

AN IOT BASED AIR POLLUTION MONITORING SYSTEM FOR SMART CITIES

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Abstract:

As the world's population is becoming increasingly urban, the cities are under pressure to remain livable. In recent years, the air quality of the cities has become one of the major causes of concern around the world. Thus, it is necessary to constantly monitor the air quality index of a city to make it smart and livable. According to the world health organization nearly eighty percent of the people living in urban areas breathe air worse than WHO standards leading to global environmental threat. Air pollution is ranked number 4 in the list of leading risk factors for death contributing to 9% of deaths annually accounting to nearly 1 in 10 deaths. With the advancement in sensing and embedded technology, Internet of Things(IoT) has become one of the economic alternatives to implement air quality monitoring systems(AQMS) compared to costly and fixed air quality monitoring stations. In this project, we propose and develop an IoT based Air Quality Monitoring System for Smart Cities. The real-time data of the air quality is accessed through the smart devices and analyzed to measure the impact on city dwellers. It will transfer the data through MQTT protocol. So that we can see the real time air quality in our mobile. The smart devices are capable of measuring the Smoke and other hazardous particulate matters in the atmosphere. This Air Pollution Monitoring System will monitor the Air Quality using a gas sensor, large amounts of harmful gasses are present in the air like CO₂, smoke, benzene, NH₃ and NO. It will trigger an alarm and we can monitor in mobile networks when the air quality goes down a certain level. It will show the air quality in PPM (Parts per Million) and like "Fresh Air", "Poor Air".

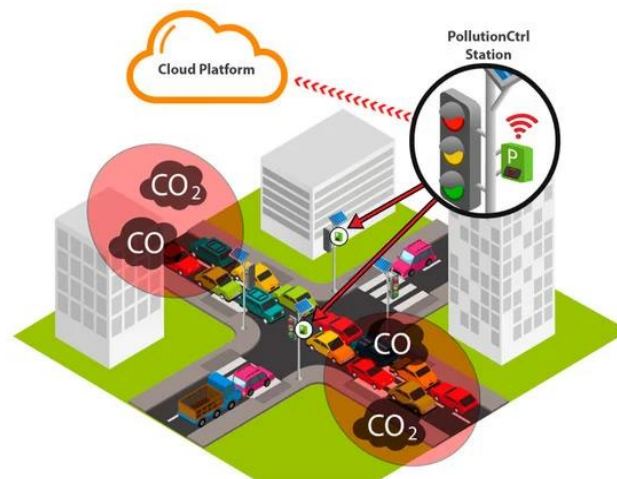
Keywords: IOT, AQMS, PPM, MQTT.

1. INTRODUCTION

The Air Excellence Guide (AEG) may be a common indicator of air quality. The Air Quality Indicator (AQI) is calculated and supported on air pollutants like CO and NO₂ compounds that consume opposing possessions happening the atmosphere and human health. The Air Quality Indicator may be a range that represents the very finest meditation of a specific air unused matter at a particular time. I propose an air quality as well as air pollution monitoring system that allows us to monitor and check live air quality as well as air pollution in an area through

Internet of Things (iot). It uses air sensors (Gas Sensor MQ135) to sense presence of harmful gases/compounds in the air and constantly transmit this data. In addition, system keeps measuring air level and reports tithe sensors interact with Arduino Uno (Microcontroller) which processes this data and transmits it over the application. This allows authorities to monitor air pollution in different areas and act against it. In addition, authorities can keep a watch on the air pollution near schools, and hospitals areas. Normally, little concentrations area unit measured exploitation ppb (parts per billion), that represents units of mass of a material per one billion units of total mass. Parts per million (ppm) may be similar and unremarkable used unit to measure concentrations of pollutants. It determines the requirements of a new system and analyze on product and resource requirement, which is required for the successful system. The product requirement contains input and output requirements it gives the wants in term of input to produce the required productivity. The resource requirements define in brief about the hardware that are needed to achieve the required functionality. In this project I am going to make an iot based Air Pollution Detection Monitoring System in which I monitor the Air Quality using MQ135 gas sensor and a trigger alarm when the air quality goes down a certain level means when there is amount of harmful gases is present in the air like CO₂.

Figure 1: Air Quality Monitoring System in Urban Cities



Proposed Algorithm

The project is an implementation of IoT (Internet of Things) Based Air Pollution Monitoring System Using Arduino. Air pollution is a growing issue and it is necessary to monitor air quality for a better future and healthy living for all. IoT is getting popular day-by-day and standards are on its way. Therefore, collection of air quality information is easier. Analysis of monitoring data allows us to assess how bad air pollution from day to day. According to the recent survey, Dhaka, the capital of Bangladesh is the third in the list of most air-polluted city. Thus because of this expansion in the quantity of vehicles contamination is developing quickly and it influencing people groups well-being too. This air contamination makes disease and harm safe, neurological, regenerative and respiratory framework. In extraordinary cases, it can likewise cause passing. As indicated by overview 50000 to 100000 unexpected losses occurred

to us only because of air contamination [2]. Along these lines, there is a requirement for checking air quality and to monitor it. IoT is the system of physical gadgets, vehicles, home apparatuses, and different things implanted with hardware, programming, sensors, and availability which empowers these articles to associate and trade information. IoT permits articles to be noticed or controlled. In this paper, we are proposing and going to piloting a model which IoT to screen air contamination. The relationships between the data collected and the information to be derived from them must be taken into account when a monitoring program is planned, executed and reported. This emphasizes the need for users and potential users of the data to be involved in planning surveys, not only to ensure that the surveys are appropriate to their needs but also to justify committing the resources.

2. LITERATURE SURVEY

Air Quality Index This chapter reviews some of the past works in processing and understanding IOT based air pollution detection monitoring system. Air pollution is not only natural medical matters impact on creating nations alike. The strong effect of air pollution on well-being are extremely mind blowing as there are a broad area of sources and their particular influence differ from one another. The synthetic substances reason an assortment of mankind and natural medical issues enlarge in air contamination impacts on condition also on human well-being. The proposed framework unit incorporates an Arduino, MQ135 Gas sensor, LCD. Almost all the past and recent works in IOT based on methods that implement these steps sequentially and independently. The IOT create a huge network of billions or trillions of “Things” communicating each other. The IOT is not dissident revolution over the existing technologies, it is comprehensive uses of existing technologies, and it is the creation of the new communication modes. The IOT blends the virtual world and the physical world by transporting different concepts and technical components together: pervasive networks, reduction of devices, mobile communication, and new ecosystem. In IOT, applications, services, middle ware components, networks, and end nodes to structurally planned and used in entire new ways.

The IOT regarded as an extension of existing interaction between people and applications through a new dimension of “Things” for communication and integration. The IOT development process is a multifaceted large-scale technological novelty process. The IOT is developing from the vertical application to polymeric application. At the early stage of IOT placement, driving of domain specific requests is the main development approach. A domain specific application might be an industrial control system with its own industry features. The application can provide various enterprise management services being combined with the industry manufacture and business processes. Polymeric requests are cross-industry applications founded on public information service stages. These requests provision both home users and industry users. The application is provided and promoted by communication operators and solution providers with large scale. For example, a vehicle integrated with sensor networks, a global positioning system (GPS), and radio communication technology provide inclusive detection, navigation, entertainment, and other information services. By preserving such information through the public service platform, consumers, original equipment

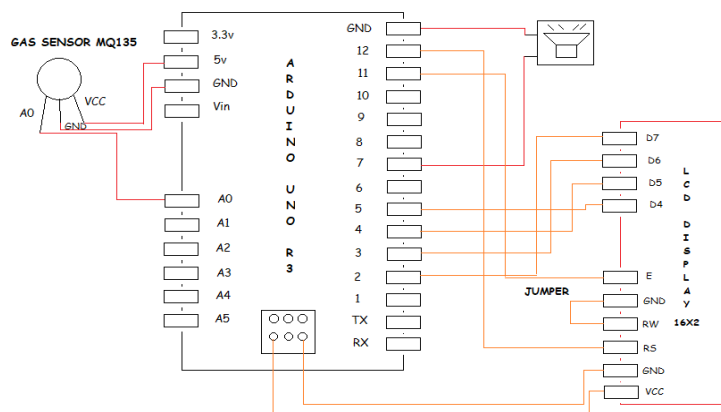
manufacturers (OEMs), maintenance providers, and vehicle organization agencies can share this information and segment services to improve the vehicle, the vehicle component design, and the fabrication process through the vehicle growth management.

3. METHODOLOGY AND RESULT

The paper aims at designing an air pollution monitoring system which can be installed in a specific locality and to enhance the system from the previously developed systems beating the earlier disadvantages by developing an android app available for the public. This app can be used by anyone to get in live updates about the pollution in their region. It uses Arduino integrated with individual gas sensors like carbon monoxide, ammonia along with particulate matter, humidity, and smoke which measures the concentration of each gas separately. The collected data is uploaded to the cloud using thing speak platform at regular time intervals. Ethernet shield is used for connecting Arduino and cloud. Pictorial or graphical representation of values can be shown in Thing speak the users can install an android application through which they get the recent updates and graphical content up to date. The average concentration of each gas is analyzed using mat lab. Then certain time control is assigned based on the standard level of each gas measured and the result can be viewed in android application. The architecture of air pollution monitoring and awareness creation system. The concentration level of each gas can be viewed both as a graph and in numerical format. Based on these values the air quality index value is calculated and the nature of the air quality in that area is determined which is also displayed through the app. Along with this, the health effects for the corresponding air quality is displayed to create awareness among the public. Additionally, they could also get to know the temperature and weather in that region. The users will not get disturbed with irrelevant data as the values displayed are location specific and help them stay tuned to the current status of air pollution.

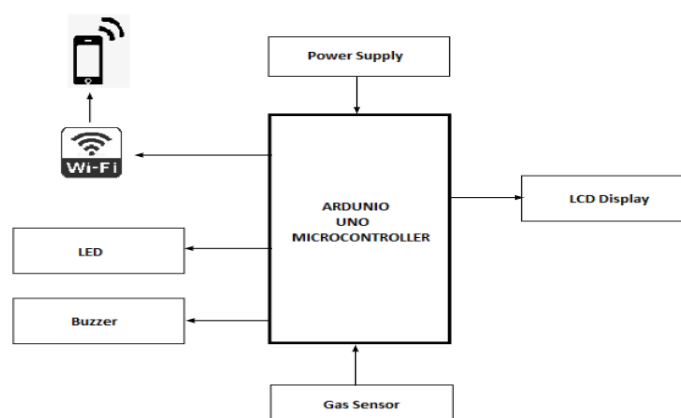
Internet of Things (IOT) mainly deals with connecting smart devices to internet by joining the advantage of OSI layered Architecture. In the context of this work we propose a cluster of Air Quality Monitoring Gas Sensor MQ135 motes, which are used to measure the concentration of Air pollutants in the air. The Gas Sensors MQ135 is interface with a tiny entrenched platform equipped with other. We have mainly used the Arduino UNO which is an open source development boards. MQ135 Gas Sensor is used to collect gas concentration measurements. This sensor data would be captured and sent to the Arduino UNO for IoT (Internet of Things) based data acquirement.

Figure 2: Circuit Diagram



The major components of my project have been mentioned in the above section. Here we explain the architecture. Gas sensor connected to the Arduino board. Also LCD connected to the Arduino board for displaying information. We monitor the Air Quality over a serial monitor & LCD using Gas sensor and trigger an alarm when the air quality goes down beyond a certain level, means when there is sufficient amount of harmful gases are present in the air like CO₂, smoke, alcohol, benzene and NH₃. It is shown the air quality in PPM on the LCD as well as serial monitor so that we can monitor it very easily. We have used MQ135 sensor which is the best choice for monitoring Air Quality as it can detect most harmful gases and can measure their amount accurately. In this Internet of Things (IoT) project, we can monitor the pollution level from anywhere using computer.

Figure 3: Block Diagram



We have connected the MQ135 gas sensor with the Arduino. Connected the VCC and the ground pin of the sensor to the 5V and ground of the Arduino and the Analog pin of sensor to the A0 of the Arduino. Connected a buzzer to the pin 7 of the Arduino which is start to beep

when the condition becomes true. The MQ135 sensor can sense NH₃, NO_x, alcohol, Benzene, smoke, CO₂ and some other gases, so it is faultless gas sensor for our Air Quality Observing Detection Project.

Figure 4: Running System

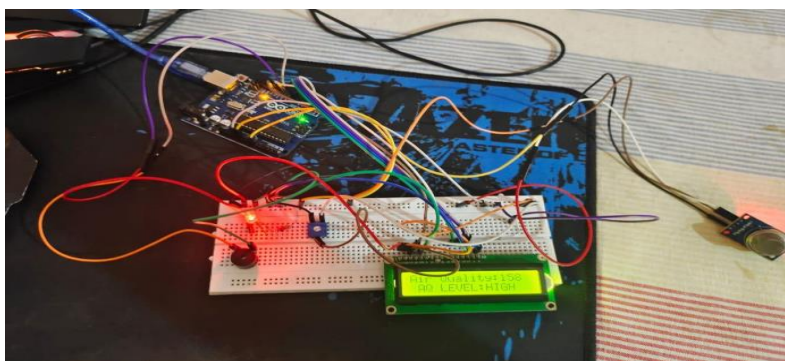
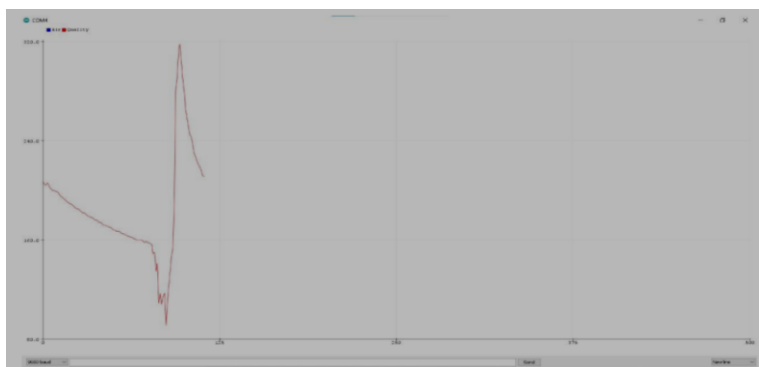


Figure 5: Result Graph of proposed system



When the value is being less than 150 PPM, then the LCD and serial monitor is displayed “Fresh Air”. Whenever the value is increased 150 PPM, then serial monitor is displayed “Poor Air, Open Windows”. If it is increased 150 PPM, then the buzzer is kept beeping and the LCD is displayed “Danger! Move to fresh Air”. After uploading the code, the value is being less than 150 PPM, then the LCD and is displayed “Fresh Air”. After uploading code, the value is increased 150 PPM, then the LCD and are displayed “Poor Air, Open Windows”. After uploading code, when the value is increased 150 PPM then the buzzer is kept beeping and the LCD and displayed “Danger! Move to fresh Air”. When we connect it to Arduino then it senses the gases, and we get the Pollution level in PPM (parts per million). MQ135 gas sensor gives the output in form of voltage levels and we need to convert it into PPM. Sensor is giving us value of 30 when there is no gas near it and the safe level of air quality is less than 150 PPM and it is not exceeding 150 PPM. When it exceeds the limit of 150 PPM, then it starts cause Headaches, sleepiness and stagnant, stale, stuffy air and if exceeds beyond 1 PPM then it can cause increased heart rate and many other diseases.

IV.CONCLUSION

The system to monitor the air of environment using Arduino microcontroller, IoT Technology is proposed to improve quality of air. With the use of IoT technology enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed in this paper. Here, using the MQ135 gives the sense of different type of dangerous gas and Arduino is the heart of this project. Which control the entire process, Arduino module connects the whole process to LCD and serial monitor is used for the visual Output. The future scope is that device which we are having can be done in a compact way by reducing the size of the device for further implementation or the modifications which can be is that detecting the vehicles amount of pollution which can be determined. In future the range can be made increased according to the bandwidth for the high range frequencies. Further research can be made by making the people in the right direction for their welfare. Therefore, there is another beneficiary by using this device in an app so the all can be used in a GSM mobile phones for their daily updates by increasing their range.

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