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# PROMOTING OCCUPATIONAL SAFETY: IOT-ENABLED HARMFUL GAS DETECTION AND MONITORING SYSTEM FOR INDUSTRIAL ENVIRONMENTS

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**ABSTRACT:** Explosions of toxic gasses are the leading cause of death among workers in industries that rely heavily on chemicals. Modern information technology and the internet of things can assist locate and repair gas leaks fast. This project uses the internet of things and an Arduino Uno R3 to detect toxic gasses, prevent workplace mishaps, and notify the relevant industry's safety control board. The main CPU, an Arduino Uno R3, is coupled to a sensor. Sensors capable of continuously measuring the appropriate environmental conditions include those that detect alcohol, gasses, and temperature. This gadget can detect a wide range of gases due to its fast response time. When the gas level exceeds a predetermined threshold, an instant alert is transmitted via the internet-specific receiver component. The monitor transfers the data it collects to the internet for further processing and analysis in order to tighten safety regulations. If this strategy is used in the future, it has the potential to improve the quality of life for those who live near pollution-controlled companies.
***KEY WORDS***-Ardunio Uno R3, gas sensor, radiation sensor, Wi-Fi module, internet of things.

## I. INTRODUCTION

Currently, harmful gas leaks are the leading cause of workplace fatalities and injuries. Pollution of the environment is exacerbated by factories that emit hazardous gasses and pollutants into the atmosphere, which are harmful to both human and animal health. Oxygen levels fall when gases such as ammonia, carbon monoxide, nitrogen trifluoride, sulfur hexafluoride, and others are emitted. These gases are the primary source of the increased pollution in the atmosphere. Chemical-using enterprises are mostly responsible for releasing these pollutants into the environment. Environmental safety is not the primary priority for industry management.

This has an impact on the air quality and health of industrial workers who live near these facilities, as hazardous gasses are more prevalent in industrial locations than in residential ones. Every day, around 1.1 billion people worldwide are believed to breathe in polluted air, which kills 7 million.
Sensors and IoT automation can assist control gas leaks and detect harmful gasses in and around industrial sites. A simple system for detecting and measuring hazardous gasses was developed, which included a self-calibrated ppm scale. If there is a gas discharge in any location, it can notify persons in the sector by SMS. The MQ-6 Semiconductor Sensor for Combustible Gas Detection is an effective gas sensor. This MQ-6 gas monitor detects $SnO_2$, a molecule that does not transmit electricity as effectively in pure air. When the flammable gas of interest is present, an increase in gas content causes the sensor to activate. Because conductivity increases, the monitor's resistance decreases as the current in its circuit increases.

This alteration is performed to ensure that the gas concentration output signal is in the correct location. The MQ-6 gas monitor can detect both butane and methane due to its high sensitivity. The sensor is not only inexpensive and useful in a variety of situations, but it can detect a number of combustible gasses, including methane. If the received number exceeds the configured threshold, the microcontroller will display the message on the 16x2 LCD screen and activate an LED and alarm. Furthermore, it delivers the data for gas removal via the internet with a few milliseconds delay. An app on a smartphone can generate this type of message, which is then sent over an internet server. Users see server information on a webpage.

## II. RELATED LITERATURE

### Gas leakage Detectors

There are two basic approaches for detecting gas leaks: stationary sensing and mobile devices. Fixed instrumentation includes monitors in areas where leaks are likely to occur. In general, these instruments operate on a constant power supply and give out alarms based on the data they collect. These warning signs can be seen or heard, and they are only applicable to plant management. Often, mobile sensors are portable devices. The expert must examine the readings while placing the equipment near the source of the suspected breach. Various estimated reports are distributed over time, either through coordinated emailing between the expert and other plant representatives or by connecting remotely. Although each of these technologies has advantages and disadvantages, it is typical to use both stationary and mobile sensors together. A fixed sensor, in particular, can monitor an area continuously, whereas an employee can only inspect the same region for a brief period of time. Because our suggested system will not move, we are particularly interested in stationary sensors. It is recommended that a range of radio safety equipment be used to detect gas leaks. Its primary responsibility is to keep people secure within the country. Most of these devices have detecting, transmitting, and receiving modules. A unique sensing circuit in the receiver module can detect changes in gas concentration. If the change in gas concentration exceeds the threshold, a warning is issued and a signal is transmitted to the receiving module. Additionally, this module functions as a mobile alarm system, allowing people to wander throughout their home.

**Internet of Things**

The term "Internet of Things" refers to the interconnectivity of real-world objects such as cars, buildings, electronics, common household appliances, and other devices that are wired together and have actuators, network connectivity, sensors, and the ability to share and act on information. It allows you to perceive and manipulate objects from a distance. As a result, it is easier to connect the physical world to the network. This increases accuracy and productivity while reducing the time required to complete the operation manually. The economic benefits are also significant, helping them gain a larger portion of the global market. Connectivity extends beyond machine-to-machine interactions, allowing devices, hosts, and servers to communicate with one another. This enables automation in practically any business.

The Internet of Things can be used in practically every business. Examples include smart houses, smart cities, smart logistics, smart transportation systems, and smart supply chains.

Because it contains an embedded computer system, each device in the network is assigned a unique address and can interact with the network architecture using conventional protocols and domains. Assuming a network design, the Internet of Things will include approximately 50 billion devices. This is what the experts in the field say.

As the network expands and more autonomous devices are added, a large volume of data from various sources will be created, which must be processed and analyzed immediately so that actions may be performed. IoT can be utilized in the manufacturing sector to track assets and manage processes. Along with higher throughput, intelligent manufacturing will enhance real-time production and supply chain management capabilities. Precision and output will improve as automation increases while human participation decreases.

The term "IoT" is frequently used to refer to manufacturing and production methods based on the Internet of Things. It could fall into the category of an industrial subset of the Internet of Things. Companies are expected to increase productivity by employing analytics to accelerate data processing and create new business models. According to fresh forecasts, the Internet of Things (IoT) might generate close to $12 trillion by 2030. The massive amount of data generated necessitates data flow regulation and rerouting. As a result, new data mining techniques and routing algorithms may be required to facilitate communication across all connected devices.

When connecting devices or items, the most important thing to consider is the small amount of memory provided by each. To achieve interconnectivity standards, devices must employ lightweight operating systems and protocols. When connecting to networks and delivering data, IoT devices with limited functionality offer security threats. From a technical standpoint, these devices face identical security issues to traditional PCs. However, because they only perform a few functions, it is difficult to configure firewalls or anti-malware systems to prevent unauthorized access. In 2016, devices connected to the internet of things deployed the Mirai malware to perform a distributed denial-of-service assault, which brought down both big websites and a few DNS providers. As a result, security issues must be addressed in order to ensure that device communication and administration remain secure and private.

## III. WORKING PRINCIPLE

The zigbee module, which operates at a speed of 250 kilobits per second, facilitates data transmission and reception in the existing system. This system sends and receives data at a rate of 54 megabits per second, primarily via a WiFi module. Wi-Fi modules are used to expedite the distribution of information to people in the designated region or location, as well as government employees that require it.

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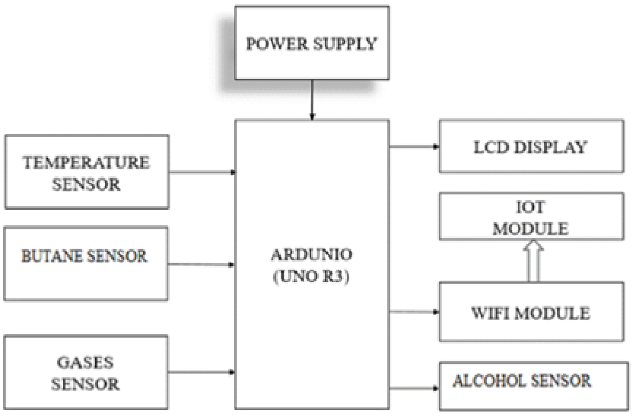


FIGURE 1: Block Diagram of Harmful gas detection and monitoring system In industries using IOT

## HARDWARE USED

### MQ2 Sensor

MQ2 gas monitors can detect carbon monoxide, propane, methane, hydrogen, alcohol, and smoke. These parts can also function as chemiresistors. It is constructed of a sensor material whose resistance changes as it comes into contact with gas. Gases can be identified by measuring the change in resistance number.

### MQ7 Sensor

This carbon monoxide (CO) sensor is simple to use and effective in detecting carbon particles and gas radiation. It has a distinct overall focus. This MQ-7 monitor detects carbon particles and gas radiation between 20 and 2000 PPM. It makes a powerful emotional impression and responds rapidly.

### MQ135

Among other harmful gases, the MQ135 gas sensor is extremely sensitive to smoke, ammonia, sulfur, and benzene vapor. Mq135 gas sensors detect gases using the sensor $SnO_2$. In comparison to clean air, this substance conducts electricity poorly. When this gas sensor is activated, the air contains more harmful gases, therefore it conducts electricity more effectively.

### Linear Monolithic 35 Sensors

When you use the LM35 to measure temperature, the analog output value changes as the temperature rises or falls. The voltage at the output is expressed in degrees Celsius. There is no need for extra calibration circuitry. The LM35 can only detect 10 mV/°C. The output power increases in proportion to the temperature. A three-terminal monitor measures the temperature surrounding it. It can detect temperatures ranging from -55 to 150 °C. A thermistor provides a more accurate temperature reading than the LM35.

### Wi-Fi Module

Doctors of Intelligence and Technology (SZDOIT) in Shenzhen are designing and creating an ESP8266-based Arduino serial Wi-Fi bridge. Cloud Server will collect information so that informational indexes can be created. It also sends emails or texts to the expert and alerts the owner to interesting developments via email or text message. If your cloud server supports multi-client framework properties, you can connect as many clients as needed. In this scenario, there is only room for one cloud server, but many individuals can access it via their laptops or Android devices.

### LCD Display

Clear and intelligible LCD (Liquid Color Displays) for Arduino facilitate communication between the user and the electronic system. Any microcontroller must be capable of reading and writing letters to the LCD, and Arduino excels at this. Arduino allows you to easily create prototypes and connect LCD displays, motors, sensors, and other components. In accordance with your specific demands and specifications.

### Alarm

The primary purpose of using this framework as a warning or signal is to get those who work and have relocated to a safe location prepared to safeguard the public's life and health.

### Power Supply

To activate the circuits, use electricity ranging from 6 to 20 volts. When the supply voltage is less than seven volts, a 5V stick delivers less than five volts. This could render the board unstable. If you put more than 12V into the voltage controller unit, it may cause damage to the circuit board due to saturation. The range is 7 to 12 volts. In my experience, 9V works really nicely. To connect the battery, wire up the Arduino VIN to the positive terminal and the Arduino Ground to the negative terminal.

### Arduino UNO

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The Arduino UNO is a microcontroller based on the ATmega328P. The Arduino Uno R3 pins are displayed in the diagram below. There are one hundred and fourteen-digit I/O ports built in. There are six PWM outputs on these ports. The board includes a resonator (16 MHz), a power port, an ICSP header, fourteen digital input/output pins, six analog inputs, a USB connection, and a resonator (16 MHz).

**SOFTWARE USED**

**Arduino IDE Software**

The Arduino Integrated Development Environment (IDE) includes a text editor for writing code, a message box, a text console, a toolbar with icons for common activities, and a number of options. It connects to the Arduino hardware, communicating with and writing to it. The Embedded C program and this software were used to address errors in the Arduino UNO program. The Arduino Software (IDE) is modeled after the structure of a sketchbook, which is commonly used to store programs (or sketches). You may access the sketches in your sketchbook by clicking the Open icon on the toolbar or selecting File > Sketchbook in the menu bar. When you initially launch the Arduino software, it automatically creates a directory for your sketchbook. The Preferences dialogue box allows you to modify and return to the sketchbook's position.

**Thingspeak Software**

ThingSpeak is a cloud-based IoT analytics application for combining, displaying, and rating real-time data streams. ThingSpeak provides real-time images of the data that your devices have posted. ThingSpeak can collect, process, visualize, and use data in real time, as well as support apps and plugins. ThingSpeak uses a channel-based design. A route is the location where you send data to be stored. Each channel consists of eight fields for various forms of input, three for location, and one for status. The Sensed numbers were saved using Thingspeak program.

**ALGORITHM**

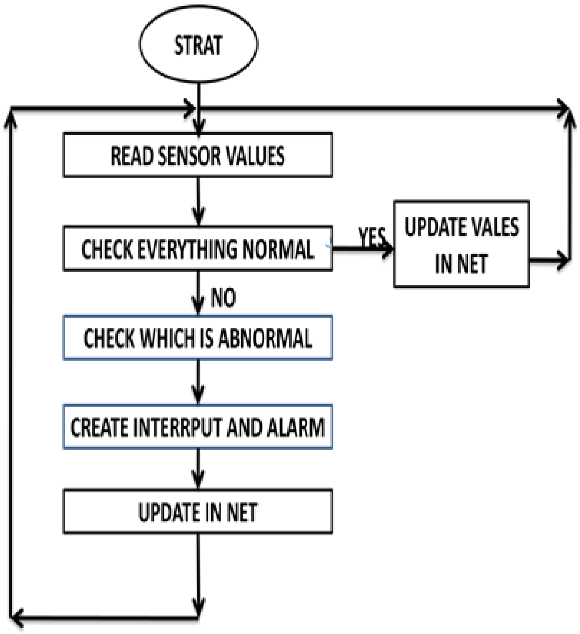


Figure 2 algorithm of system

Sensors communicate the data they collect about the gases in their surroundings to a server where it may be evaluated and stored later. During continuous monitoring, if the amount of a gas in the air exceeds the established limit, the alert system will raise the warning and, if necessary, send an SMS message to the company's safety control board and each employee's mobile phone. Figure 5 depicts the syntax of parameter (maximum allowable value) = value, which was found at this stage. When the current amount detected exceeds the maximum value allowed, an SMS is sent using commands encoded in the microcontroller that appear to come from the GMS module.

## IV. PROPOSED ALGORITHM

**Step1:**Initialization is accomplished out.

**Step2:**Connect the power to its source.

**Step 3:**Sensors will monitor the gas quantities.

**Step4:**Arduino is notified of the sensed value that was sent.

**Step5:**The location where it determines if the gas levels it detects are normal or abnormal.

**Step6:**When the detected gas levels exceed a predetermined threshold, an audible alert will sound.

**Step 7:**The WiFi and IoT modules allow gas levels to be stored in the cloud.

**Step8:**To obtain information on previous gas levels, visit the Cloud website.

**Step 9:**Repeat the process.

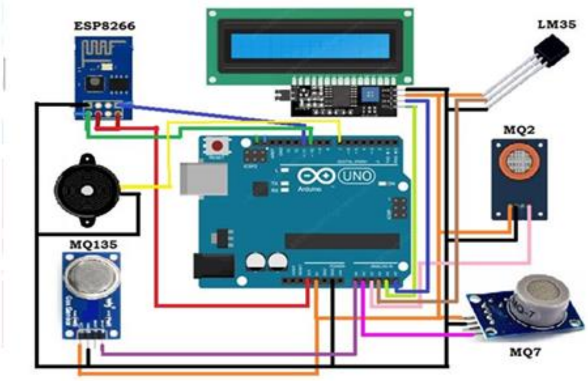


Figure 3 simulation layout

For this project, the Arduino UNO is the most significant component. The MQ2, MQ7, MQ135, LM35, alarm, ESP8266 WiFi module, and 16x2 LCD monitor are all connected to the Arduino. Each of the gas sensor's analog ports can be accessed via an Arduino analog input. It connects to the Arduino via the LM35 temperature sensor's output connector. All of the sensors' VCC and ground pins are connected to the Arduino's 5V and ground ports. When connected between the Arduino and the LCD screen, the I2C module converts the serial input into a parallel output.
Gas and temperature monitors are designed to continuously measure and record the amount of gas and temperature in the air. If the gas levels discovered are deemed normal, an IoT module will communicate the data to the cloud. An LCD panel displays the numbers that have been discovered. If exceptionally high levels of gas are discovered, a buzzer sounds, and the cloud is updated to reflect this. Similarly, the sensor detects temperature. If something goes wrong, an alert is triggered, and the data is saved to the cloud for later use.

## V. RESULT AND DISCUSSION

Proteus Software was used to reproduce the screen, allowing various sensors to track the whereabouts of hazardous compounds and radiation. Different monitors can detect and report changes in the levels of carbon monoxide, odorant chemicals, radiation, and methane. Figure 4 shows a sample of the system design. Figure 5 depicts how much of each gas the detectors are continuously taking up. A temperature sensor must be used in conjunction with the gas monitor.

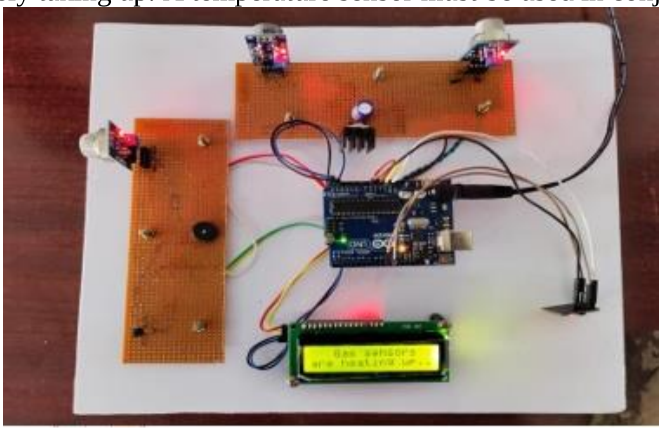

Figure 4 Complete experimental setup

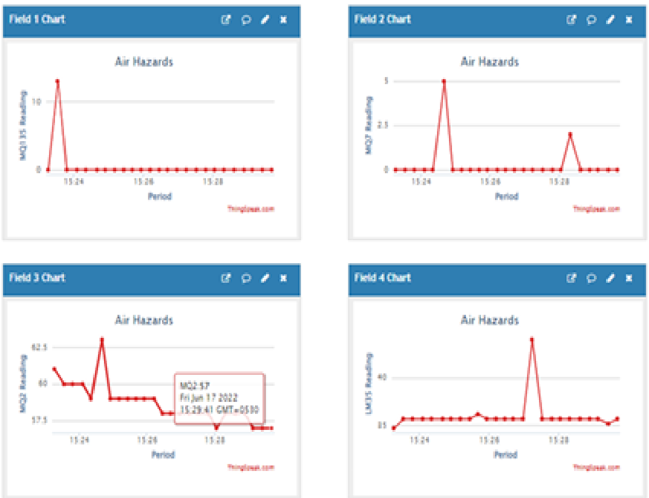

Figure 5 graphical representation of different gases

## VI. CONCLUSION

In this study, Wi-Fi modules and the internet of things are utilized to develop a new system for monitoring and warning to toxic chemicals and radiation. This is done to avoid a problem that has been encountered with previous techniques. Because of this, serial communication connects the framework to both the Arduino controller and the Internet of Things. The IOT door associate remote sensor checks that the gas and alcohol monitoring gadget is operational by connecting to the internet. It employed a restricted number of sensors. Created an Android app that measures the amount of radiation and gas in the air. The biggest restriction of our solution is that the GAS must be close to the monitor or within a specific range in order to detect a breach. Outdoor weather circumstances, such as fluctuating wind directions and the rapid spread of gas clouds from leaking outdoor systems, might cause gas detection to fail. In this instance, the gas does not reach the sensor at all. In the future, we can use the GSM module to receive alert messages tailored to our business. Once the alarm message appeared on staff members' phones, they were free to exit the premises.

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