I. INTRODUCTION

Air pollution, the most serious environmental problem, has a range of detrimental effects on the climate, water resources, and public health. Industries continue to be the second-largest source of pollution in all major cities as vehicles remain the primary culprit. The huge increase in air pollution is caused by people using automobiles more often. This explains why environmental pollution affects people's health. It results in skin rashes and other respiratory problems, including asthma attacks [2][3]. The installation of the pollution monitoring system enables the identification of airborne component gases in a specific location, where there are indications of acute pollution that may have negative effects on both human health and the health of other living creatures [1]. Using an Arduino and other gas sensors, this technique can evaluate the presence of harmful gases including CO, NH3, particulate matter, and smoke. Carbon monoxide gas is given the most importance since it may be a serious pollutant and a greenhouse gas emission that is warming the world [3].

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II. LITERATURE REVIEW

Monika Singh Et al. proposed a method for monitoring air pollution in August 2019. The MQ135 and MQ6 gas sensors are coupled to an Arduino microprocessor, which allows the system to detect a broad range of environmental gases. It is then linked to a Wi-Fi module that accesses the Internet. When the ppm level reaches a predetermined threshold, a buzzer alert is sounded and the output is shown to the user on the LCD. Its uses range from reference monitoring stations to industrial perimeter monitoring, data disposal, and interior air quality monitoring [7]. Yamunathangam Et al.In November 2018, the Internet of Things was used to measure the gas concentration utilizing a variety of sensors that were seen via an Arduino serial monitor. Through the use of an Ethernetshield, which is accessible in real time for further processing, this data is gathered in the thin talk channels. These studied data were presented graphically using things speak. The findings of the time-controlled Mat lab analysis were used to compute the average pollution level, and an Android app was used to display the results. The air quality index value was also determined using the location using the android app. additionally; the health consequences were also shown in this app so that users may always be informed of the pollution levels [2].K. S. E. Phala Et al. An air quality monitoring system featuring a data server, sync node module, communication lines, and air quality monitoring station was unveiled in November 2014. Based on GSM modules, they built a sync node with a data server PC. The data server and the microSD card both contain text-based real-time data (PC). You choose MySQL as the database management system. Electrochemical and infrared sensors are used to monitor the levels of CO, CO2, SO2, and NO2. GSM modules are used to build the wireless connection between the base station and the distant sensor node. Every function of the sensor node is carried out by the MCU, and the GSM modules connect with one another through cellular networks. The MCU samples sensor outputs using an internal ADC before calculating gas concentrations and sending the information as GSM packets. A test incubator was created and constructed to evaluate the sensor node's performance. By putting the sensor node in an incubator, adding gas, and keeping an eye on the sensor node readings, the sensor node was put to the test. A sync node base station formed by the GUI program is serially linked to the active PC. The receiving node, also known as Sync, gathers the data sent from the distant sensor node and delivers it serially to the computer.

The data is plotted in the GUI after being saved to text files [6].Nitin Sadashiv Desai Et al. presented a system using Beagle bones in 2017. Interfaced with air pollution sensors, including noise, carbon dioxide, and carbon monoxide sensors. The Analog pin on the Beagle Bone Black, which receives input signals in the 0 v to 1.8 v range, was used to read the analogue output from the sensor. Python SQL was used to upload sensor data to the Azure Cloud. The beagle bone itself served as the foundation for the reserved data repository. CSV data. The same facts are provided at the conclusion of each day. The cloud database receives an upload of a CSV file. An automated shell script was used to erase outdated data from the beagle bone. Data was saved in the Azure database from various sensors. This database data was downloaded in order to provide input for the machine learning service. Utilizing historical data, a machine learning service was employed to train the module. Sensor data that was retrieved by the BeagleBone Black was represented using Power BI[9].Harsh Gupta Et al. An IOT-based air pollution monitoring system was unveiled in 2019 and is composed of sensors that were meant to continuously track the levels of temperature, humidity, carbon monoxide, smoke, LPG, PM2.5, and PM10 in the environment. As a result of their effort, a one-way connection between an Android application and the open source cloud platform Thing Speak has been created. A gateway has been utilized to connect the physical system and Raspberry Pi. Firebase capabilities like Analytics, Authentication, Storage, Messaging, Hosting, Crash reporting, Real-time Database, etc. were utilized after the firebase API was integrated into an Android or iOS app. The graphs were created in Thing Speak using the sensors' data, and they were tabulated in an Android app for viewing [2].RajatSankhe Et al. In 2017, a carbon sensor was used to detect air pollutants or carbon particles. It also determines the quantity of pollutants present and outputs an analogue signal. The analogue output of the sensor was converted into digital form using the ADC and sent as an input to the microcontroller because that device only accepts digital input. On the LCD, these values are continually presented. The crucial value was entered using a switch pad. The buzzer will sound and a notice will be sent to the website on the mobile phone by the microcontroller through the GPRS module if the amount of pollutants in the air exceeds the critical value specified. The website, which is accessible from anywhere in the world, is constantly being updated with this information. When the pollution level exceeds the critical threshold, a notice was also sent to the website. When a mobile phone gets a signal from a modem, the server forwards it to the internet. The data that the server receives from the smart phone is analyzed. It draws conclusions from the data it has gathered and then distributes those conclusions through the internet [3].Poonam Pal Et al. In October 2017, an Arduino microcontroller-based air monitoring gadget was created. To manage the whole process, they employed the Arduino and the MQ135 gas sensor to identify different kinds of dangerous chemicals. The output of the MQ135 gas sensor is shown as voltage levels that may be translated into PPM. The visual output was provided by an LCD, and the process' connection to the Internet was made possible via a Wi-Fi module. When the PPM limit is surpassed, the buzzer begins to beep and the LCD and website show "Bad Air, Open Windows." The LCD and website will show fresh air if the value is less than 1000 PPM. When it hits 2,000, the siren keeps going off and "Danger!" appears on the LCD on the website. The fresh air [11].

III. PROPOSED SYSTEM

In our proposed system, we are implementing a revolutionary method of air filtration monitoring in metropolitan cities [7]. The system has MQ4 sensors for methane and CNG gas measurement as well as MQ3 alcohol sensors. The sensor data is continuously monitored by a microcontroller. If any sensor value exceeds the threshold value, the microcontroller will trigger an alarm and send an alert to the authorized person using the IOT module [2][3]. All sensor data is continuously displayed on an LCD and updated on a website with the aid of an IOT module. A text message is further sent so that the person can initiate a proper response [6].

IV. BLOCK DIAGRAM

The following block diagram illustrates the many hardware elements that make up the IoT-based air pollution monitoring system. The primary hardware components are the Arduino microcontroller, IoT, sensors, and LCD display. The auxiliary components are the buzzer and LCD [5]. LPG, methane, CO2, and alcohol sensors which are the primary ones utilized to discover the pertinent gases. The system needs Android as a core platform for the application [4]. The Wi-Fi connection on the device is also necessary for the system to work.

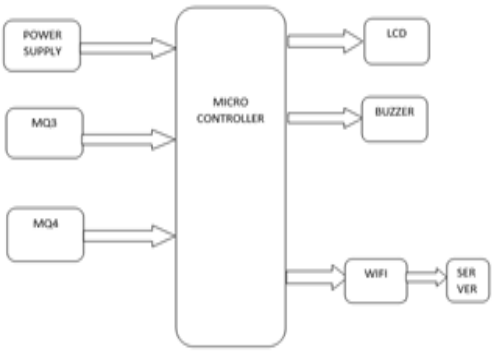

Figure.1. Block Diagram

V. METHODOLOGY

PHASE – 1: Detection of Air Pollutant Level
Air pollution is detected by the development of an IoT-based air pollution detecting kit. The information is delivered through Wi-Fi for storage after being collected from gas sensors attached to a microcontroller.
PHASE - 2: Creating the interface
Clarification of the many optional performance components is required at this level. The MCP3008 is a 10 bit converter with on-board sample and hold circuitry that is calibrated to transfer analogue data to digital.

The mobile application allows for the storage, processing, and monitoring of the acquired data. Through the app, users may examine the saved data [4].

PHASE - 3: Execution and Testing

With the aid of various circuit designs, the components are interfaced with each other and the project deliverables are constructed. The design is put through testing, debugging, and troubleshooting to check the performance in different scenarios. A new circuit design should be implemented and tested if the old circuit design fails the tests [10].

VI. HARDWARE REQUIREMENTS

A. Arduino UNO:

Alternatively, it can be an Arduino Uno ATmega328P compatible microcontroller board. Six analogue pins, fourteen digital I/O pins, the Arduino IDE, a USB port, a power connector, an ICSP, and a programmable 16MHz resonator with a reset button are all included on the board. It enables separating programs into separate sections of code in order to perform certain tasks [2].

Figure.2. Arduino UNO

B. LCD Display:

Liquid Crystal Display is known as LCD. It is a flat panel display that runs mostly on liquid crystals. It joins a nine-pin D-connector to a two-line, 16-character alphanumeric LCD display. It comprises two pieces of sandwich liquid crystal material between two pieces of polarized glass [8].

Figure.3. LCD Display

C. Wi-Fi modules:

Many products need Wi-Fi modules (wireless fidelity), also known as WLAN modules (wireless local area network) modules [2], in order to create a wireless internet connection.

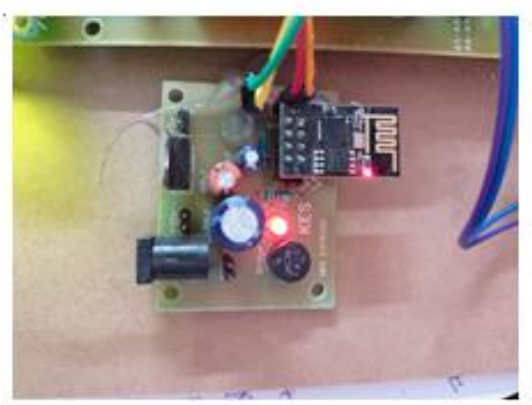

Figure.4. WIFI Module

D. BUZZER:

It is an electrical gadget for signaling that emits a buzzing sound [2]. It has an outside housing and two pins for connecting to power and the ground. The ceramic disc stretches or shrinks as the current is applied. This alteration causes the nearby discs to vibrate.

Figure.5. Buzzer

E. MQ3:

This module was developed using a MQ3 Alcohol Gas Sensor. Alcohol gases can be detected by this semiconductor sensor at concentrations between 0.05 mg/L and 10 mg/L. The sensitive material used in this sensor is SnO2, a chemical whose conductivity decreases in clean air [3].

Figure.6. MQ3 sensor

F. MQ4:

The MQ4 methane gas sensor measures the amount of methane gas present in the atmosphere and outputs the result as an analogue voltage [3]. Leak detection may be done using concentration detection ranges which range from 300ppm to 10,000ppm. For instance, if the gas stove is not lit, the sensor may still detect it even if it is turned on.

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Figure.7.MQ4 Sensor

G. Implementation

Arduino IDE

Integrated Development Environment, or IDE, is a name for the official software that Arduino.cc released. It is primarily used for editing, compiling, and uploading code to Arduino devices [2][3]. It is a cross-platform program that runs on Windows, macOS, and Linux and is created using C and C++ functions. The primary purpose of the open source software Arduino IDE is to write and compile code for Arduino Modules. It contains a serial monitor, which is primarily used for computer-based communication with the Arduino board. This makes it an excellent tool for real-time monitoring and troubleshooting [5].

Figure.8. Arduino IDE

H. Implementation IOT:

The Internet of Things or IoT, is a network of interconnected computers, mechanical and digital equipment, items [7].People who may exchange data across a network without having to physically interact with each other

Fig .9. IoT Implementation

VII. RESULT AND DISCUSSION

In this paper, based on our research the outcomes are recorded i.e MQ3 value was 700 and MQ4 value was 1000, is considered normal as it lies within the threshold limit. Threshold values are set accordingly if MQ3 value >600 and MQ4>1000 its normal condition and there's no trace of air pollution and if MQ3 value <600 and MQ4 value <1000its detecting air pollution. All these values will be updated in the website. By using the data stored on the website we can monitor the air pollution status continuously.

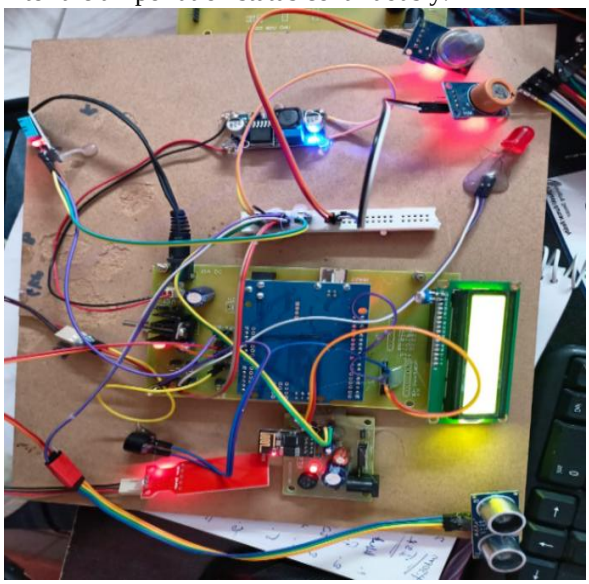

Figure. 810. Connectivity of Sensors and the Arduino Uno and Wi-Fi Module

Data is gathered from sensors linked to an Arduino board, transferred to a cloud platform, and stored there [4]. Create a user-friendly, portable Android application that the user may use to learn the degree of pollution in their specific location. Utilize the analytical module to forecast air quality [2]. When a high amount of pollution is identified, more information about the pollution is captured and communicated to a designated individual so they may take the appropriate action [3].

VIII. CONCLUSION

Air pollution is a dangerous issue that has worsens with time. It is essential to solve the issue with regard to human health. This method has been created to monitor the air quality in order to preserve it and reduce air pollution [3]. In addition to monitoring, it also keeps a record of the pollution-related information for future use. This technology helps in taking necessary action by sending a text message to the individual if there is excessive pollution [5].

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