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Arduino Based Compact Air Quality Monitoring System

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Abstract- Air Quality Management refers to protection of Human Health and Environment from the harmful effects of Air Pollution. Thus it is important to undertake on-going evaluation on whether air quality goals are being met. Air quality managers use Modeling and other Assessment tools to understand the quality problems. Air Quality Portable Monitoring System easily monitors Air Pollution level in an area. In this project Arduino Open Source electronic platform as core, Sharp GP2Y1010AUOF a Dust sensor as PM2.5 and DHT11 sensors are used to detect Temperature, Humidity, Dust Level in the air within the short span through the data displayed on LCD (16*2) that indicates quality of air we breathe.

Keywords—Arduino, DHT11 Sensor, MQ2, MQ6, LCD

1.INTRODUCTION

Air pollution is the biggest problem of every nation, whether it is developed or developing. Health problems have been growing at faster rate especially in urban areas of developing countries where industrialization and growing number of vehicles leads to release of lot of gaseous pollutants. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. According to a survey, due to air pollution 50,000 to 100,000 premature deaths per year occur in the U.S. alone whereas in EU number reaches to 300,000 and over 3,000,000 worldwide. Various kinds of anthropogenic emissions named as primary pollutants are pumped into the atmosphere that undergoes chemical reaction and further leads to the formation of new pollutants normally called as secondary pollutants. For instance, according to the fifth assessment report of Intergovernmental Panel on Climate Change (IPCC), nearly all climate-altering pollutants either directly or indirectly (by contributing to secondary pollutants in the atmosphere) are responsible for health problems.. Almost every citizen spends 90% of their time in indoor air, Outdoor air quality of the cities of developed countries improved considerably in recent decades. In contrast to this, indoor air quality degraded during this same period because of many factors like reduced ventilation, energy conservation and the introduction to new sources and new materials that cause indoor pollution.

The design of buildings for lower Power consumption resulted in decrease of ventilation which further decreases the quality of air inside the building. This increases the need for indoor air quality considering the daily newspapers and any other electronic or print media, a devastating news which is spreading day by day is people is becoming sick and the climate is changing such a way that it has become miserable for living of people. From the aspect from top to bottom, every people are suffering the curse of climate change. The main reason for the climate change and people health is air pollution. It has brought changes in climate

Global warming, global dimming, over raining, drought, storms, acid rain, foggy weather etc. The living things on earth and under water are suffering many problems like change in life due to lack of proper facilities of life. Air is the most useful thing for each and every living thing. Researching on this serious issue this system's main purpose was to estimate the quality of air for people and any other living thing which exist on earth. Very important to know for our living is that how much safe we are now and how the weather and climate has changed for air pollution and it will sustain sound. This system will ease to know the answers for air quality. Four major gas sensors which are responsible for the most air pollution mostly are being used in the system to know the best result of the whole condition

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of the air. CO2, CO, LPG, Humidity are declared to be the most responsible for air pollution and in the system all are used [1]

2. LITERATURE SURVEY

1.Air quality using ZigBee

This paper discusses a monitoring system that gives information about environmental conditions and briefly touches the technological advancements in monitoring the environment and bringing out the new scope in monitoring the current environmental problems • The system is developed using Arduino, Raspberry Pi 3, and Zigbee which proves to be cost-ineffective and having low power consumption. • The sensors will gather the data of various environmental parameters and provide that data to Raspberry Pi via Zigbee from the Arduino. The sensors will gather the data of various environmental parameters and provide it to the raspberry pi which acts as a base station. Realization of data gathered by sensors is displayed on Raspberry pi 3 based Webserver. • Experimental results demonstrated that the system can accurately measure the concentrations of carbon monoxide, carbon dioxide, combustible gases, smoke, and air quality.

2.Air Quality Monitoring Using Raspberry Pi

A prototype for an Environmental Air Pollution Monitoring System for monitoring the concentrations of major air pollutant gases has been developed. • The system uses low-cost air-quality monitoring nodes comprised of a low-cost semiconductor gas sensor with a Wi-Fi module. This system measures concentrations of gases such as CO, CO 2, SO 2, and NO 2 using semiconductor sensors. • A MEAN stack is developed to display data over a website. • The fundamental aspect of the proposed work is to provide a low-cost infrastructure to enable data collection and dissemination to all stakeholders[2]

3. OBJECTIVE

• To measure and display temperature and humidity level of the environment to combine advanced detection technologies to produce an air quality sensing system with advanced capabilities to provide low cost comprehensive monitoring. To display the sensed data in user friendly format in LCD display panel.
• Facilitate background concentrations measurements;
• Monitor current levels as a baseline for assessment;
• Check the air quality relative to standards or limit
• Enable comparison of air quality data from different areas
And countries.
• Collect data for AQM, traffic and land-use Planning
Purposes.
• Observe trends (related to emissions)
• Develop abatement strategies
• Determine exposure and assess effects of air pollution on health, vegetation or building materials. Inform the public about air quality and raise awareness.Develop warning systems for prediction of air pollution episodes. Facilitate source apportionment and identification[3]

4. PROBLEM STATEMENT

During past decades, as result of civilization and urbanization there is a huge growth in Polluting industries, open burning of refuse and leaves, massive quantities of construction waste, substantial loss of forests and vehicles (particularly diesel driven cars) on roads that give rise to health endangering pollution. Therefore, it is necessary to regularly monitor and report the hazardous impacts from air pollution. To monitor the quality of air, a new framework is proposed that monitors the parameters of the environment around us such as CO2, CO, presence of Smoke , Alcohol , LPG, Temperature and Humidity with the help of Arduino Uno Controller.

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5. AIR QUALITY PARAMETERS

The important parameters that are considered in the proposed framework include:

1] **Sulphur Dioxide (SO2)** - Sulphur Dioxide is a colour less gas, detectable by the distinct odour and taste. Like CO2, it is mainly due to fossil fuels burning and to industrial processes. In high concentrations may cause respiratory problems, especially in sensitive groups, like asthmatics. It contributes to acid rains.

2] **Carbon dioxide gas** -CO2 is colour less, odor less gas and non-combustible gas. Moreover, it is considered under the category of asphyxiate gases that have capability of interfering the availability of oxygen for tissues. It is certified study that if the oxygen is unavailable for 3 to 5 minutes, it can cause brain damage or death. Many times, occupant generated CO2 act as a Substitute for measurement of IAQ. The requirement of outdoor air can be easily predicted by the content of CO2 and according to the guidelines of ASHRAE CO2 levels must be less than 1000ppm.Generally CO2 levels of outdoor air are under 350ppm.

[3] **Smoke**-About 1 million people are in habit of tobacco smoking globally of which majority population is from developing countries. Every year nearly 4.9 million people died due to smoking according to 2007 report. In addition, second hand smoke is serious threat to the health of people of all age's causes 41000 deaths each year.

[4] **LPG-Liquefied petroleum gas (LPG)** - is an odor less and colour less liquid which evaporates readily into a gas. Leakage is normally detected by adding an odorant into it. It is considered under the category of highly flammable gases and it can be classified as a carcinogen and mutagen if Butadiene content is more than 0.1%. LPG may leak in the form of a gas or a liquid. If it leaks in the form of a liquid it evaporates quickly and will eventually form large cloud of gas in air which is relatively heavier than air thus drops to the ground. Whereas, LPG vapors travel along the ground for a long distance and gets collected in drains or basements. Gas leads to burn or explode after getting in touch with a source of ignition.

[5] **Temperature and humidity**- Measurement of temperature is important for safety of people and affects our life skills. Greenhouse effect can be monitored by measuring temperature and comparing temperature changes from historical to present time especially since the industrial revolution using climate data. Humidity is a type of gas that protects us from UV rays from the sun and helps trap heat on Earth, thereby making the climate on Earth, a pleasant one for living. But as humidity increases, the warmth on Earth also increases which makes our life uncomfortable. Humidity is essential for various storage and food processing facilities.

6. EXISTING METHOD

The Existing Method mainly consists of power supply, Node MCU, Arduino , MQ-2 Gas Sensor as shown in block diagram 6.1

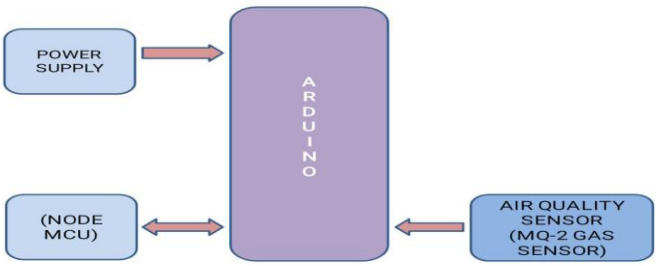

Figure 6.1 Block Diagram of Existing System

MQ2 Gas Sensor is a metal oxide semiconductor type gas sensor mainly used to detect gases like Butane, LPG, Smoke, Methane etc. It can detect gas in a range of 100-10000ppm in existing method.

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But in proposed method contains MQ2, MQ6, DHT11 Sensors.MQ6 sensor we can sense more type of gases like cooking fumes, Smoke, Alcohol , Cigarette.

7. PROPOSED SYSTEM

The different components along with their intended purpose are discussed below:

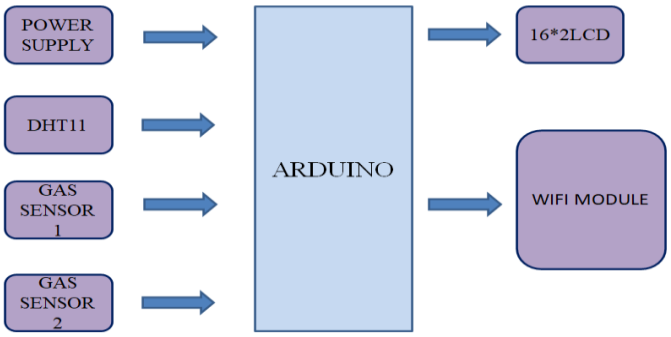

Figure 7.1 Block Diagram of Proposed System

The model is for monitoring smoke levels in the atmosphere to make the environment intelligent. The proposed prototype model is shown in above fig6.1, which is more adaptable and flexible to monitor the environmental parameters. The goal of developing pollution observing is to augment quality of life by mistreatment technology to augment the potency of services and meet resident's desires. Consider an area that is being surveyed for estimating how much the area is affected by pollution. The constituents of air along with its proportion are calculated and if it above traditional then the officers intimated and desire air filter and exhaust fan start according to the threshold which are predefined in the controller. In the proposed Arduino Uno based Air Quality Monitoring and Filtering System consist of different types of sensors which are used for measuring the different gases and Temperature and Humidity of the surrounding environment. In proposed system the different sensors used for MQ2, MQ6, which are used for measuring different gases present in the environment. DHT11 sensor is used for measuring Temperature and Humidity in Environment[4]

1) Arduino Uno

Arduino UNO is a low cost, flexible and easy to **use** programmable open-source microcontroller board that can be integrated into a variety of electronic projects. Arduino UNO is a microcontroller board based on the ATmega328P shown in fig 7.2

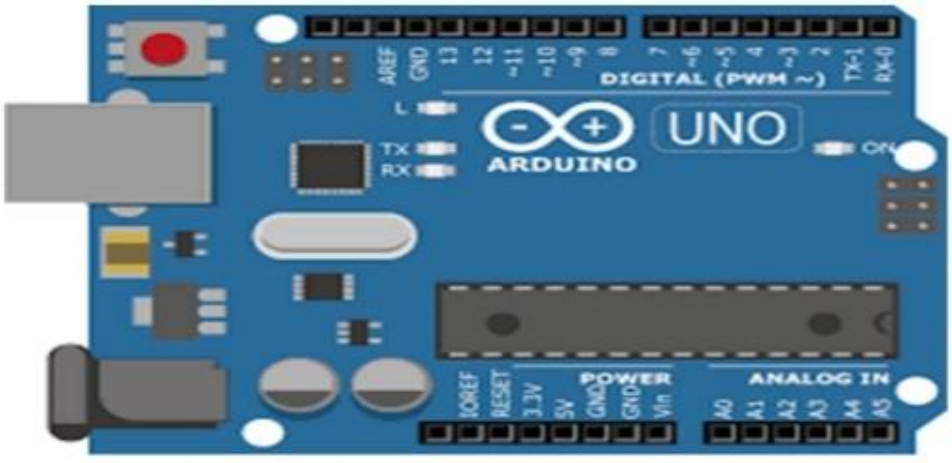

Figure 7.2 Arduino Uno

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2)Node MCU(ESP8266)

Node MCU is an Open Source Prototyping Board Design. Node MCU is a low cost and included firmware which runs on the ESP8266 WI-FI SOC shown in fig 6.3

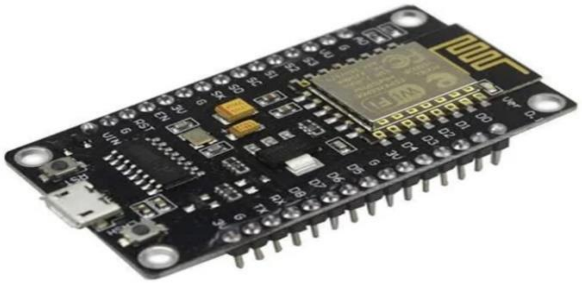

Figure 7.3 Node MCU (ESP8266

3)LCD:

An LCD (Liquid Crystal Display) screen is an electronic display module that uses the light modulating properties of liquid crystals. It is used for displaying output in digital formatting LCD is shown in fig 6.4

Figure 7.4 16*2 LCD

4) MQ2

MQ2 gas sensor is used to detect the presence of LPG, Propane and Hydrogen. It is also used to detect Methane and other combustible steam. It is low cost and suitable for different application. This sensor is sensitive to flammable gas and smoke. Smoke sensor is given 5 volts to power it. Smoke sensor indicates smoke by the voltage that it outputs, more smoke more output. A potentiometer is provided to adjust the sensitivity. SnO2 is the sensor used which is of low conductivity when the air is clean. But when smoke exist sensor provides an Analog resistive output based on concentration of smoke. The circuit has a heater. Power is given to heater by VCC and GND from power supply. The circuit has a variable resistor. The resistance across the pin depends on the smoke in air in the sensor. The resistance will be lowered if the content is more and voltage is increased between the sensor and load resistor.MQ2 sensor is shown in fig 6.5

Figure 7.5 MQ-2 Smoke/ LPG/ CO Gas sensor

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5) MQ6

The MQ-6 Gas sensor can detect or measure gases like LPG and butane. The MQ-6 sensor module comes with a Digital Pin which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. When it comes to measuring the gas in ppm the Analog pin has to be usedMQ6 sensor is shown in fig 6.6

Figure 7.6 MQ6 LPG and Butane

6)DHT11 (Temperature and Humidity Sensor)

The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

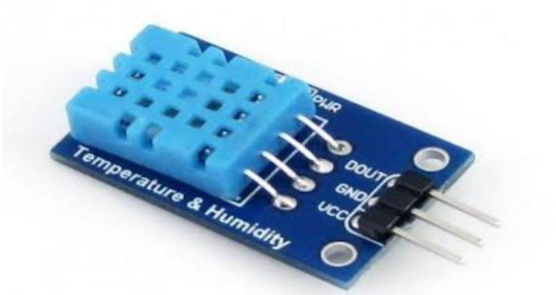
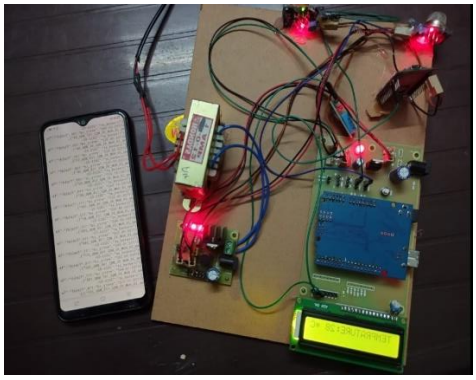


Figure 5.7 DHT11

6.RESULT



7.CONCLUSION

This research proposed a smart air pollution monitoring system that constantly keeps track of air quality in an area and displays the air quality measured on an LCD screen the system helps to create awareness of the Quality of air that one breathes daily. This monitoring device can deliver real-time Measurements of air quality. The system to monitor the air of environment using Arduino microcontroller proposed to improve quality of air. Here the using of MQ6 gas sensor gives the sense of different type of dangerous gas and Arduino is the heart of this project which controls the entire

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process and LCD is used for the visual Output. The Automatic Air management system is a step forward to contribute a solution to the biggest threat. The air & sound monitoring system overcomes the problem of the highly-polluted areas which is a major issue. It supports the new technology and effectively supports the healthy life concept.

8. FUTURE SCOPE

Inserting a SDCARD we easily store data for future analysis. Through GPS module we can monitor the air pollution. This project can also be used in the "SMART CITY".

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