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Digital Air Quality Monitoring System

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ABSTRACT-

In this paper a cost effective, portable and easily manageable air quality monitor has been presented to measure the quality of the air using Arduino and some specific sensors. This device works by collecting the amount of specific toxic molecules present in air and display it on the OLED. Data collected from the different place can analysed and used to state the air quality and also help concerned individualities to act upon it.

1.Introduction-

The most essential element for life is air. The air we inhale today is a combination of unsafe poisons in high fixation. As the population grows, so does the amount of pollution. Because of the expansion in air contamination life is becoming jeopardize to us and other living things. The contaminated objects are affecting people's health and surround them. This represents a danger to the group of people yet to come. Examining air quality is a significant however troublesome undertaking. Thus, we needed to raise this framework to actually look at the air quality and to go to vital safeguards and lengths to lessen this for better future and cleaner air. Air pollution is a critical issue and a justification behind huge concern these days. A report circulated in 2014 by the World health Organization (WHO) communicates that 7 million individuals are passed on generally in2012 as a result of air contamination. Volcanic emissions and forest fires were two forms of air pollution that existed long before humans. Regardless, it ended up being significantly more normal after the Modern Unrest. Quick present day improvement, unregulated releases and an enormous gathering of various issues basically added to the climb in air defilement. The severity of the air pollution sometimes reached a point where government intervention was required. In 1952, London's Great Smog was an outrageous example of air pollution that was difficult to perceive. Additionally, it was the cause of numerous illnesses and the subsequent deaths of numerous regular people. In Delhi, the levels of air pollution in November 2017 were as high as possible multiple times higher. As a point of comparison, the air quality record ranges from 0 to 50; however, during that particular time period, the air quality list reached 500 or higher. This capability is as of now called the Incomparable Brown haze of Delhi. Every person who is exposed to the air will suffer irreversible lung damage and a wide range of other ailments if the air quality list contains 500 or more contaminants. As a result, appropriate actions must be taken to prevent similar situations in the future. The internet, sensors, processors, and storage are the primary components of the Internet of Things (IoT) network. In this network, each of these devices is connected to each other. We will be able to get a clear picture of the extent of the damage caused by air pollution.

2.LITERATURE SURVEY

2.1 AIR POLLUTION MONITORING SYSTEM USING ARDUINO WITH MQ135SENSOR:

Anand kanti et al Analysing the data enables us to evaluate how bad air pollution is on a daily basis.The evolution of human health, ecosystems, and the climate are all negatively impacted by air pollution, which is a major concern in nature. The primary aspect that determines how well the air is in cities and other metropolitan places is reduces the quality of air and has a direct impact on disease occurrence.

2.2 A SMART AIR POLLUTION MONITORING SYSTEM:

Kennedy Okokpujie et al The real-time monitoring and analysis of air quality along with the logging of data to a remote server that receives updates through the internet are all features of the air pollution monitoring system. Based on the measurements of the air quality.With the use of Microsoft Excel, parts per million (PPM) values were examined. The system's measurements of the quality of the air were precise. The outcome might be viewed on the display interface of the developed hardware and accessed over the cloud on any intelligent mobile device.

2.3 AIR QUALITY MONITORING IN INDUSTRIAL ESTATE:

Filson M. Sidjabat et al The lack of a trend in the AAQ and meteorological data meant that this analysis was unable to accurately assess the state of the local air quality. As a lesson learned and to get insight into how to enhance the JIE AAQM System, an evaluation of AAQM and Management in other industrial estates was conducted. The AAQ data can be examined using an open-air model.Weather information at the sampling point region is displayed using the pollution rose function. The results and analysis will be constrained by the AAQM's and weather's restricted data. Real-time/continuous AAQM and meteorological data must be created as a goal of future research in order to obtain more accurate and thorough data modelling and analysis.

2.4 PROTOTYPE OF AIR QUALITY SENSOR FOR GAS POLLUTANTS MONITORING SYSTEM IN INDUSTRIL AND RESIDENTIAL ESTATES:

Enndi Chiu et al The experiment, in which a table and graph are displayed for analysis and summarization, has been completed successfully. The measurement results are then contrasted with the required level of environmental air quality. As a result, the typical Industrial areas have ppm levels of 30 ppm for CO2, 28.9 ppm for NH3, and 27.08 ppm for CO. While the average ppm in a residential area for CO2 is 21.32 ppm, 19.3 ppm for NH3, and 20.93 ppm for CO.

2.5 LOW COST AIR QUALITY MONITORING SYSTEM USING LORA COMMUNICATION TECHNOLOGY:

The test findings demonstrate that the system's architecture could read air pollution levels and send them to the Thingspeak server. Up to a distance of 32 metres, data could be successfully received from outdoor-located sensor nodes by an indoor gateway with a 100% success rate. The success percentage of data reception by the gateway at a distance of 50 metres was 99.17%, while at a distance of 70 metres, it was 78.3%.

2.6 AIR QUALITY MONITORING USING IOT:

Suresh Babu et al The goal of this study was to develop an Internet of Things-based air quality system to assess local air quality. The instrument is capable of monitoring the air rates of various chemicals, such as O3, SO2, CO, and particle matter by sensors. Read the sensor detail for the Arduino microcontroller. After being transferred to the cloud system, the data used an Arduino WIFI module to access the cloud system. A cloud Site page makes the tracking's results accessible. The present model has been successfully implemented and can be used to construct actual systems.

2.7 IOT BASED SOUND AND AIR POLLUTION MONITORING SYSTEM:

Karthikeyan Sengunthar et al Using a wireless embedded computing system, a method to monitor the levels of noise and air pollution in an industrial setting is suggested in this work. The result of combining the fields of computer science and electronics is the technology known as the Internet of Things (IoT). Sensing devices are linked to the embedded computing system in this scenario to monitor deviations from typical levels of parameters like noise and air pollution. This approach is adaptable and distributive for any infrastructure setting, meeting the needs of continuous monitoring, regulating, and behaviour analysis.

2.8 REAL-TIME AIR QUALITY MONITORING SYSTEM USING MQ135 AND THINGSBOARD

Shola Usha Rani et al Real-time air quality monitoring requires a technical approach. Periodic manual sample collection to measure pollution levels is not feasible. Therefore, an Internet of Things (IOT)-based solution that can be implemented in real time will serve the intended purpose. The work in this paper is concentrated on information transfer and system communication over the internet network protocol.

2.9 CLOUD -BASED AIR QUALITY MONITORING THROUGH WIRELESS SENSOR NETWORK USING NODEMCU:

A WIFI-enabled ESP8266 Node MCU microcontroller is used to implement this, and it is connected to air quality monitoring sensors MQ135 and DHT11 (Humidity and Temperature), as well as a geophone sensor to measure vibration levels in industrial settings and a flame sensor to protect workers from fire accidents. The buzzer serves as an alerting component. The software is interfaced with Node MCU to record the sensor data, analyse it, store it in the cloud, and monitor it on the BLYNK (an IoT platform).

2.10 A COMPREHENSIVE REVIEW ON INDOOR AIR QUALITY MONITORING SYSTEMS FOR ENHANCED PUBLIC HEALTH:

Jagriti Saini et al This article discusses how wireless technology can be used to create cyber-physical systems that can monitor activity in real time. It also offers a critical analysis of the difficulties in creating real-time monitoring systems as well as microcontrollers utilised in system architecture. Additionally, this study offers researchers some fresh perspectives and avenues to explore in the field of IAQ monitoring.

3.HARDWARE DESCRIPTION

The Components used in this project are

- Arduino Nano
- MQ135 Sensor
- DHT11 Sensor
- Bread Board
- OLED Display
- Jumper Wires

3.1Arduino Nano

Robotics, embedded systems, automation, Internet of Things (IoT), and electronics applications frequently use Arduino boards. Originally intended for non-technical consumers and students, these boards are now often employed in industrial projects.

Important features of Arduino Nano:

1. Microcontroller used in Arduino Nano is Atmega328p.
2. The operating voltage of the Arduino nano is 5V
3. The Input Voltage is approximately 6V-12V.
4. The Maximum Current Rate is 40mA
5. The USB used for the connection to the power supply is Type-B Micro USB.
6. It does not has any DC Power Jack.

The Pin description of Arduino Nano is given by:

D0-D13 -Digital Input/Output Pins

A0-A7 -Analog Input/Output Pins

Pin 3,5,6,9,10,11 – Pulse Width Modulation Pins.

Pin 10,11,12,13 - SPI Communication Pins

Pin A4,A5 - 12C Communication Pins

Pin 13 -Built in LED for Testing that the arduino is working

D2 & D3 -External Interrupt Pins

3.2 MQ135 Sensor

Ammonia (NH3), sulphur (S), benzene (C6H6), CO2, and other dangerous gases and smoke can all be detected by the MQ-135 Gas Sensor. This sensor features a digital and analogue output pin, just like the other gas sensors in the MQ series. The digital pin goes high when the airborne concentration of these gases exceeds a predetermined threshold.

Specifications of MQ135 Sensor:

- The operating voltage of MQ135 Sensor is 2.5V to 5.0V
- Power Consumption is 150mA
- The operating Voltage is 5V
- The Digital Output provided is 0V to 5V through Vcc pin
- The Analog Output provided is 0 – 5V @ 5V Vcc

3.3DHT11 Sensor

A basic, extremely affordable digital temperature and humidity sensor is the DHT11. It measures the humidity in the air using a thermistor and a capacitive humidity sensor, and it outputs a digital signal on the data pin without the requirement for analogue input pins.

Specifications of DHT11 sensor:

- Power source: DC 3.3 to 5
- Maximum current usage is 2.5mA.
- Operating range: 0-50°C, 20-80% RH.
- Range of humidity measurements: 20 to 90% RH
- Accuracy of humidity measurements: 5% RH
- Range of temperature measurement: 0 to 50 °C
- Accuracy of temperature measurements: 2°C

3.4 Breadboard

A breadboard, solderless breadboard, or protoboard is a construction platform used to create electronic circuit prototypes that are semi-permanent. Breadboards are reusable since they don't need to be soldered or have their tracks destroyed, unlike perfboards and stripboards.

3.5 Jumper wires

An electrical wire, or group of them in a cable, with a connector or pin at each end is called a jump wire. It is typically used to connect the parts of a breadboard or other prototype or test circuit internally or with other machinery or parts without soldering. Male to female jumper cables are used in electronic prototype and testing applications to quickly and easily connect components without soldering. Building your own electronics on a breadboard is made simple by the male to male breadboard jumper wire. With prototyping board connectors on both ends, these cables are versatile. Your microcontroller and the breadboard on the bots can easily be connected using a jumper cable.

3.6 OLED

The OLED display is built on the same organic substance that is used as the semiconductor material in light-emitting diodes (LEDs). The display is made by sandwiching two conductors with thin organic sheets. When an electric current is passed through this object, a bright light is released. Because OLED displays don't require backlighting, they can be lighter and thinner than previous display technologies. OLED displays also have a wide viewing angle of up to 160 degrees, even in intense light, and only need two to ten volts to run.

4.SOFTWARE DESCRIPTION

4.1. ARDUINO DEVELOPMENT ENVIRONMENT

Almost all Arduino Modules may be programmed, compiled, and uploaded using the Arduino IDE, an open-source tool developed by Arduino.cc.

• Code compilation is so straightforward because it is official Arduino software that even the typical person with no prior technological ability can start learning.

• It is compatible with all operating systems, including MAC, Windows, and Linux, and works on the Java Platform. For debugging, editing, and compiling the code, the Java Platform has built-in functions and commands.

• The Uno, Mega, Leonardo, Micro, and many other Arduino modules are among the options.

The Uno, Mega, Leonardo, Micro, and many other Arduino modules are all readily available.

• The core code, frequently referred to as a sketch, will eventually output a Hex File that is transferred and uploaded into the controller on the board after being developed on the IDE platform.

• The Editor and the Compiler are the two core elements that make up the majority of the IDE environment. The required code must be written in the Editor, and it must be compiled and uploaded into the given Arduino Module using the Compiler.

This environment supports both C and C++.

The IDE environment is composed mostly of three components.

Text Editor, Output Pane, and Menu Bar

• Sketches are the name for programmes written using the Arduino Software (IDE).The text editor is used to create these sketches, which are then saved with the file extension.

• The editor has tools for text substitution and text searching.

• The console displays text produced by the Arduino Software (IDE), together with further details and thorough error warnings. Using the toolbar buttons, you can create, open, and save sketches, validate and submit programmes, view the serial monitor, and more.

A program's startup function called setup () is used to initialise settings.

The function loop () is run repeatedly until the board shuts off. The Menu Bar at the top of the screen has the following five options.

• File - To write the code, open a new window or reopen an existing one. The following table shows how many extra categories the file option is separated into.

After you click the upload button, the Output Pane will show you the code compilation as you check the compilation section in the choice area.

• Edit - Used to copy the code and paste it while making additional font changes.

For programming and compilation, use Sketch.

The majority of tool usage occurs in testing projects. Using the Programmer section of this panel, a bootloader is written to the new microcontroller.

• Help - If you have questions regarding the software, complete online help is available, from installation to troubleshooting. Compilations of Compilations.

• Interaction (1235)

Device control (994); Data processing (313); Data storage (154);

Sensors (1152), Other (467), and Display (483)

Input/Output Signals (429)

Libraries

• Communication (1235)

• Data Processing (313)

• Data Storage (154)

• Device Control (994)

• Display (483)

• Other (467)

• Sensors (1152)

• Signal Input/Output (429)

4.2. EMBEDDED C LANGUAGE

Most of the syntax and semantics found in standard C are used by embedded C, including the main() function, variable definitions, datatype declarations, conditional statements (if, switch case), loops (while, for), functions, arrays and strings, structures and unions, bit operations, macros, etc.

It is used to programme microcontrollers and processors in industries like automotive, industrial automation, consumer, aerospace, and medical applications. It is suitable for developing programmes that must directly connect with the hardware because it is a low-level language with direct access to the hardware. It is ideal for use in resource-constrained applications due to its smaller memory footprint than other languages. Additionally, embedded C can be used to create trustworthy and efficient software.

5. METHODOLOGY

- Design :The first step in developing a Digital Air Quality Monitoring system is to design a system. This includes building a overall system hardware components and algorithms which helps to process the data.
- Sensor Selection: The next step is to select the sensors which can be placed in the monitor. This includes considering factors such as sensitivity, cost, accuracy and compatibility of the design .

- Signal Processing: After the selection of sensors the signal from the sensors must be processed and analysed.
- Air Quality Sensor (MQ135): This sensor is used to detect the quality of the surrounding air.
- The Air Quality Sensor module consists of a steel exoskeleton under which a sensing element is housed. The gas coming close to the sensing element get ionised and are absorbed by the sensing element.
- In addition to that DHT11 temperature sensor is used to measure the temperature and humidity of the surrounding.
- Both sensors can be interfaced to the Arduino nano using their respective libararies and appropriate connections.

6. DESIGN AND IMPLEMENTATION

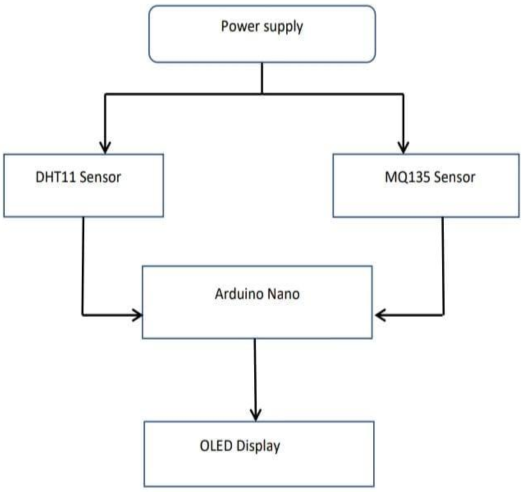

Fig 1 BLOCK DIAGRAM

6.1 INTERFACING THE MQ135, DHT11, OLED DISPLAY WITH ARDUINO

- Connect the Arduino nano to the power supply.
- Connect the DHT11 sensor and MQ135 sensor to the Arduino nano.
- Connect the OLED display to the Arduino nano board.
- Program the Arduino board to receive the input from the sensor and the display.
- Test the connection by sending a signal from the MQ-135 sensor.
- As the results obtained, the display shows the quality of the surrounding air.
- Program the Arduino nano to display the quality of the air, temperature and humidity of the surrounding air in OLED display.
- Once the components are interfaced properly, test the complete system by measuring air quality.

7.RESULT

The output is displayed on the OLED once the MQ-135 and DHT 11 sensors have measured the air quality in the immediate area.

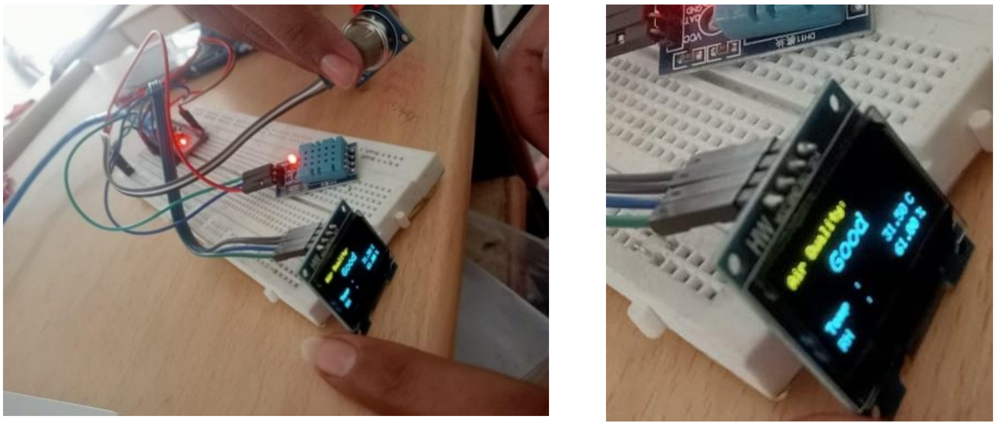

Fig 2 OUTPUT

8.CONCLUSION:

Our device is a useful technological tool that is used to assess the air quality in an area where air pollution is the primary contributor to many emerging diseases.Our tool also enables us to take some preventative actions that lessen air pollution.

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