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IoT-based Air Monitoring System

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ABSTRACT

The contamination of an indoor or outdoor environment by any chemical, physical, or biological substance that affects the inherent features of the atmosphere is referred to as air pollution. The most common causes of air pollution include fires in forests, automobiles with internal combustion engines, factories, and other types of industrial operations. Pollution in the air is quite close to the top of the list, which makes it one of the most important contributing factors to bad health all over the world. Not only does exposure to air pollution shave years off of people's lives, but it also has a significant impact on the quality of their lives while they are still alive. world health organisation research indicates that almost all of the world's population, or 99%, breathes air that is considered to be unhealthy since it exceeds the guidelines set by WHO and contains high amounts of pollutants. The countries with the lowest and intermediate incomes experience the highest levels of pollution exposure. The climate and ecosystems of the world are intimately connected to the quality of the air that we breathe. PPM's air quality monitored globally by an air pollution monitoring system that makes use of the internet of things (IoT). The proposed system identifies any gas leakage and record the data collected on online servers for later use. In the event that the air quality falls below a predetermined limit, the proposed system will sound an alarm using MQ135 and MQ6 sensors. These sensors are able to identify dangerous chemicals that are present in the atmosphere and determine the precise concentration of those gases in real time. In addition, the systems have a gas sensor, which is able to identify the presence of any gas leakage that may have occurred.

Keywords – Air Pollution, Internet of Things, MQ135 and MQ6 Sensors

I. INTRODUCTION

One of the most important components that make up a man's environment is air. The atmosphere surrounding the planet is filled with air that includes gases like nitrogen, oxygen, and carbon monoxide as well as traces of some extremely rare elements. The air that humans breathe must not include any harmful

substances in order to survive. This is incredibly important for both the survival and health of humans. Any deviation from the normal make-up of the atmosphere has the potential to do irreparable damage to the various forms of life that exist on planet. The presence of one or more contaminants in the atmosphere, such as gases, in an amount that is harmful to people, animals, and plants is what we mean when we talk of air pollution. These days, the air we breathe contains a high level of pollution. In recent years, there has been an increase in the prevalence of pollutants such as car emissions, chemicals from manufacturers, smoke, and dust. Because of this, the air quality in the current condition is extremely filthy. The effects of air pollution are extremely detrimental to human health, particularly in areas of our bodies where the air is used for respiration, such as the lungs.

Pollution in the air is not something that can be felt by humans. Ozone, particulate matter, sulphur dioxide, nitrogen dioxide, carbon monoxide, and lead are only few of the potentially harmful components that could be present in polluted air. The proposed solution employs a wireless sensor network that makes use of sensors and hardware components that are available at a low cost, along with the essential software, in order to perform an efficient monitoring of the phenomenon of air pollution. The most serious threat to the environment is air pollution, which has a myriad of negative impacts not just on people's health but also on water bodies and the climate as a whole. The use of motorised transportation is the primary contributor to air pollution in every major city, with industry continuing to be the second-most important contributor. The air pollution monitoring systems that are deployed in a specific area where there are indications of severe air pollution in order to detect the constituent gases of the air that may lead to detrimental effects on the health of humans and other living organisms in the area. The substances that are found in contaminated air are extremely hazardous. For instance, if the concentration of carbon monoxide is higher than 100 parts per million, it will cause individuals to feel lightheaded and sick, and they may pass out within minutes. Through this research, people are able to determine which components of the air are polluted. Because there is a Wi-Fi module included in the node MCU esp8266, we are able to do remote monitoring of the air quality using the module node MCU esp8266. Because of this, the temperature and humidity of the room may be checked at any time.

Parts per Million (ppm) and micrograms per cubic metre (ug/m3) are the units of measurement for air contaminants. Direct emissions into the atmosphere constitute the primary source of pollution. When the primary pollutant interacts with other air substances, secondary pollutants are formed. The quality of the air has an effect on public health. For the purpose of monitoring air pollution, a number of researchers from across the world have created models to monitor a variety of pollution gases, including sulphur dioxide (SO2), carbon monoxide (CO), carbon dioxide (CO2), nitrogen oxides (NO), and others. The design and deployment of a sophisticated air pollution monitoring system are the primary objectives of this article. It describes how a gas sensor, Arduino microcontroller, and a Wi-Fi module can be used in conjunction with one another to monitor the concentration of contaminants in the atmosphere. The primary purpose of this paper is to design a smart air pollution monitoring system that is capable of monitoring, analysing, and logging data about air quality to a remote server and keeping the data up to date over the internet. This system will be the result of the research and development carried out in this paper.

II. METHODS AND MATERIAL

A. Objective

The first objective is to exercise regulatory control through surveillance and monitoring. Control agencies and citizen organisations require information on the

amounts of the compounds indicated in the rules in areas where there are air quality limits. This information is gathered via networks of stations, the sites of which ought to be generally acknowledged as being indicative of urban settings. In certain cases, the network design and station siting standards may have been established in an ordinance or a by-law.

The second objective is to discover the existing circumstances and patterns through exploratory monitoring. For the following associated reasons, monitoring networks may be constructed in order to identify both the current circumstances and the changes over time: (1) to ascertain whether or not 5 The Design of Air Quality Monitoring Networks, by R. E. Munn, published in 1981 by R. E. Munn. There is a need for regulatory action due to the existence of 6 monitoring networks; (2) as a diversionary tactic, in order to postpone a politically difficult decision to control emissions; (3) in order to promote public relations, by providing comparisons of the quality of the air in different parts of a city, or even in different cities, in order to reassure the citizens that the air they breathe is not excessively contaminated; (4) in order to determine trends from consecutive observations, in order to provide an early-warning system that air quality standards may be exceeded if control measures are not implemented;

The third objective is to make forecasts for the near future (1-5 days). Monitoring is necessary for the creation of models, the validation of such models, and the actual application of those models in the forecasting of air pollution events. It's possible that the data needs for developing and validating models are going to be different from the data requirements for operational usage.

Objective 4: to model the consequences of different land-use plans on the quality of the air Monitoring is necessary in order to create and validate models of multiple source air pollution that anticipate climatological frequency distributions of concentrations. These models are used to inform policy decisions. The models are utilised in the process of preparing several land-use scenarios for the purposes of industry, transportation, and power production. Similar to the situation with Objective 3, the data requirements for model creation and validation could be distinct from those that are necessary for operational usage.

B. Components selection model was designed using an Arduino Uno microcontroller, Wi-Fi module 8266, MQ135

Gas Sensor, in addition to a liquid crystal display (LCD) Screen measuring 16 by 2. Figure 1 is an overall perspective of the proposed system, and Figure 2 is a block diagram illustrating the functionality of the system. Figure 3 displays the suggested organisational chart for the process. As can be seen in figure 1, the system overview method was divided into a total of five (5) distinct tiers. The first layer consisted of the environmental factors that are gleaned through conducting measurements. The examination of the properties and features of the sensors constituted the second tier of the project. The decision making, sensing, measuring, adjusting of the threshold valve, periodicity of sensitivity, time, and space made up the third layer. The data acquisition from the sensors comprised the fourth layer. The fifth layer was the environment containing the background intelligence. When activated by the microcontroller, the sensor would gather data, which would then be transmitted over the internet to the Wi-Fi module so that it could be analysed. On their mobile devices, users were able to keep an eye on the various measured metrics. Table 1 contains a description of the design specifications that will be used for the proposed system.

Table 1: The Design Specification

Sr.no	Component Required	Quantity
1	Arduino UNO	1
2	MQ135 Sensor	1
3	16 by 2 LED screen	1
4	ESP 8266 WiFi Module	1
5	10 k Potentiometer	1
6	1 ohm Resistor	1
7	220 ohm Resistor	3

Using an ESP8266 Wi-Fi module, the project may connect to either Wi-Fi networks or the internet. It is a fairly affordable piece of hardware that gives your projects a significant boost in power. It is able to connect with any microcontroller, and it is the device that is in charge of driving the Internet of Things platform. Discover more about it by reading on. After that, we will establish a connection between the Arduino and the MQ135 sensor. Connect the VCC pin of the sensor to the 5V pin of the Arduino, the ground pin of the sensor to the ground pin of the Arduino, and the Analogue pin of the sensor to the A0 pin of the Arduino. When the condition is met, the buzzer you have connected to pin 8 of the Arduino will begin to sound off. Since the MQ135 sensor is able to detect NH3, NOx, alcohol, Benzene, smoke, and CO2 in addition to a few additional gases, it is an ideal candidate for the gas sensor role in our Air Quality Monitoring Project. Once we have successfully connected it to Arduino, it will begin to detect the gases, and we will be able to determine the degree of pollution in PPM (parts per million). The output of the MQ135 gas sensor is in the form of voltage levels, and we need to convert it to parts per million (PPM). The sensor was giving us a value of 90 despite the fact that there was no gas in the vicinity of the sensor. The safe limit of air quality is 350 PPM, and it should not exceed 1000 ppm. It starts to induce headaches, tiredness, and air that is stagnant, stale, and stuffy when it surpasses the limit of 1000 PPM, and if it exceeds the limit of 2000 PPM, it can cause an elevated heart rate in addition to a number of other disorders. If the number is lower than 1000 PPM, then "Good Quality of Air" will be shown on both the LCD and the website. When the figure reaches 1000 PPM, the buzzer will begin blaring and "Bad quality of air" will be displayed on both the LCD and the website.

III. SYSTEM DESIGN

After loading the library into the Arduino, a message was then transmitted to the LCD. The MQ135 sensor was used to capture the data on the air's quality. Because the sensor was calibrated, the analogue output voltage became proportional to the concentration of polluting gases expressed in parts per million (ppm). The information is shown on the LCD screen first, and then it is transmitted to the Wi-Fi module. Because Arduino lacks Wi-Fi capability, we have to utilise this chip, which is also known as the ESP8266 Wi-Fi chip, in order to push this data to the cloud. Because of this, we use this chip and link this Wi-Fi to our mobile hotspot. 5V Power supply is one of the power supplies that is utilised most frequently in today's society. LCD Displays have become an industry standard, and the H44780 Character LCD is an industry standard device for interacting with embedded systems. In this particular undertaking, the 16X2 Configuration 4-bit write mode is being applied. In the Buzzer itself, we make use of an electromagnet, and for the software component, we make use of a platform called Things Speak. In addition to that, a MATLAB option is at your disposal. Additionally, we setup the Twitter account so that we could monitor the output.

The measured data is uploaded to the server on the internet by the Wi-Fi module. The Wi-Fi module has been set up in such a way that it will communicate any data that has been measured to an application on a

distant server named "Thing speak." The web application enables users all around the world to have access to measured data through the use of any device with internet connection capabilities. The information that was being transmitted to the remote server was given an update after the data that was obtained from the sensor was translated into a string and utilised. The system's block diagram is depicted in figure 1, which may be seen here.

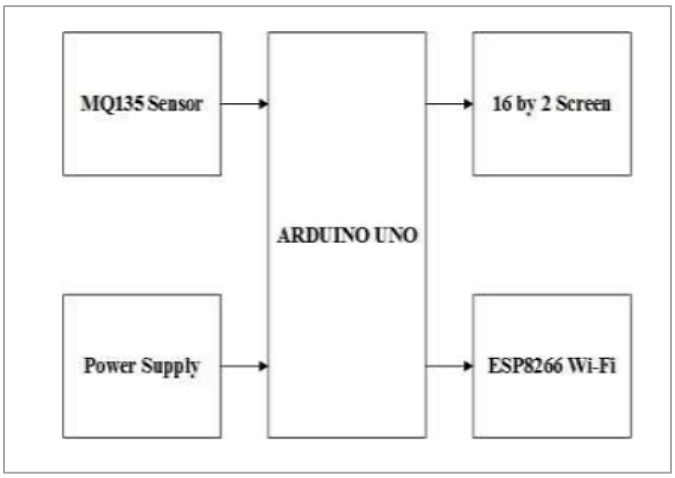

Fig. 1. Block diagram of the system

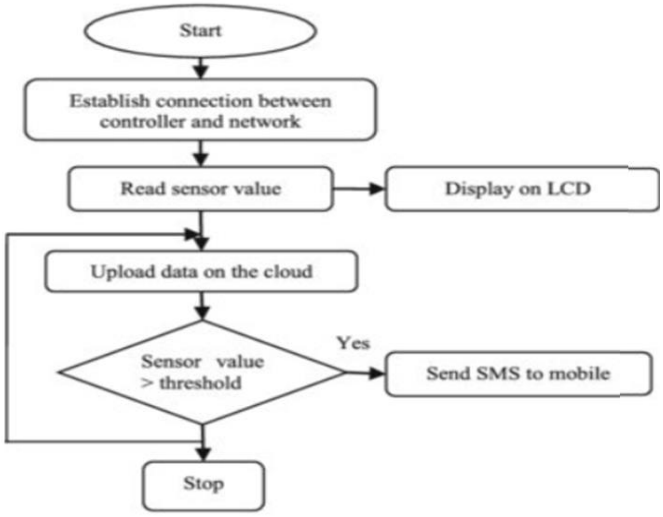

Fig 2: Flow chart of system

IV. Experimentation and Result

A. Hardware Testing

Hardware was implemented by interfacing the gas sensor with Arduino. Calibration of the system was done by verifying the angle observed on the serial monitor of the Arduino ide and data observed.

1) The NodeMCU is set inside the breadboard.

2) Gas Sensor Connection:

a) Vcc is connected to Vin port of the NodeMCU.

b) GND is connected to the GND pin of NodeMCU

c) A0 pin is connected to the A0 pin of the NodeMCU

3) LEDs Connection

a) The +ve pins of the LEDs are connected to the Vin port of the NodeMCU and the -ve pins to the GND of the NodeMCU rotate. Observations of the hardware setup: -

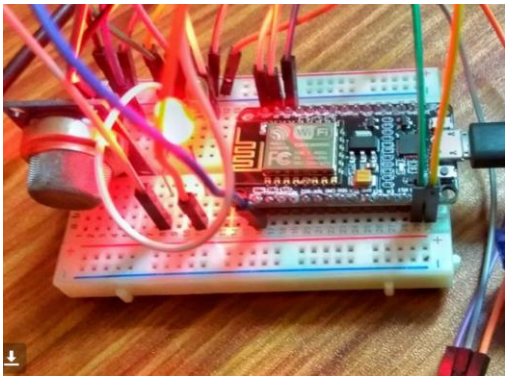

Fig. 3. Hardware system

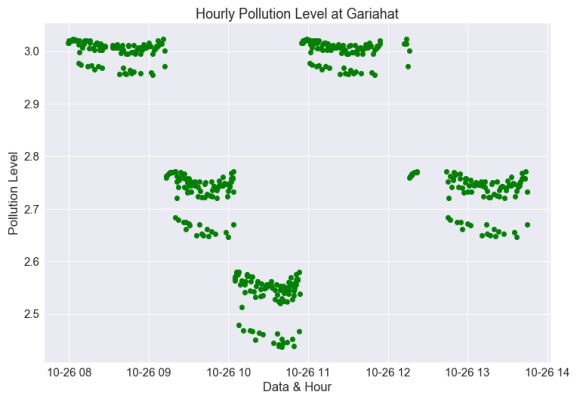

Fig 4: Data and indication of pollution in different regions

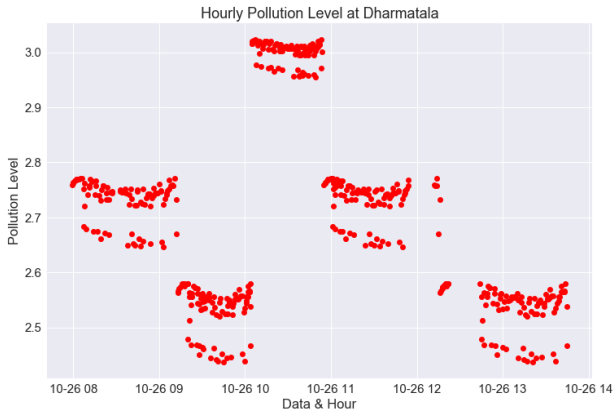

Fig 5: Data and an indication of pollution in different regions

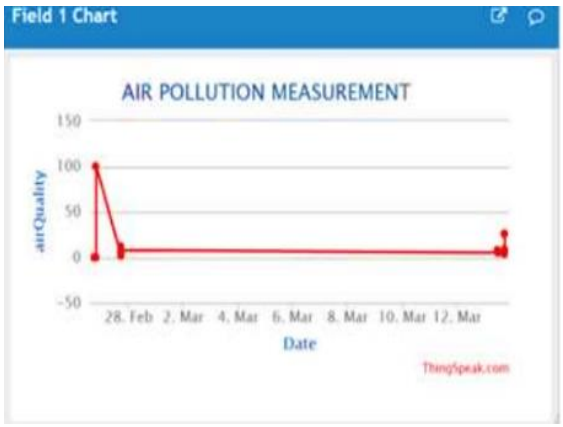

Fig 6: Air Quality on Selected Days with Biogas as Sample Pollutant

V. CONCLUSION

An intelligent air pollution monitoring system is proposed in this work. This system monitor the air quality in a region on an ongoing basis and display the results of its measurements on an LCD screen. In addition to that, it communicates measured data to the "Thing speak" platform. The system contributes to raising awareness about the standard of the air that people breathe on a regular basis. This monitoring tool is capable of providing readings of the air's quality in real time. The microcontroller receives the data from all of the gas sensors that are being utilised for the purpose of measuring pollutants in the air. This data is then analysed, and the outcome is the pollution level expressed in PPM (parts per million). The output from gas sensors comes in the form of voltage levels, and digital data is produced by converting the analogue data to its digital equivalent. Fixed air quality monitoring stations are what cities employ to assess the levels of pollution throughout the city in today's day and age. While these stations may provide very high levels of accuracy, they also have expensive prices, which makes it difficult for the authorities to attain coverage throughout the entire city.

In comparison to conventional air quality monitors, IoT technology with mobile air quality monitoring can tackle this issue at a lower cost, with greater coverage, and greater flexibility than what is offered by the traditional monitors. Traditional methods of monitoring air quality are supplemented with Internet of Things (IoT) sensors that monitor air quality. This allows for the collection of larger amounts of more granular data. These sensors monitor not just temperature and humidity but also altitude, air pressure, levels of carbon dioxide, and other pollutants including methane, carbon monoxide, and ammonium. Other parameters that can be measured include temperature, atmospheric pressure, and altitude.

The following are the benefits of the proposed system

1. Better monitoring and information that impacts regulations of air quality control.
2. Better planning in the placement of hospitals in areas with low air quality for better treatment of sick patients.
3. Empower the city residents to make more informed decisions that can limit their exposure to harmful gases.
4. Planning of industrial areas, so that they are not concentrated in one place and release harmful gases.

VI. ACKNOWLEDGMENT

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VII. REFERENCES

[1]. Tomic, J., Kušljević, M., Vidaković, M. and Rajs, V., 2014. Smart SCADA system forurban air pollution monitoring. Measurement, 58, pp.138-146.

[2]. Uppugunduru Anil Kumar, G Keerthi, G sumalatha, M. Sushma Reddy, "IOT BASEDNOISE AND AIR POLLUTION MONITORING SYSTEM USING RASPBERRY PI," 2017.

[3]. Dhas, Y.J. and Jeyanthi, P., Environmental Pollution Monitoring System Using Interne of Things (IoT). Journal of Chemical and Pharmaceutical Sciences, 2017.

[4]. Nayak, R., Panigrahy, M.R., Rai, V.K. and Rao, T.A., 2017. IoT Based Air Pollution Monitoring System. Imperial Journal of Interdisciplinary Research, 3(4).

[5]. Balasubramaniyan, C. and Manivannan, D., 2016. Iot enabled air quality monitoring system (AQMS) using raspberry Pi. Indian Journal of Science and Technology, 9(39).

[6]. Pal, P., Gupta, R., Tiwari, S., and Sharma, A., IoT Based Air Pollution Monitoring System Using Arduino, 3(4), 2017.

[7]. Rukmani, P, Teja, G.K. and Vinay, M.S., 2018. Industrial Monitoring Using Image Processing, IoT and Analyzing the Sensor Values Using Big Data. Procedia Computer.

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