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IoT based Air Pollution Monitoring System using Arduino

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ABSTRACT

Our daily functions and quality of life are both impacted by air pollution. The biosphere and the standard of living on the globe are at risk. Since there have been more industrial operations in recent years, there is a very obvious necessity to check the quality of the atmosphere. The human activity affects air quality must be made clear to the public. Utilizing an Arduino microcontroller, the system was created. The real-time monitoring and analysis of air quality along with data logging to a remote server were all features of the air pollution monitoring system that was created. To assess the necessary level of worker safety, air monitoring identifies and quantifies airborne pollutants. To make sure the air in the workplace or other environments complies with legal requirements and to assist occupational hygienic practices and health and safety experts in determining individuals exposed to airborne dangers, air sampling is done. This framework only considers five parameters, but it can be expanded to take into account more parameters that contribute to pollution, particularly those caused by programs. The model consumes too much energy, thus in the future we can use solar energy as an external source of energy, which would increase the stability of the framework.

Keywords: Air Quality Index, Gas sensors, Pollutants, Arduino board.

1 Introduction

A crucial component of a person's environment is air. Oxygen, Nitrogen, carbon monoxide, and quantities of a few rare elements are among the gases that constitute the air that makes up the earth's atmosphere. Humans require a clean air environment. For the sake of human life and health, this is absolutely essential. Any modification to the air's natural composition could be extremely harmful to earth's living beings [1]. Air pollution is measured in parts per million (ppm) or ug/m3 [2]. Direct atmospheric release of primary contaminants occurs. When the primary pollutant combines with other substances in the atmosphere, air pollutants are created [3]. Public health is impacted by air quality. Asthma and emphysema flare-ups, sneezing, and difficulties breathing are just a few of the effects of pollutants [4]. Visibility can also be affected by air pollution. 7 million people globally per year, or one in every eight premature mortality, are caused by air pollution [5]. Annually, respiratory infections connected to indoor air pollutants and passive smoking cause almost 570,000 deaths in kids under the age of five

[6].The current air pollution monitoring systems have undergone numerous upgrades. For illustration [7] a system for assessing indoor air quality was suggested. The device keeps track of a home's indoor air quality and shows the sensor information on a screen. To monitor the air quality in places that were difficult to access, the researchers in [8] used a system based on unmanned aerial vehicles (UAVs). The collected pollutant data was examined using an adaptive algorithm. Sydney's air pollution will be tracked by a participatory sensor system, according to scientists' suggestions. [9]. In the suggested system, sensors were installed on moving cars, and data was uploaded to a centralised repository using a mobile application. The user received information from the system regarding their individual susceptibility to air pollution. The effectiveness of wireless air pollution monitoring systems was increased in [10] by using the Recursive Converging Quartiles (RCQ) algorithm.

This study makes the argument that a system can only be implemented in crucial monitoring sites for a small number of crucial businesses, making it impossible to predict the state of pollution at large using system data. Using experimental analysis, typical air automated monitoring systems have highly sophisticated equipment, a big physical footprint, erratic performance, and expensive costs. Large-scale installation is not practicable due to the high cost and mass. This research suggests a technique that combines IoT technology with environment monitoring to address flaws in conventional monitoring systems and detection methods and lower test costs.

2 Recent Works

Jingchang Huang et al [2019] [11] give the city scale, real time, finely gathered air quality data, considerably boosting the practicality and reliability of the sensing system. When a car's windows are open, the air constituent concentrations inside is quite comparable to that of the surroundings because air will interchange between the inside and outside of the car through the open window. The main motivation for this research. Real-time air quality data sources are gathered and analysed in our data centre using our IoT cloud platform, which allows for the detailed display of a fine-grained city level ambient air map. Experiments using 500 crowd sourced floating cars are run in Beijing for 3 months to indiscriminately sample relating to air quality in order to show the efficacy of the suggested strategy.

Haomin Yu et al [2020] [12] Due to increased use of energy and other natural resources, air pollution is becoming increasingly significant. Authorities' static monitoring systems often give precise data on air pollution, however they are sparsely dispersed throughout the environment. Micro stations, a type of inexpensive air monitoring apparatus, on the other hand, can be placed widely despite having a poor level of precision. In this analysis, we provide a deep calibration method (DeepCM) for inexpensive air monitoring sensors that are put in the micro stations and comprise an encoder and a decoder. In addition to capturing local,

worldwide, and periodical trend information, these features can help reduce cross-interference and noise effects.

Galo D. Astudillo et al [2020] [13] Industries, manufacturing, transport and agricultural all have rules in place to lower air pollution. However, not enough is being done to monitor the air quality in urban and rural regions to ensure that these policies are being implemented. An obstacle to overcome is the fact that reliable monitoring of air pollution often relies on expensive fixed stations. The validation and assessment sets were collected across two distinct time periods of one and two months, respectively, in order to test the station under realistic conditions. The complete procedure was carried out using reference data from an accredited fixed station for air quality in the city of Cuenca, Ecuador.

Dan Zhang et al [2020] [14] suggested an increase in interest in studies evaluating and forecasting the quality of the air around people. The conventional method of using stationary sensors can't effectively give a full perspective of air pollution in people's local surroundings because the closest ones may be kilometres away. It focuses on mimicking the air quality pattern in a particular area using both stationary and mobile IoT sensors that are installed on vehicles patrolling the area. With the help of our method, the complete range of air quality variations in close by areas can be examined. With the help of various machine learning algorithms and actual data from the real world, we show the viability of approach in measuring and forecasting air quality in an accurate manner.

Markus Lücking et al [2020] [15] have suggested a recorded environmental data susceptible to manipulation since these PMSs centrally handle the environmental data. Additionally, the examination of pollution data is frequently opaque to outsiders, which could result in poor decisions concerning environmental rules. To solve these problems, a software architecture for PMSs based on distributed ledger technology (DLT) and the long-range (LoRa) protocols for flexible, open and resource efficient environment data collection and data processing. We performed a thorough analysis of the needs for PMSs in order to design the PMS. On the premise of this, we developed and tested a prototype PMS in the real world.

3 Proposed Work Explanation

The system includes an Arduino microcontroller, humidity, temperature, and gas sensors, as well as a Wi-Fi module. In this paper a model that would screen and regulate a level of air pollution as well as the humidity and temperature that are emitted from automobiles and industries. We are employing a MQ135 gas sensor, which can detect dangerous chemicals including CO2, smoking, and many more. It will concurrently communicate information to Arduino about the amount of gas it has detected. The Arduino receives data from a moisture and temperature sensor called DHT11. The user will receive a web page alert if the level of polluting gas exceeds the required limit.

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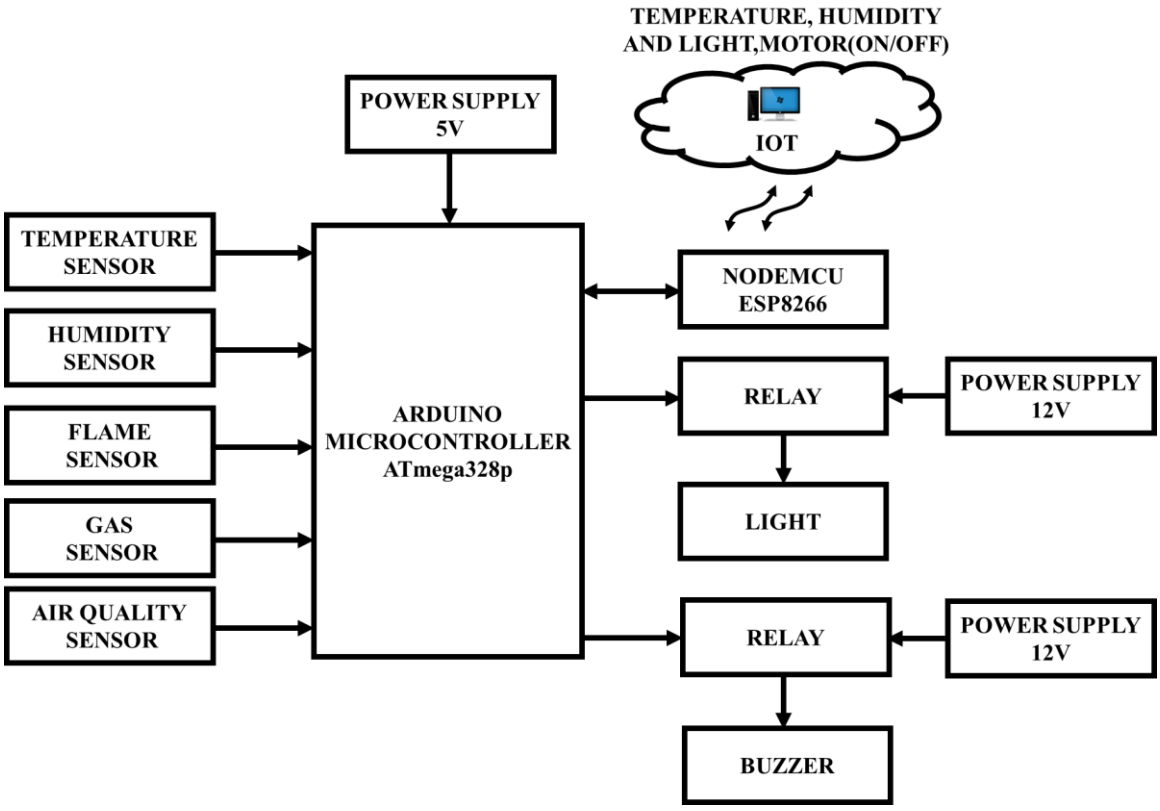


Figure 1: *Block Diagram of Proposed System*

A wireless network of sensors will be created as the mechanism to track air pollution. The sensors are placed at various sites where the levels of pollution are to be measured in order to implement this method. At various times and under various environmental conditions, the sensor data are read and recorded. To gather data sets for the values of contaminants at various environmental areas, this is done. Real-time data obtained is checked against these threshold values to determine whether there is any violation of or threat to the air quality. These datasets are utilised to choose the threshold value for various gases. The user receives a beep when the flame sensors detect it. The Arduino board, which houses the microcontroller and receives the allow devices, processes them and sends the real-time data to the cloud for storage. Therefore, the suggested system model comprises of the following Arduino board, which houses a microprocessor, various flames sensors, and gas sensors that are tailored to individual gases. The Arduino hardware connects to the internet so that the real-time data captured is delivered to the cloud for storage in the cloud database. The location is also provided as real-time data and stored in the cloud thanks to the use of a global positioning system. Additionally, a purifying system is installed that can be operated remotely via IoT.

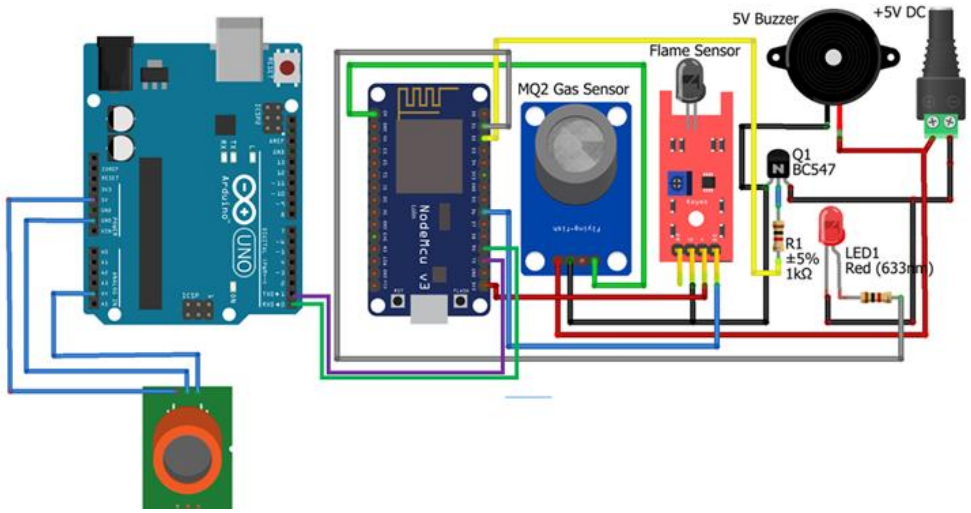


Figure 2: *Proposed circuit diagram*

This paper aims to develop an air pollution monitoring system that can be implemented in a specific area, improve the system over recently developed frameworks and address previous shortcomings by creating a publically accessible android application. Anyone can use this programme to receive real-time updates regarding the contamination in their local.

3.1 Temperature Sensor

This sensor's voltage-sensitive diode is the foundation of its basic operation. The resistance of this diode is directly correlated with the temperature variation. To measure the internal temperature of different structures, such as power plants, temperature sensors are used.

3.2 Humidity Sensor

It measures the air around it using a thermistor and a capacitance humidity sensor and transmits a digital signal on the data pin.

3.3 Flame Sensor

A flame sensor module, also referred to as a fire sensor module, is capable of detecting a flame source or other powerful light source.

3.4 Gas Sensor

When it comes into touch with gaseous reactants, a platinum coil inside a catalytic gas sensor heats up. The coil's internal temperature rises as a result. In the event that the temperature change falls within what is regarded as a dangerous range, the catalytic gas sensor will sound the alarm and notify people.

3.5 Air quality sensor

There are sensors for volatile organic compounds (VOCs) that can find pollutants with strong odours and volatile substances. Frequently used equipment for detecting airborne particles.

3.6 Arduino microcontroller

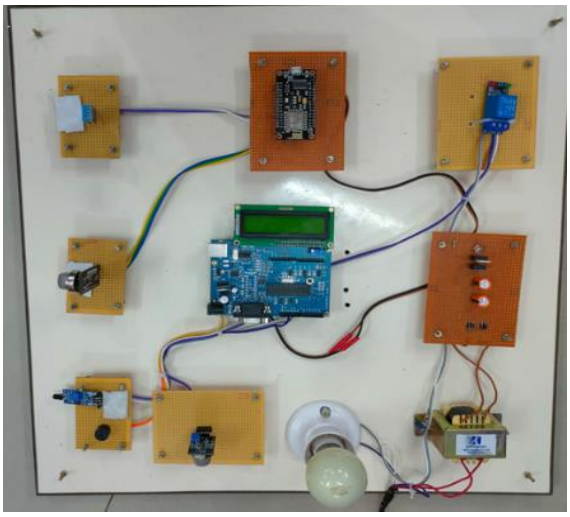
Open-source hardware and software serve up the foundation of the electronics platform known as Arduino microcontroller.

3.7 NodeMCU

The open source NodeMCU system, which is based on the ESP8266 chip, networked learning.

4 Results and Discussion

This paradigm holds up under scrutiny in the disciplines of contaminant observation, health monitoring, employment estimates, reliability assessments, and estimation-related fields. The information is subsequently stored in the database, where professionals can use it to make quick decisions. It also aids common people in considering the quantity of poisons in their general area and in implementing control measures. This is a strong framework that aids in initiatives due to the rising contaminants as a result of an increase in businesses. This framework is inexpensive and helpful to the customer. This paradigm only examines five variables, therefore it can be expanded to take into account additional variables, notably those caused by plans that lead to pollution.



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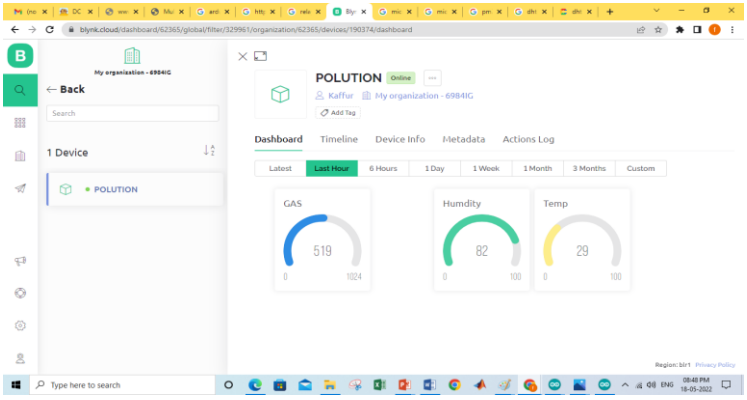

5 Conclusion

To ensure greater consistency of the data evaluated by the various sensors in this station, it is recommended that a measurement protocol centred on observable measuring performance of the mentioned machine learning techniques, including random forest, artificial neural networks, and linear regression, be used. The examples timestamp is further used as a temporal heuristic at the system's input on the premise that typical environmental dynamics are comparable in order to choose the highest suitable selection of sensors for the modelling approaches. The model consumes too much energy, thus in the future we can use solar energy as an external source of energy, which would increase stability of the system. As a result, the suggested system model consists of the Arduino board below, which includes a microprocessor and various gas sensors. Specific to each type of gas, gas sensors are employed.

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