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BREATHING EASIER IOT-BASED AIR POLLUTION MONITORING SYSTEM

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ABSTRACT: Develop and implement a low-cost method for monitoring air pollution. The proposed solution will inform workers about data on polluted locations that have been investigated nearby. Several components of the recommended system are linked to an ESP32 microprocessor. These components include temperature, humidity, and air quality sensors. The ESP32 Wi-Fi module is used to record and deliver data to the cloud. The MQTT (Message Queuing Telemetry Transport) technology sends the data to the cloud platform. The software then notifies the user. The proposed system could be employed in a variety of applications, particularly in fields where it is critical to monitor the amount of dangerous gas pollution. More information regarding pollution is utilized to alert workers that the air quality where they are is poor.

KEYWORDS— Internet of Things, Blynk, Arduino, arduino IDE, sensors, Air pollution.

I. INTRODUCTION

In today's business and technological world, the internet of things system is rapidly expanding. The importance of employee well-being, which encompasses their health, safety, and any potential negative consequences, has expanded for many firms across all industries. The Internet of Things is a collection of physical objects that are linked together and may be handled and monitored from a distance via wireless networks. Environmental issues have the potential to produce major tragedies. Pollution of the air and sounds are major issues. The primary purpose is to identify and quantify the amount of pollution in the air.

Air pollution is the most serious problem in any country, regardless of how developed or growing it is. Gas pollution can make breathing difficult, irritate the eyes, and cause lung cancer in humans and animals. Pollution can lead to more serious health concerns such as coughing, heart disease, pneumonia, lung infections, and exacerbated asthma. It may also induce mild allergic symptoms in the nose, eyes, and throat. These are the issues that frequently arise when a company fails to comply with regulations and reduce emissions. More and more people are experiencing health concerns. This is especially true in developing-country cities where transportation and industry have emitted a high concentration of gaseous pollutants.

The proposed study is a smart strategy to address this issue since it demonstrates how critical it is to monitor pollution levels near companies in a precise, reliable, and effective manner. The technology monitors harmful gases in factories and compares high pollution levels to determine standards. It also alerts people when the air quality dips below a specific threshold, indicating that the region is dangerous. In the current configuration, the sensors MQ6 and MQ135 communicate with an Arduino CPU. An LCD (Liquid Crystal Display) is used to display information on the device. Rapid technological advancement has enabled the development of compact, low-cost sensors that are both technically and financially viable. A lot of attention is paid to issues that may have an impact on both the natural system and people's health. The primary function of an Internet of Things (IoT) air pollution tracking system is to monitor and record pollution levels, which are currently high. To protect everyone's health and brighten the future, we must diligently

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adhere to and maintain air quality standards. The Internet of Things (IoT) is becoming increasingly popular because to its flexibility and low cost.

IOT - The term "Internet of Things" (IoT) refers to a collection of physical items, or "things," that can be linked together by sensors, software, and other technologies. These devices can exchange information and connect with other devices and buildings via the internet. These gadgets range from common household goods to cutting-edge office technology. Experts predict that there will be over 7 billion Internet of Things (IoT) devices connected by the end of 2020. That number will increase to 10 billion by 2022, and 22 billion by the end of 2025. Oracle collaborates with other firms to create tools.

Arduino - Arduino is an open-source hardware and software platform that is simple to use. Arduino makes it easy for designers, artists, amateurs, and others to create interactive items or surroundings using electronics. Giving the board's processor a set of instructions allows it to do specific actions. This is accomplished using the Wiring-based Arduino programming language and the Processing-based Arduino software (IDE).

Arduino IDE - An integrated development environment (IDE) is a piece of software that provides all of the tools that computer programmers require to create software. Integrated Development Environments (IDEs) typically include a debugger, build automation tools, and a source code editor. Most Integrated Development Environments (IDEs) now contain powerful code completion tools.

Blynk – Blynk is a set of tools that allows smartphone users to interact with electronics such as Arduino, Raspberry Pi, and other similar devices. It is used by builders, makers, designers, educators, and technology enthusiasts. Blynk works with a variety of commonly used shields and boards. Customers can benefit from Blynk Cloud's ease of use. Furthermore, it is crucial to understand that cloud technology is free and open source. Blynk is a versatile tool that may be used with a variety of shields. Instead, it is designed to keep the coverings and boards protected. It is compatible with PCs running Android and iOS.

Sensors - A device that can detect varied amounts, such as fire, smoke, and other comparable substances. Sensors are what enable the Internet of Things (IoT). They collect data to help individuals make better decisions.

II. BACKGROUND

The proposed method for monitoring air pollution uses an Internet of Things infrastructure. Using this strategy, a comprehensive review of the existing literature is conducted. This allowed them access to a wide range of methodologies and technology developed by other writers in the field. In 2016, Marin B. Marinov This work uses a scalable sensor array with built-in infrared and amperometric gas sensors to demonstrate a cost-effective method for measuring crucial environmental parameters. The measurement was compared to data from the local environmental control body's stations after tests were conducted throughout the city. After seeing some first outcomes, this method appears to be a less expensive alternative to employing high-end tools. Another major issue is the sheer number of gadgets and links required.

Name: David Marquez-Viloria. (2016) This study describes how an inexpensive georeferenced air pollution measuring system was created and put into service. The system uses scatter-based methods to measure PM1, PM2.5, and PM10 particles. The instrument measures not just ozone levels in the air, but also temperature, humidity, and barometric pressure. The entire system is linked to a low-cost microcontroller with WiFi built-in. This allows data to be transferred to the cloud right away via the MQTT protocol. The data can subsequently be georeferenced and shared on an open-access website, similar to how the Internet of Things (IoT) collects and displays data. Some people may consider this strategy to be pricey software. Furthermore, a vast amount of data must be entered, with an increasing number

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of entries required to make it relevant for various purposes.

Chen Xiaojun was born in 2015. The air pollution and forecasting method presented in this paper is an effective solution to address the complex issue of air pollution. Multiple devices are utilized to increase monitoring accuracy, reduce monitoring costs, and ensure that data collected in the monitored region is correct and logical. The perception, network, and application layers make up the majority of the IOT design. Because this technology is only employed at a few corporate monitoring stations, the data it generates cannot be used to predict how dirty the air would be overall.

Vasim K. Ustad published his study in 2014. The suggested architecture consists of a portable data acquisition (DAQ) unit and a fixed pollution surveillance system with Internet connectivity. The Mobile-DAQ gadget has a GPS receiver, a set of air pollution detectors, and a microcontroller constructed on one chip. A "Pollution-Server" is a high-performance, dedicated application server for computers connected to the Internet. The Mobile-DAQ device measures and combines the levels of CO, NO2, and SO2 in the air. After that, it stores this information in a container along with the GPS coordinates, time, and date. We wish to use a zigbee device to communicate data to the Pollution-Server. Additionally, ZigBee has a slower pace of data transfer than WiFi. The Zigbee protocol allows for just a limited amount of data to be transmitted at once.

Ibrahim Kadri (2013 To detect air pollution immediately, a wireless sensor network is deployed. This study depicts a system composed of numerous dispersed monitoring stations that communicate wirelessly to a back-end server via machine-to-machine (M2M) technology. Real-time data from the stations is delivered to the back-end computer, where it is converted into information that users may access via mobile apps and websites. Solar energy is required and can be used cost-effectively. The device must always have an internet connection.

Khan, Khaled Bashir Shaban (2016 This essay discusses the Air Pollution Monitoring System and the portion of it that makes forecasts. The principal pollutants in the air are sulfur dioxide (SO2), nitrogen dioxide (NO2), and ground-level ozone (O3). The system employs low-cost air quality monitoring devices with a range of gas and weather sensors built in. These motes communicate wirelessly with an intelligent sensor base containing many modules. Receiving is the modules' task.

The film Bathiya Bhavika was released in 2017. Environmental quality measures have declined over time as cities and industry have grown at a rapid pace. Our main goal is to integrate Wireless Sensor Networks (WSN) into a system that monitors its surroundings. Each sensor node contains several sensors and radio devices. Even though XBee radio modules were utilized, alternative radio modules might be used depending on the requirements. In network architecture, a tree construction method is used to track the hierarchical relationships between parents and children as well as to organize sleep cycles. People who want to use xbee-compliant items must thoroughly understand how the system works. When compared to WiFi-based security systems, this technology lacks sufficient security measures.

In 2019, JunHo Jo proposed an Internet of Things (IoT)-based indoor air quality monitoring solution, which was developed further. The system consists of a web server and a "Smart-Air" device that monitors air quality. This technology leverages cloud computing and the Internet of Things to continuously monitor the air quality inside any structure, at any time. Smart-Air uses Internet of Things technology to swiftly evaluate air quality and deliver real-time data to a web server via LTE. It consists of a CPU, an LTE modem, and pollution detection sensors. To monitor air quality, the study device was designed to assess aerosol, volatile organic compounds (VOC), carbon monoxide (CO), carbon dioxide (CO2), temperature, and humidity.

III. SYSTEM REQUIREMENTS

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Hardware Requirements

The ESP32 Microcontroller can be used as a secondary device to a primary MCU or as a standalone system, decreasing the load on the core application CPU's communication stack. It can link to other computers via Bluetooth and Wi-Fi, as well as the SPI/SDIO or I2C/UART interfaces. The subject is an Arduino LCD display module with an I2C interface and a 16x2 character resolution. Two lines contain sixteen characters, each sized 16 by 2 pixels. Black writing is presented against a green background. The LCD screen requires only four ports: SCL, VCC, GND, and SDA.

The DHT11 is a simple and inexpensive digital thermometer that accurately monitors temperature and humidity. To detect ambient air conditions, the device uses a thermistor and a capacitive humidity sensor. It then sends a digital signal via the data pin, which eliminates the need for analog input connections. While the tool is simple to use, care must be used when retrieving information.

The MQ-5 sensor module can detect gas leaks in both residential and commercial installations. This gadget is capable of detecting alcohol, hydrogen (H2), liquefied petroleum gas (LPG), methane (CH4), and carbon monoxide. The device's remarkable sensitivity and rapid reaction allow for instantaneous readings.

The MQ-135 Gas Monitors are helpful for measuring or detecting CO2, alcohol, benzene, smoke, NH3, NOx, and smoke. They are employed in devices for air quality control. The MQ-135 sensor module contains a digital pin that allows it to function without a CPU.

The MQ-3 Sensor module can detect gas leaks in both residential and commercial buildings. Its components include carbon monoxide, liquid petroleum gas, benzene, hexane, methane, and alcohol. As someone drinks more alcohol, their resistance decreases. The resistance is tested to determine the amount of alcohol present.

Any smartphone that can connect to the internet can function as a mobile phone. To connect the breadboard components to the Arduino header pins, you will need to utilize jumper wires.

Software Requirements

Embedded C is a set of language extensions designed to operate with the computer language C. To incorporate advanced microprocessor functions such as fixed-point math, multi-memory, banking, and basic input-output (I/O) processes into the embedded C system, the C language must be expanded in unexpected ways. Embedded C makes extensive use of the -C standard's syntax and semantics.

The Arduino IDE includes code editors, message boards, text displays, toolbars with commonly used buttons, and menus. It establishes a connection with the Arduino hardware in order to access connections and programs. Software developed by Blynk.

IV. PROPOSED SYSTEM

This section goes into considerable detail about the proposed system. This system will employ an internet-based app to monitor and report air quality. It will immediately send out a warning if the air quality drops below a specific threshold. This level is determined by the presence of hazardous gases such as smoking, alcohol, benzene, ammonia (NH3), carbon dioxide (CO2), and liquid petroleum gas (LPG). The level of air quality will be displayed on both the LCD screen and an easy-to-use mobile app. It will be measured in parts per million (ppm). This system, which is widely used in houses, now includes an LPG indicator. An LCD screen displays the system's temperature and humidity.

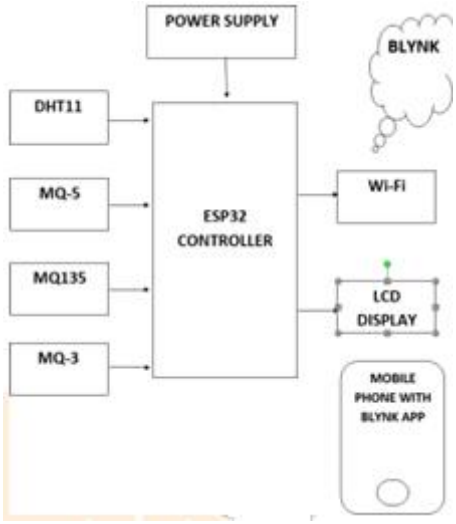

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Figure 1: Block diagram for Air Pollution Monitoring System

Sensors, a microcontroller, I2C, and a cell phone running the Blynk software are utilized to create the system. All of the sensors in the system are linked to the ESP32 microprocessor. The system's sensors would detect all gases and calculate pollution levels in parts per million (PPMs). The MQ135, MQ3, and MQ5 gas sensors will produce voltage values. The voltage figures are converted to parts per million (PPM), and the output voltage increases in tandem with the gas concentration. To convert the result to parts per million (PPM), libraries for MQ135, MQ3, and MQ5 gas sensors are utilized. The proposed model takes input from four sensors to calculate temperature, humidity, and gas concentration. The blynk app and the LCD both function as output devices. The sensors function as entrance devices and begin collecting data as soon as the system is turned on. The above information is transmitted to the ESP32 microcontroller. The module transfers the data it has collected to the LCD, which displays the results.The LCD displays the gas levels in ppm, the temperature in degrees, and the humidity in percentages.

The ESP32 chip sends data to the Blynk app as well. The humidity and temperature data are clearly displayed in the Blynk application. Because this software keeps data on the cloud, it has its own cloud. The application displays the data and generates graphs based on the information provided. This includes data that has previously been received.

V. FLOW CHART DIAGRAM

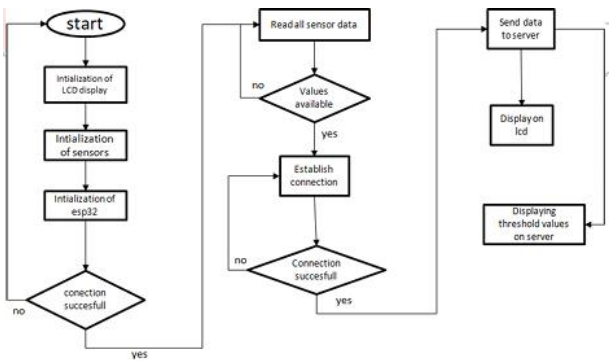

Figure 2: Flow Chart of proposed system

A flow chart is a picture that depicts how a process or workflow operates. Before turning on the system's hardware, the sensors and other devices must be initialized. If the startup procedure is not complete, you only need to check and configure the hardware links once. When the sensors begin collecting data, values are returned immediately. Once the values are accessible, the data is displayed and transmitted to the cloud via the Wi-Fi module. The information is retrieved from the Blynk server and verified using the Blynk app.

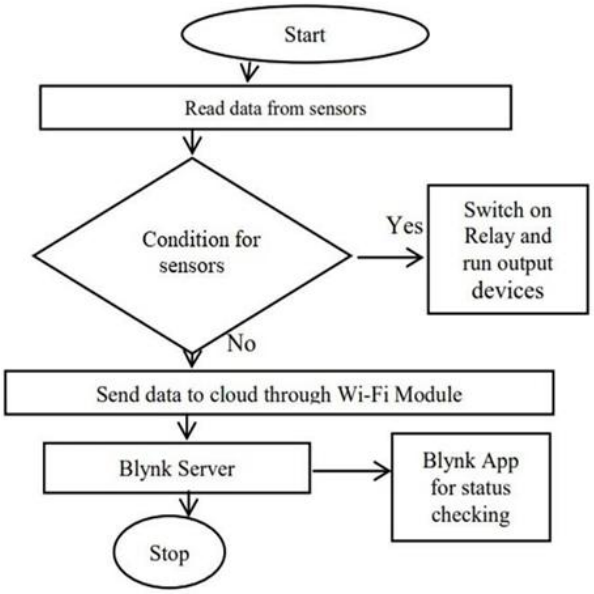

Figure 3: DFD for air pollution monitoring system

VI. RESULT AND DISCUSSIONS

	Experimental result	Expected result
Temperature	29 ppm	28 ppm
Humidity	83 ppm	80 ppm
Mq2	400 ppm	383 ppm
Mq5	905 ppm	912 ppm
Mq135	1230 ppm	1252 ppm

Figure 4: test result (*ppm – parts per million)

Both the experimental result and the table above show the numbers produced by the system. The test results are approximately 2% to 3% inaccurate.

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Figure 5: Application output

The recommended system has three sensors that will detect gases, gather data, display it on a screen, and transfer the results to Esp32. The data is then collected by Blynk, allowing us to see what happens in that specific program.

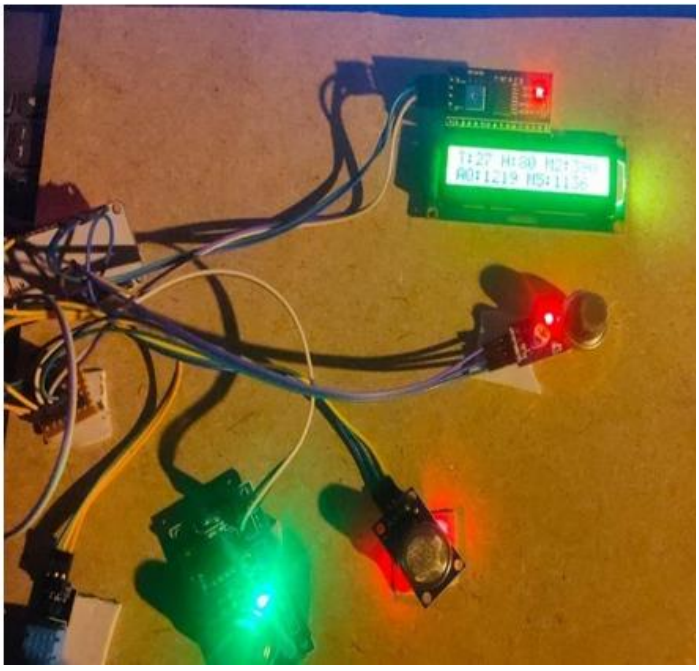

Figure 6: Hardware implementation

VII. CONCLUSION

The suggested system monitors pollution levels and detects the emission of harmful gasses using an ESP32 microprocessor, the Blynk app, and the Internet of Things (IoT). This study describes a model that uses MQ135, MQ2, MQ5, and DHT11 sensors to monitor air pollution, detect harmful compounds in the environment, and provide alarms when air quality deteriorates. The microcontroller is the most significant component of this module because it drives the entire operation. The entire system is connected to the Blynk program via a Wi-Fi module, and the results are shown on an LCD. Experiments are utilized to validate the proposed method for monitoring air pollution.

A 97% accuracy rate indicates that the strategy performed successfully. This technology makes it easier to detect pollutants in the air. Individuals will soon have access to information on the air quality in their immediate surroundings, allowing them to respond accordingly if it changes. The air tracking device can assist with the difficult task of devising innovative solutions to clean up highly polluted places. Adding more sensors allows you to monitor the amounts of pollutants in the system, including more harmful gasses.

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