AUTOMATED CONTROL SYSTEM FOR AIR POLLUTION DETECTION IN INDUSTRIES

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Abstract—In the terms of damage caused to the environment, air pollution can be easily characterized as the main culprit. The main sources of air pollution are industries. Therefore, this paper aims at using semiconductor sensor for detecting the various pollutant gases at the emission outlets which detects the level of pollutants in the industries. Specifically in this paper, gas sensor MQ135 is used. When the pollution/emission level shoots beyond the permissible level, the process/machinery causing the polluted emission is immediately shut down and there will be an alarm (light alarm or buzzer) to indicate that the limit has been reached at a specific emission outlet. Simultaneously, the factory control room will be informed via GSM that the process/machinery has been shut down and corrective action has to be taken. The execution and synchronization of the entire process is monitored and controlled by a microcontroller (PIC16F877A).

Keywords—Gas sensor MQI35, GSM, Microcontroller (PIC16F877A), Air Pollution.

I. INTRODUCTION

Over the past few decades, one of the major concerns regarding the environment is air pollution. Air pollution is defined as the addition of various hazardous chemicals, particulate matter, toxic substances and biological organisms into the Earth's atmosphere [1].

The rest of the paper is organized as follows. Section II gives a brief note about the results obtained from various research activities on air pollution and its impact on the environment. It gives an overall analysis and critical evaluation of research previously done on air pollution also deals with detection and control systems. Section III discusses about the various functional blocks of the proposed system.

II. LITERATURE SURVEY

There are numerous serious ecological implications and health risks associated with industrial air pollution. Some of them are discussed at length below. Global warming is largely considered one of the most hazardous and serious complications associated with air pollution caused by industries and other stationary sources of air pollution. The liberation of certain gases such as methane, or CH4, and carbon dioxide, or CO2, together known as greenhouse gases, is often considered to be prime factors causing global warming [2].

Industries often emit large amounts of nitrogen and sulphur gases into the Earth's atmosphere. When these gases react with water vapors in the atmosphere, they often change into more aggressive gases, namely nitric acid and sulphuric acid respectively. The rain containing large amounts of these acids is known as acid rain. Acid rain has various health and natural dangers. It results in the erosion of monuments and buildings, makes the soil acidic in nature, resulting in reduction of plant and animal growth, among other issues [3].

The emission of various gases such as carbon monoxide, or CO, often results in various respiratory disorders such as bronchitis, asthma, chronic obstructive pulmonary disease, or COPD, in individuals. CO damages air passages in individuals, leading to respiratory disorders. However, if carbon monoxide is present in increased levels in the atmosphere, it can even cause the death of the person, by inhibiting oxygen intake by combining with hemoglobin [4].

Several researchers have made efforts to combat air pollution by identifying the source of pollution and taking precautionary measures. Researchers in University College London looked at the use of metal oxide semi-conductor gas sensors in environmental monitoring [5]. This has helped us identify the effectiveness and efficiency of semi-conductor gas sensors in detecting sources of air pollution. Other researchers have proposed an automated control system for air pollution detection for vehicle [6]. Just like factories, vehicles are also a major cause of air pollution. These researchers have proposed the use of semi-conductor sensors at the emission outlets of vehicles which detect the level of pollutants and also indicate this level with a meter. When the emission level shoots beyond the already set threshold level, there will be a buzz in the vehicle to indicate the vehicle will stop after a certain period of
time, a cushion time given for the driver to park his/her vehicle. During this time period, the GPS starts locating the nearest service stations. After the timer runs out, the fuel supplied to the engine will be cut-off and the vehicle has to be towed to the mechanic or to the nearest service station.

III. PROPOSED SYSTEM

The overall block diagram of the proposed system is given in figure 1.1

![Sector Block Diagram](image)

**Figure 1.1**

A. Sector

The sector basically represents the various different process/machinery in an industry/factory. Largely, it consists of three sub-blocks namely gas sensor MQ-135, alarm (light or buzzer) and driver circuit. The MQ135 sensor is the main component of the detector block which is embedded onto the exhaust of the sector. The sensor senses the amount of emission from the vehicle and feeds the data to the microcontroller at regular intervals of time.

The analog electrical signal is then converted into a digital signal using an in-built ADC, so that, it can be compared with the predefined values, in the microcontroller. MQ135 sensors are used in air quality control equipments and are suitable for detecting of CO, NH3, NOx, alcohol, Benzene, smoke, etc. The reason why MQ135 is used in a factory environment is because of its wide detecting scope, fast response, high sensitivity, stable and long life. A simple circuit diagram of MQ-135 is given in figure 1.2

![MQ135 Gas Sensor Connection Diagram](image)

**Figure 1.2**

B. Microcontroller

In this paper, PIC16F877A is used, which features 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications. The microcontroller takes in two inputs; one from the gas sensor’s output and another being the pre-defined threshold value specified by the government. When the smoke sensor output is more than the threshold value, the microcontroller triggers the driver circuit to stop the pollution causing process/machinery and an alarm is set off to inform controller of the sector, about the same and also indicate that corrective measures have to be undertaken.

C. GSM module

A GSM module assembles a GSM modem with standard communication interfaces like RS-232 (Serial Port), USB etc., so that it can be easily interfaced with a computer or a microprocessor/ microcontroller based system. The GSM Module is initiated by the microcontroller to inform the factory control room that the process/machinery have been shut down and corrective action has to be undertaken.

IV. RESULT

This paper when implemented will help factories to identify and detect air pollution in real time at its processing/manufacturing units. It will also make sure that pollution causing processing/manufacturing unit is immediately shut down and rendered non-operational unless corrective measures are taken. As a result of which, polluted gas emission for industries will greatly reduce.
V. CONCLUSION

This whole paper mainly focuses on two major aspects. Firstly, the concept of detecting the level of Pollution and indicating it to the factory control room. There is an increase in the level of Pollution over the last couple of decades, leading to several Environmental problems. There will be a large number of corporations that may not take pollution from their factories seriously, which has already resulted in several environmental problems such as Ozone layer depletion and so on. So, this system will be highly beneficial in curbing this problem. Secondly, this system will be one of the greatest improvements in technology to keep the Environment free from industrial gas emission and bring it down to a reasonably permissible level as mentioned by the Government. The fact that this system is just an add-on, as it does not change the configuration of the factory machinery by any means, will make it easier to employ this system in factories.

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REFERENCES


