Leveraging IoT for Industrial Pollution Monitoring and Control Featuring Power and Waterline Disconnection

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Abstract

The Industrial pollution poses significant environmental and health risks, requiring effective monitoring and control measures. This project presents an IoT-based solution for autonomous industry pollution management and control. The system integrates various sensors including sound sensor for noise pollution, MQ135 sensor for air quality and lm35 for temperature monitoring within industrial premises. The core functionality involves real-time monitoring of pollution parameters. Upon detecting any violation of predefined thresholds, the system triggers automated actions to mitigate pollution. This includes cutting off the electrical(EB) and water supply lines through relay mechanisms. Additionally, an alert notification is sent to the concerned authorities via SMS through a GSM modem. The SMS notification contains crucial information including the Google Maps URL pinpointing the exact location of the industry, facilitating prompt response and intervention. By employing this innovative approach, industries are compelled to maintain pollution levels within permissible limits to sustain operations. Ultimately, the system aims to ensure environmental sustainability and public health by preventing and controlling industrial pollution effectively.

Keywords: Smart Industrial Solutions, Pollution Mitigation, Pic16f877, MQ135, IoT Technology, Lm35, Condenser Microphone.

1. Introduction

Industries are essential for economic growth, but their increasing pollution levels are a serious environmental concern. As industries expand and install more machinery, emissions rise, creating risks to human health, ecosystems, and the climate. While regulations exist to control pollution, enforcement remains a challenge. Traditional methods rely on periodic inspections, which are slow, labour-intensive, and reactive, allowing industries to exceed pollution limits before action is taken. By the time authorities intervene, significant environmental damage has already occurred.

The biggest gap in current systems is the lack of real-time monitoring and immediate action. Pollution levels often go unchecked for long periods, as industries continue operating beyond their allowed limits. This system fills that gap by continuously tracking pollution levels and taking immediate action when thresholds are crossed. Instead of just collecting data, it automatically cuts off power and water supply, ensuring that the industry cannot continue operations until pollution is brought under control. At the same time, it sends an alert with a location link to regulatory authorities, allowing for immediate enforcement.

By eliminating delays and ensuring that industries operate within pollution limits in real time, this system makes environmental laws more effective and actionable. It reduces reliance on manual inspections, prevents excessive pollution before it causes harm, and ensures that industries take immediate responsibility for their environmental impact. This proactive approach bridges the gap between regulation and enforcement, creating a cleaner and more accountable industrial landscape.

1.1 Objectives

1. **Monitor Pollution in Real Time** – Continuously check air quality, noise, and heat levels in industries.
2. **Take Immediate Action** – Automatically cut off power and water when pollution goes beyond the allowed limit.
3. **Send Instant Alerts** – Notify authorities with the industry's location for quick action.
4. **Enforce Rules Automatically** – Reduce the need for manual checks by using a system that responds instantly to pollution levels.
5. **Protect the Environment** – Prevent industries from polluting too much to keep people and nature safe.

2. Block Diagram

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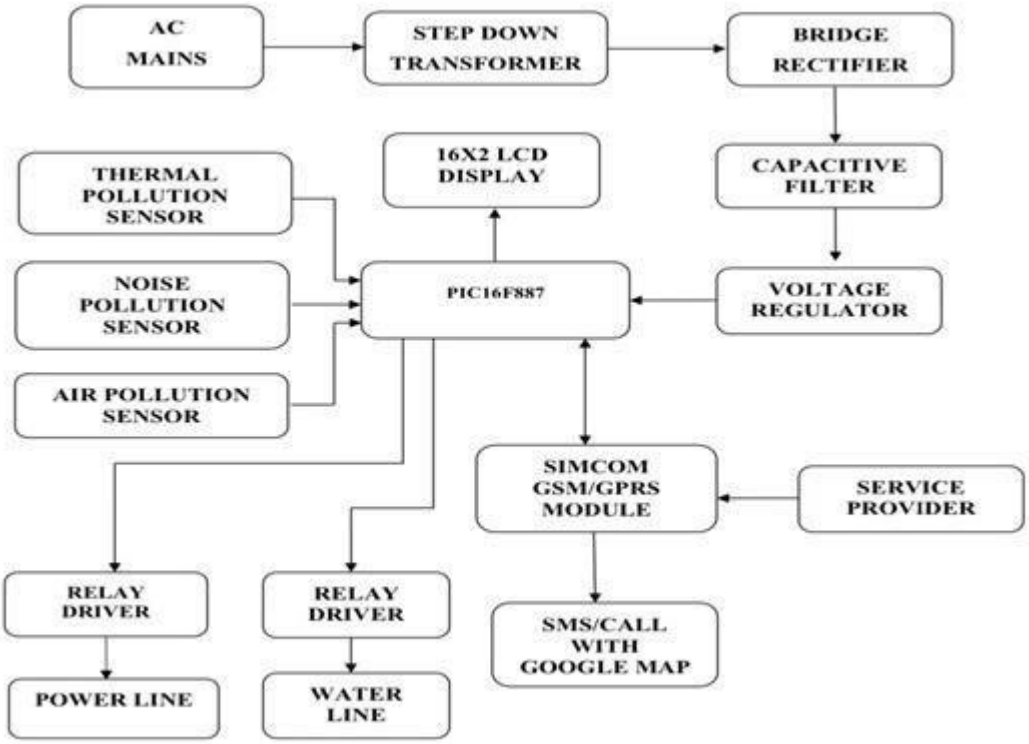

Figure 1. Block Diagram of the Proposed System

The block diagram represents the Leveraging IOT for Industrial Pollution Monitoring and Control featuring Power and Waterline Disconnection System designed to ensure optimal pollution emissions from an industry. The core of the system is Pic16F877 microcontroller which integrates various sensors such as MQ135 gas sensor for detecting pollution level in air, lm35 to identify the amount of heat generated within the industry and a condenser microphone for detect noise pollution. These three sensors collect and transmit data continuously to the microcontroller. Pic16f877 analyze the given data and if the data given by any one of the sensors found exceeding the threshold, the Pic microcontroller then performs the enforcement actions by cutting off the power and waterline connection which are represented here by two relays and a SMS is sent to a designated phone number containing the Google Maps URL indicating the exact location the industry this system is placed using GSM module. Additionally, an LCD display used to display the present air toxicity, noise and heat levels and also a buzzer that goes off when the industry pollution is found exceeding its threshold levels.

3. Working

This is an automated system that utilises Pic16f877 as its microcontroller. The AC power supply is decreased using a stepdown transformer. Then it is passed through a bridge rectifier to convert the AC to DC. A voltage regulator is used to stabilize the pulsating DC power given to the microcontroller to function. This system considers three potential polluting parameters such as Noise, Air and Temperature. The Microcontroller integrates three sensors, including

MQ135 gas sensor for detecting pollution level in air, lm35 to identify the amount of heat generated within the industry and a condenser microphone for detect noise pollution. The three sensors used in this system continuously collect and transmit data to the microcontroller, ensuring real-time monitoring of pollution levels. The PIC16F877 microcontroller process this data by analysing the readings received from each sensor. If any of the sensors detect pollution levels exceeding the predefined threshold, the microcontroller immediately triggers enforcement actions. These actions include cutting off the power and water supply, which is achieved through two relays that act as control switches, effectively stopping industrial operations until pollution is brought under control. Additionally, the system is designed to alert the relevant authorities by sending an SMS notification to a designated phone number. This message includes a Google Maps URL, allowing officials to pinpoint the exact location of the industry where excessive pollution has been detected. This communication is facilitated through the GSM module, ensuring a quick and efficient response. To provide real-time status updates, an LCD display is integrated into the system, showing the current levels of air toxicity, noise, and heat. This allows industry to monitor pollution levels and take preventive measures before enforcement actions are triggered. Additionally, a buzzer is included as a warning mechanism, sounding an alarm whenever pollution exceeds the allowed limits. This alert acts as an immediate indication for workers and industry managers, prompting them to address the issue before regulatory actions are enforced.

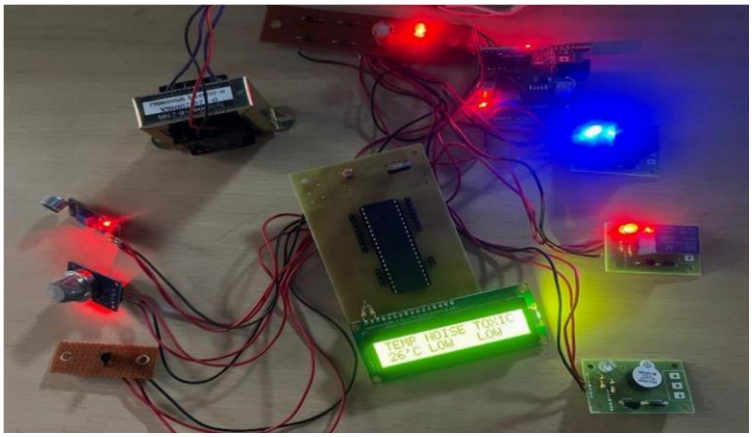

Figure 2. Working Model of the System

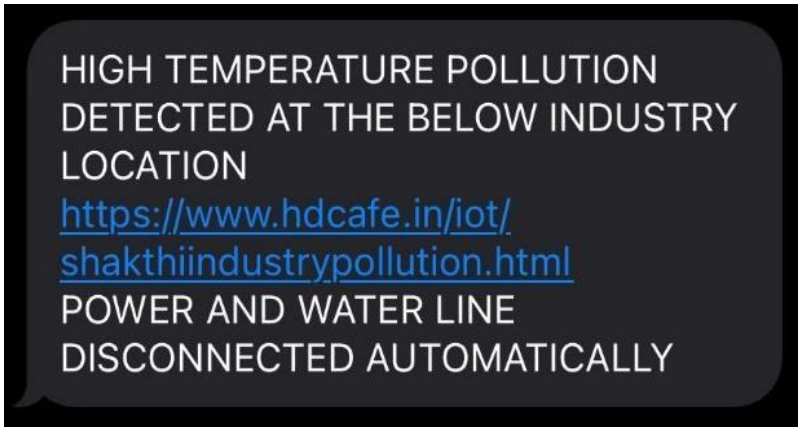

Figure 3. SMS alert sent using GSM Module

4. Result and Discussion

This pollution monitoring and control system was tested in an industrial setting and performed well in detecting and controlling pollution. It successfully monitored air quality, temperature, and noise levels. The MQ135 sensor detected air pollution, the LM35 sensor measured heat levels, and the condenser microphone identified noise pollution. If pollution exceeded safe limits, the system triggered actions such as shutting down operations and sending alerts via SMS. The LCD screen displayed real-time pollution levels, while a buzzer warned workers about rising pollution.

The system provided accurate and continuous monitoring, ensuring quick responses to pollution levels. The relays effectively controlled power and water supply to enforce regulations. The GSM module successfully sent alerts to authorities for enforcement action. The system was easy to use, helping industry workers take preventive measures.

However, some improvements are needed. The sensors require periodic calibration for accuracy. A backup power source could prevent system failure during power cuts. Additional sensors could monitor more pollutants, and cloud-based storage could help track pollution data over time. Overall, the system successfully monitored pollution and helped industries follow environmental rules.

5. Conclusion and Future Scope

The pollution monitoring and control system effectively detected and managed industrial pollution by continuously monitoring air quality, temperature, and noise levels. It provided realtime alerts and automated enforcement actions, making it a reliable solution for industrial pollution control. The system helped industries maintain environmental pollution and take preventive measures to reduce pollution.

In the future, improvements can be made by integrating more advanced sensors to detect additional pollutants such as carbon monoxide and fine particulate matter. Cloud-based data

storage could enhance real-time monitoring and long-term analysis. Implementing AI and Machine Learning algorithms could improve predictive maintenance and pollution forecasting. Additionally, expanding the system to include more industries and public areas could enhance its overall impact in ensuring a cleaner environment.

Acknowledgments

The authors express their sincere gratitude to the Management and Principal of Sri Shakthi Institute of Engineering and Technology, Coimbatore, for their support and provision of excellent research facilities.

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