IoT Based Garbage Methane Gas Detection System

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Abstract- *Biogas is an essential component of both rural new energy development and the country's long-term growth. The majority of individuals are willing to create methane gas from organic waste at home. This article presents a gas detection gadget that makes use of the Internet of Things. It is equipped with a PIC Microcontroller as well as gas and temperature sensors. This detection gadget may also be used to detect gas leaks in underground mines. Ambient gas detection and measurement have become critical in many sectors and applications, including accident prevention, equipment malfunction prevention, air pollution warnings, and providing the proper gas mixture to patients in hospitals. Gas leaks may be massive, impacting entire neighborhoods or even cities and wreaking havoc on the environment. Using the Internet of Things, this article expands on the gas detection and automated alerting system.*

Keywords- PIC Microcontroller, Internet of Things, Gas sensor

I. INTRODUCTION

Methane gas detection is critical for safety in the oil and gas industries, water treatment facilities, waste sites, and commercial or residential settings where methane gas may filter up from the earth and cause an explosion danger (the lower explosive limit, LEL, for methane is 5 percent by volume methane gas). Portable gas detectors for identifying gas leaks are vital in many of these applications, but they must be low-cost to be widely used and available. The catalytic sensor [1–3] is the most widely used technique for detecting methane gas. However, it is not methane-specific since it detects any gas whose ignition is catalyzed by the pilaster. Furthermore, catalytic sensors do not function properly in low-oxygen conditions and can be poisoned. As a result, such detection systems may need periodic functioning inspections [2]. Methane Gas is a kind of natural gas used to heat homes, create power, and fuel automobiles. It can be produced by organic waste; individuals in rural areas are mostly responsible for methane gas production. Methane gas is a dangerous gas as well. Because it is 16% blended with the air volume, it has a possibility of igniting and producing an explosion. This gas harmed people who worked in deep mining and sewage cleanup. Detecting methane gas is therefore critical [5]. As a result, we create a design for a methane gas detector.

The PIC microcontroller serves as a controller in this arrangement. The design includes a methane gas sensor, a temperature sensor, a 16x2 LCD, a buzzer, and a wifi module. IoT was used to advance the design. Using a wifi module and the internet, we may monitor the live status of a gadget that has been installed in a certain location. This gadget may be used for both home and industrial purposes. We can detect methane gas in the range of 200ppm to 10000ppm with this instrument. In four Asian countries, a sustainable strategy to waste management in an integrated landfill composting was tested. It reveals the technologies that have been used in landfills and leachate characteristics during the last few decades. It made recommendations for landfill exercise, filled a gap in technical materials and cost-effective waste disposal, and handled environmental issues created by waste management operations [8]. The Bio-degradation model was developed to model biochemical processes in municipal solid waste. When compared to the normal disposal method, it will minimize the landfill by half.

II. BACKGROUND STUDY

The study presented in reference [1] offers wireless sensor network-based precarious environment monitoring using Bluetooth technology utilizing data mining algorithms and ID3 algorithms. Sensor values are detected by the sensor grid, which is made up of several sensors. A microcontroller will be used to convert analogue values to digital values. To determine the pollutants emitted by the chemical industry, data mining is employed. The ID3 method is used to compute probability-based values. Reference [2] describes a master-slave wireless network for monitoring hazardous gases based on Zigbee and GSM technologies. A distant detection terminal, a control master station, and a mobile monitoring terminal are all part of this system. The remote monitoring terminal monitors levels of gas concentration. A remote sensing terminal is used to assess ambient conditions as well as gas concentration levels. The harmful environment monitoring design utilizing Zigbee technology is described in reference [3]. This system included multi-hop and multi-sink functionality. Temperature and humidity are chosen as the

environmental factors to be monitored. The study described in reference [4] declares monitoring hazardous gases in fire locations and petrochemical plant regions using a recurrent neural network model and comprehending the critical early warning of toxicant and dangerous gases. The reference [5] presents a GSM-based environment monitoring solution for people safety applications. The parameters to be monitored in the environment are H2S, CO, and CH4. If the concentration of this gas exceeds the normal level, a warning signal is immediately generated. This design has the advantages of automated detection, rapid reaction time, and precise identification of emergency circumstances. The reference [6] shows how to create a Wireless Sensor Network-based vehicle pollution monitoring system utilizing RFID. This device is inexpensive and produces reasonable results in dominating air pollution, particularly in urban settings. The reference [7] describes an ambient air quality monitoring system that uses GSM technology. The hardware implementation for detecting cars producing environmental pollution using RFID technology is described in reference [8]. Data on vehicles that pollute the environment are collected using gas sensors installed along the route. These literature reviews present several technologies for detecting hazardous gases. These present technologies are inefficient for individuals accessing sensor data at any time and from any location, and they only enable short-distance connections. The suggested system is contemporary and well-organized, yielding results for connecting objects to the server and managing and monitoring various harmful locations.

III. METHANE GAS DETECTION SYSTEMS

Garbage is waste produced due to different activities such as industrial garbage, vegetable waste, commercial waste, home wastes, and so on. Improper trash disposal may cause several environmental problems, including the release of toxic gases, which can lead to various health problems. The most prevalent type of disposal is the curbside collection, in which garbage is collected at regular intervals by specialized vehicles and exposed to burning. Garbage must be transported and disposed of following a variety of protocols. Waste processing entails transporting garbage from one location to another using automobiles, trucks, bicycles, etc. However, when transporting the gases, waste collectors must adhere to certain laws and regulations. As a result, it should not impact the environment or the people of society. However, the time of processing in cities is critical. Because, in recent days, the waste collection has been ineffective owing to a shortage of employees, specialized trucks, and other ways. As a result, waste on the road or the ground degrades and creates a foul odour.

Furthermore, when garbage collectors are not properly cleaned, it produces a foul odour and causes various ailments such as cholera, skin disorders, etc. The appropriate disposal of waste can assist us in obtaining certain gases. Some may be harmful, while others may be beneficial. The beneficial gases emitted by the trash can be used for commercial reasons as well. The gases emitted by waste can cause a variety of illnesses and harm the ecosystem. So, to determine the concentration of rubbish in various locations and the main container, this article was created, implemented, and tested in numerous locations.

Previously, members of society and government authorities were aware that certain gases were being emitted by rubbish. However, they do not know the precise values emitted by the trash. Furthermore, they are not receiving any data. Once the rubbish has been collected, members of the community must notify the appropriate authority promptly. The PIC microcontroller uses the analogue to digital conversion concept. Temperature value detects a by temperature, and its analogue value is transformed to a digital value by the microcontroller's ADC. The methane gas sensor detects methane gas in its vicinity and provides the output data to the PIC Microcontroller. A 12v dc supply powers the PIC Microcontroller. It processes data from the temperature and methane sensors. The processed data will be shown on the output unit's LCD. The LCDs a live update of the temperature in Celsius and the status of the methane gas. A buzzer is a type of output unit.

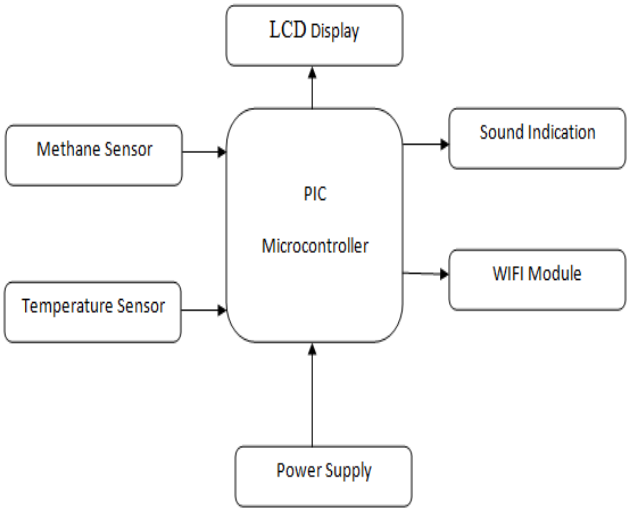

Figure 1: Block Diagram

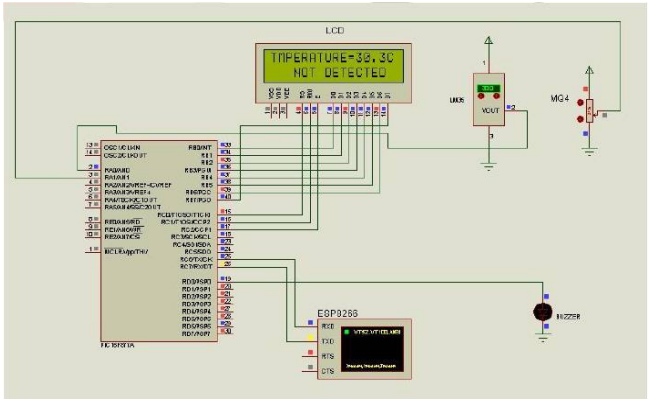

Figure 2: Circuit Diagram

When the sensor detects methane gas, it will automatically switch on; otherwise, it will stay off. Wifi Module connects the microcontroller to the wifi network, allowing it to connect to the internet and transmit sensor data to the IoT platform. We may access the device's live data from anywhere by utilizing a mobile phone or a PC and the IoT application.

IV. RESULTS AND DISCUSSION

This suggested system employs a Methane gas sensor MQ4, which detects Methane Gas and sends Digital Output to the PIC16F877A microcontroller. The microcontroller successfully activated the buzzer alert. In addition, the LCD displayed the current temperature value as well as the finished Methane Gas status. We can send data to a cloud server via serial communication. The Things Speak application is used to examine the output data from any location using a smartphone or a personal computer. The humidity and temperature sensor DHT11 measure the heat in the environment. And the temperature in Celsius is shown immediately on the LCD. When we need to know the temperature of a certain location, we may turn on the gadget and examine the LCD panel.

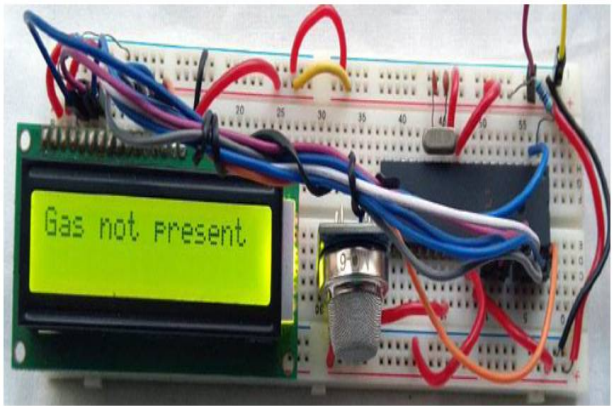

Figure 3: Gas Detection in LCD View

The MQ4 methane gas sensor detects and measures gas concentrations in the air. It has both analogue and digital pins. A digital output is linked to the microcontroller and is configured to alert anytime the sensor detects gas.

V. CONCLUSIONS

In this Paper, methane gas detection utilizing the Internet of Things has been experimentally shown to function. It suggests a better method for locating the methane gas originating from the methane tank. The temperature and methane gas condition are constantly updated to the microcontroller via the electronic sensor. The LCD allows us to determine the temperature of the surface quickly. It also sends sensor data to the cloud through wifi. This idea may also be used in other businesses such as gas industries, garbage management, sewage cleaners, and underground mines. It will be used for both security and detection.

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