Real – Time Industrial Pollution Data Acquisition and Monitoring System using IoT

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Abstract – *Modernization, Urbanization and industrial development are impacting the atmosphere's balance by releasing detrimental hazardous substances into the atmosphere, resulting in toxicity of set of components such as water, air, and soil, that are necessary for species to survive. "The four major types of pollution caused by industries are air pollution, water pollution, soil pollution, and noise pollution." These parameters need to be brought under control to avoid its negative impact on the environment. In the past decade, IOT technology has evolved to a great extent. It bridges the gap between the surroundings and the user.*

This paper emphasizes on "Real -time Industrial Air, Water and Noise Pollution Data Monitoring System using IOT". The major purpose of this paper is to create an effective and reliable system for monitoring the parameters that pollute the environment. This system will acquire data from various sensors and keep a track of real time data. It will also inform the industrial pollution regulatory board if any of the parameters causing pollution rise above the industry standards. The sensors used in this project include pH sensor, MQ6, MQ9, temperature sensor, humidity sensor, noise sensor. The proposed system keeps a real – time record of pollutants released with precision along with date, time. It also sends an alert SMS and E – mail. This is performed using sim800L GPRS modem.

*Key Words***: IOT, DAQ, GSM, GPRS, Cloud Technologies.**

1. INTRODUCTION

Over the past decade, world has observed tremendous rise in Globalisation, Urbanisation, and Industrialisation. This has led to increase in levels of CO, sulphur, and other hazardous substances in the environment. Industrial pollution has become a major concern as this is negatively affecting the environment. Untreated emissions from industries are a major contributor to rise in such pollution.
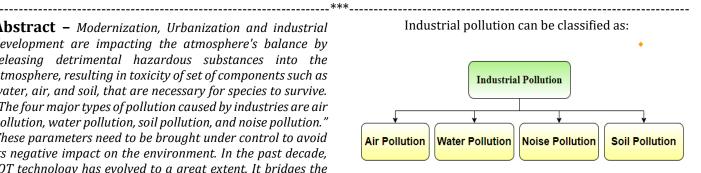
Industrial pollution can be classified as:

Fig -1: Types of Industrial Pollution

1.1 MAJOR CAUSE OF INDUSTRIAL POLLUTION

➢ Inadequate pollution-control policies.

➢ Impromptu industrial expansion.

➢ The use of antiquated technology in the treatment of hazardous residues.

➢ Manufacturers intentionally ignore waste management because they believe it will erode their profitability.

1.2 ROLE OF IOT IN FINDING SOLUTION

With the use of IOT, data can be tracked and fed into the cloud – based server and can be monitored real – time. IOT connects with the environment and interacts with the user.

IOT devices have a wide range of applications. They are used on a large scale in modern day electronic gadgets and equipment's. They are cheap, easy to handle, cost – effective and requires very low or no maintenance at all. IOT has led the foundation for modern day electronics. Information flow or data transfer is the major purpose of introducing IOT to any gadget. The proposed system can help acquire Industrial pollution data of various industries situated in even the most remote area using GSM and GPRS technology. The sensors used in this project include pH sensor, MQ6, MQ9, temperature sensor, humidity sensor, noise sensor. The system collects analog data from these sensors and records its values along with date and time. Further, if the amount of pollution increases then the standard set limit. An e- mail and SMS is sent to concerned authorities.

2. LITERATURE SURVEY

"Zumyla Shanaz, Prem Kumar S investigated 'IoT based Industrial Pollution Monitoring System'. The Author proposed to build a robust system that continuously monitors the air quality around the industry by monitoring the level of various pollutants released during the industrial process with less human intervention with the aim of providing a healthy environment to workers of the industries. Here the author used MQ-6 and MQ2 sensors for analyzing the level of CO, CO2, and quality of smoke released in the atmosphere with the help of GSM technology for the exchange of the data from sensors to the monitoring authorities. [1]"

"Ms. Aarthi, Karan Kapoor addressed 'Air and Sound Pollution Monitoring System Using IoT'. In this research, the author develops a system that monitors both air quality and intensity of noise produced during the industrial process using various sensors like MQ135 to detect the level of CO2 in the atmosphere, DHT11 sensor to monitor both temperatures and humidity, LM393 sensor to monitor sound intensity. The system is integrated using Raspberry Pi 3B module, Raspberry Pi 3B is an ARM-based credit card sized SBC (Single Board Computer) which has an inbuilt Wi-Fi and Bluetooth module in it. The author used GPRS technology to exchange the data from the sensors to the specified locations through IoT. [2]"

"Kavitha B.C, Deepa Jose proposed 'IoT based pollution monitoring system using raspberry – pi' Here the author develops a system that comprises various sensors like MQ-6, MQ-7, MQ-135, LDR, and DHT11 sensors to monitor the presence of various pollution causing parameters like carbon monoxide, carbon dioxide, smoke and butane, the system also monitors the increase in the atmospheric temperature and humidity due to pollutants released. The microcontroller used is raspberry pi with an inbuilt Wi-Fi module. The system continuously keeps an eye on data of the quantity of pollutants in the atmosphere and sends alarming messages to the governing authorities when the emission of pollutants exceeds the pre-set values by the pollution board.[3]"

3. PROBLEM STATEMENT

In past few years, the major problem faced due to increasing urbanization and industrialization was release of untreated sludge into the ecosystem. This caused severe impact on the life of various creatures and organisms. Also, it has been observed that, there is a severe rise in the health problems of people living in such polluted areas.

There are various laws and standards set by the pollution regulatory authorities. But these protocols are being neglected by the industrialists. Policies are not being followed. This has created a negative impact on the bio –

diversity. In most of the cases, as industries are in remote areas. It becomes difficult to keep a track of all such industries. As a result, not centralized data pertaining to pollution is recorded. This leads to negligence and failure of implemented policies of the pollution control board. Major research done in the field are only limited to air and water pollution.

Considering the above problems, there arises a need to build a robust and affordable system that can monitor pollution and record the values of pollutants released at specific date and time. It should be capable of sending alert sms and mails to the concerned pollution monitoring authorities, whenever rise in pollution levels are observed. So that proper action can be taken by the authorities at the right time.

4. PROPOSED MODEL

The proposed system is designed to monitor all four types of pollution by using following methods:

1. Air pollution is monitored by using MQ6, MQ9, DHT11 humidity sensor, dust – density sensors. These sensors gather data related to carbon monoxide, combustible gases like: LPG, humidity and optical dust released during industrial processes.
2. Water pollution is monitored by pH sensor. pH sensor detects the acid content in water. If waste is found to be more acidic than the standard limit set, a mail and SMS will be sent to authorities.
3. Also, LM35 temperature sensor is used to detect the temperature in case the waste is burnt. As this may rise the surrounding temperature and contribute to global warming.
4. Noise pollution is monitored using LM393 sensor, as a certain limit of sound in decibels is set. If the industrial sound goes beyond the limit, concerned authorities will be alerted regarding the same.

All these sensors will be connected to Arduino mega 2560 microcontroller. Analog data will be gathered from sensors, and it will be converted to digital data. Data transmission will occur through GSM modem module. This module will require a sim and internet. It will transmit data via SMS and mail.

5. OBJECTIVES

1. Air, water, thermal and noise pollution can be monitored with the help of this system

2. Real – time centralized data of pollution along with date and time can be acquired,
3. The system can be linked with online server and pollution records can be collected from the online repository.
4. SMS and email alerts are sent.
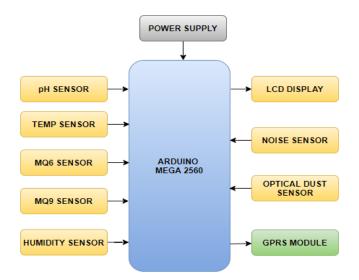
6. WORKING METHODOLOGY

Fig -2: Transmitter section of system

The proposed system has a transmitter section and receiver section. The transmitter section is composed of power supply to Arduino mega 2560, and sensors which include pH sensor to measure the acid strength of residue. Temperature sensor to detect fire, MQ6 and MQ9 sensor to measure the amount of combustible matter in air and presence of carbon monoxide (CO). Humidity sensor to measure the humidity of surrounding area. Noise sensor to track noise pollution and optical dust sensor, which measures optical dust pollutants which causes air pollution. The system is connected to a GPRS module to transmit sensor data in the form of SMS and emails.

The data is fed into the system by the sensors. The sensors collect analog data and converts it to digital data. Then the converted data is matched with the maximum limit which is already fed into the microcontroller. If the input data is exceeding the limit. A warning message is displayed on the LCD screen. Also, a SMS and mail is sent to the fed in email id.

7. HARDWARE REQUIREMENTS

- **Power supply unit**
- **MQ-9 sensor**
- **MQ-6 sensor**

- **LM-35 sensor**
- **DHT-11 sensor**
- **Optical dust sensor**
- **pH sensor**
- **LM393 sensor**
- **Arduino mega 2560**
- **SIM 800L GPRS modem**
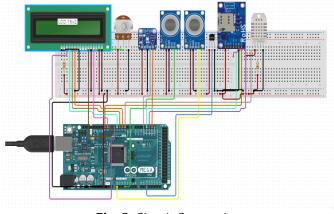
8. CIRCUIT DIAGRAM

Fig -3: Circuit Connection

Sensors are connected to the analog pins of Arduino mega 2560. An External power supply is needed to power the Arduino mega 2560. The pin connections are given below:

8. PIN CONNECTIONS

Table -1: Analog input pin to sensor connection

Sensor	Analog input pin
LM – 35	A0
MQ 6	A1
MQ 9	A2
DHT 11	A3
LM 393	A4
pH	A5
Optical Dust	A6 (Measure Pin)
LED	A7

8. SOFTWARE

Arduino Integrated Development Environment (IDE) was used to program the microcontroller Arduino mega 2560. Programming language used is embedded C.
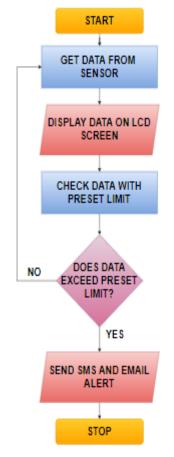
8.1 FLOWCHART

Fig -4: Flowchart of proposed system

8.2 ALGORITHM

Step 1   :   Start

Step 2   :   Declare pins using variables of datatype integer having names TEMP, MQ6, MQ9, HUM, NOISE, PH, measPin, ledPower.

Step 3   :   Read sensor data using **analogRead** function.

Step 4   :   Display Data on LCD screen using **lcd.print** function.

Step 5   :   Send alert message on mobile number using:

Serial.println ("AT+CMGS=\"mob number\"");

Step 6   :   Stop

9. RESULTS

TEMP	MQ6	MQ9	HUMIDITY	NOISE	PH	DUST	Date / Time
28	2	2	17	197	9	1.51	2021-06-16 13:48:15
60	2	2	18	197	9	2.12	2021-06-16 13:47:31
46	2	2	19	205	9	3.74	2021-06-16 13:46:17
24	2	2	20	205	9	3.74	2021-06-16 13:45:46
43	3	2	24	205	9	0.95	2021-06-16 13:43:47
31	3	2	26	197	9	0.98	2021-06-16 13:42:58
37	3	2	31	197	9	0.95	2021-06-16 13:42:01
31	203	3	16	197	9	0.96	2021-06-16 13:38:47
22	4	3	16	197	9	0.96	2021-06-16 13:38:25
21	20	207	16	196	9	0.98	2021-06-16 13:37:39
51	3	3	18	196	9	1.01	2021-06-16 13:34:31

Fig -5: Virtual Simulation Result

Initial reading of the sensors is taken and matched with the preset limit. If the reading exceeds the preset limit than an alert msg is sent along with the date and time, preset limit can be set by the regulating authority and can be varied.

10. CONCLUSION

The proposed project "Real – Time Industrial Pollution Data Acquisition and Monitoring System using IOT" is designed to monitor air, water, noise, and thermal pollution. The project will help the pollution regulatory authorities to monitor the industrial pollution and take actions and measures accordingly. A centralized repository is made where all the real time data along with date and time is stored and can be accessed by the authorities wherever and wherever required. This will help in reducing pollution and keeping a track on industrial effluents. So that proper policies can be planned for future, considering the current pollution impact.

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