Iot-Based Intimation of Poisonous Gases Using Spanning TreeAlgorithm

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ABSTRACT

Each new industrial accident contributes to an overall increase in the risk to human life. Reduces the risk of industrial disasters by developing a single device with a radiation and dangerous gas detection monitoring system that is connect to the internet of things. The purpose of this study was to ensure that industrial accidents are avoid and to monitor the activities of the pollution control board. The primary purpose of this project is to investigate Internet of Things (IoT) methods for the early warning of toxic gas emissions utilising the spanning tree algorithm. A sensor to collect data from the surrounding environment at the time of the leak. This instrument is utilised for the detection of as many different gases and types of radiation as it can. The programme was test with single or multiple dangerous gases and radiation leaking, and the results showed that the response time was high and was quite quick. An alarm is a sound signal that is produce and utilised to alert industries that are near living people. After the gas has identified, the pin will transition from 0 to 1, at which point the microcontroller will show the warning message and subsequently notify the GSM. If the levels of the gases and radiation were to rise over the typical level, an alert would send out via the internet to a certain website and to an Android app. At first, the system built so that it could build a single webpage and an android app. This information is also visible to a large number of users, and it mostly focuses on the radiation and gas leaks key advantages. It will be a solid start for sectors concerned with keeping people safe in their daily lives if sensors collecting all data store it on internet corresponding websites, which can then be use for further processing.

Keywords*:* Sensor; Amplifier; ADC; LCD Display; GSM Modem; Cloud; Website.

INTRODUCTION

People who establish businesses or owners of businesses initially focus their attention entirely on making a profit. They do not prioritise the well-being of their employees, the public, or the environment. Developed countries are responsible for building industries and companies [1], whereas emerging countries are not responsible for doing it properly (Varma et al., 2018). In most cases, industrial zones can found outside of major cities. However, several industries are situate in the middle of cities and villages for reasons relating to transportation or the availability of raw materials based on the company. In the beginning, businesses are formed with a strong emphasis on safety precautions; nonetheless, accidents can still happen in industries for a variety of reasons, including improper maintenance [2], human mistake, component failure, and so on (Singh et al., 2017). This project will used to monitor and control dangerous environments, chemical industries, and industrial areas. Utilizing the internet of things for purposes of controlling and monitoring. Safety in the workplace [3] and in the industries that surround live people are both important aspects of industrial safety (Vishwajeet & Bhide, 2014). In order to prevent significant industrial accidents or any industrial accidents from happening at the appropriate time, alert warnings should give to fire stations, police stations, hospitals, and other facilities. This initiative was also use for monitoring by the board in charge of pollution control.

Wi-Fi module can be convert into an internet of things (IoT) module. The most hazardous location and time for accidents to occur is when the data sending speed is the highest it must be. Iot module with data transmission and reception has a wide range that is as high as possible [4] and as extensible as possible (Ryu, 2015). The dangerous radiation as well as gas monitoring system achieved a detection of the real-time and the control of radiation of poisonous gas, which increased the system's capacity for automation [5] and intelligence about the detection of poisonous gas and radiation (Praveenchandar, et al., 2022). The following Figure 1 illustrates the emission of poisonous gases from various sources. Toxic gases include hydrogen chloride, benzene, dioxin, or asbestos-containing compounds, as well as elements such as mercury, chromium, and others. If their concentrations exceed the permissible exposure limits, several gases found in the environment have the potential to behave in a hazardous manner. Even oxygen can cause significant harm to a human organism, a condition that is referred to in the medical field as oxygen toxicity. Oxygen poisoning happens when the body is exposed to oxygen at partial pressures that are too high. Both high and low levels of exposure to these dangerous gases can have detrimental effects on health.

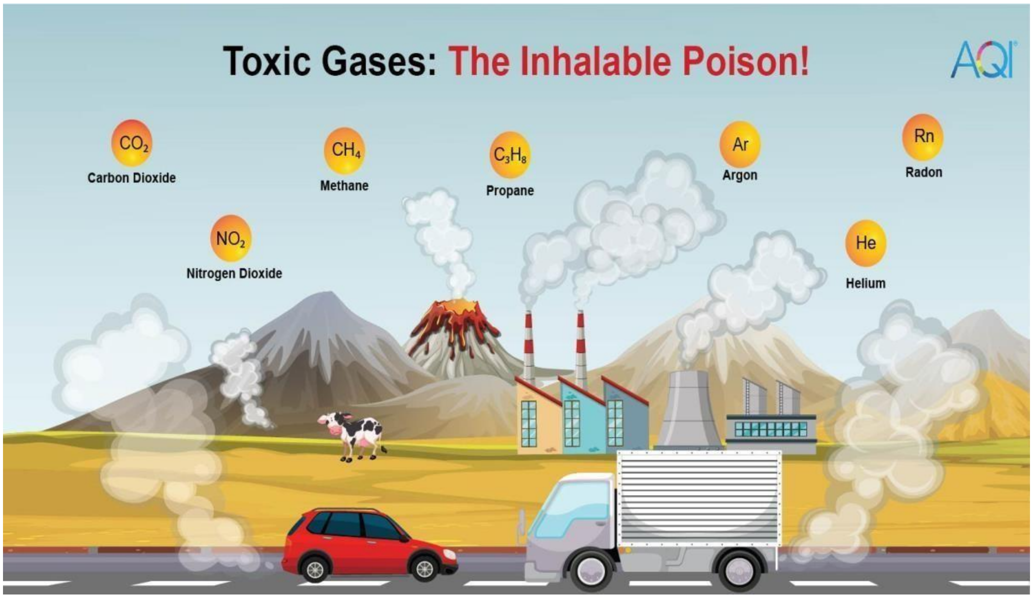

Figure 1: Emission of Toxic Gases from Different Sources

Gas leakage occurs when natural gas or another gaseous product escapes from a pipeline or cylinder into an area where it is not intended to. There is no way to tell if there has been a gas leak in the environment because these gases are often colourless and some are odourless. If these leakages are not discovered, it could cause explosions that are dangerous to life [6]. In recent years, gas leaks have been common because people don't know how to take care of their equipment and don't know what to look for [7].So, a gas leakage detection system needs to be put in place to find gas leaks from gas pipes or cylinders in homes or businesses. It is important to keep people from getting hurt or losing their homes. IoT device communication has become easier with the help of Wireless Sensor Networks (WSN), Radio Frequency Identification (RFID), and cloud computing [8]. IoT is a network of web-enabled devices that collect data from their surroundings using sensors, process it, and send it over the network [9].The Internet of Things is expanding exponentially as a result of increased internet connectivity across all aspects of life [10]. According to the World Health Organization, pollution is the main issue in every country in the globe (WHO). Hence, in order to stop pollution, we must first identify certain gases, such as CO, O3, NO2, etc. These gases are more harmful to human health and generate pollution, which increases the risk of things like lung cancer, fainting, and coughing. Simple vision cannot identify these gases. Due to the release of gases from both industries and motor vehicles, pollution has become a major issue in the majority of urban areas. Scientists have been utilising some rudimentary techniques, such as taking air samples in certain locations and analysing those in labs, to find these kinds of gases. Yet, these techniques are costly and ineffective. In the past, researchers relied on the Internet of Things (IoT) and other sensor devices, all of which are essentially made possible by IoT technology [11–14]. The Internet of Things (IoT) is becoming an increasingly important component of today's technological landscape. Therefore, IoT, which plays a significant role in human life, reveals a tremendous opportunity to identify potentially harmful gases and to examine the quality of the air using sensors. Internet of Things is used to manufacture sensors and other Internet of Things devices (IoT). These sensors aid in both monitoring the air quality and the harmful gases that are dissolved in it. We can readily track the level of environmental pollution by employing sensors. For instance, in a crowded metropolis, if these sensors are attached, they may detect the information about the air quality and pollution levels in a specific location and send it to the cloud for monitoring and prediction of pollution. High levels of particle matter have been associated with an increase in human heart problems in society. The burning of fossil fuels and the release of carbon dioxide into the atmosphere are causing global warming [15–18].

In this paper, an IoT-based, low-cost system for monitoring pollution in the environment is suggested. Users will be able to access the system through an Android app. This thing can be used to track pollution in the environment in real time. The goal of this research is to look into a personal environment monitoring device that is built into an IoT device, so that environmental detoxification can be calculated. The device uses sensors for carbon monoxide, LPG gas, and methane gas. IoT-based devices can find toxic gases in both indoors and outdoors, in places like the home, workplace, and factory. An Android app called "Environment Monitoring," which can be accessed through the internet, is being made to send the collected data to consumers.

RELATED WORKS

Gas leaks are a major cause of worker accidents (Praveenchandar et al., 2022). Chemical industry and their surroundings kill many. The present invention monitors and controls the toxic gases such as the carbon monoxide, nitrogen dioxide (NO2), sulphur dioxide (SO2), LPG, silicones, ozone (O3), hydrocarbons, hexane, alcohol, benzine, CH4, and the environmental conditions like the humidity and temperature in order to prevent the industrial accidents. Arduino UNO R3 has been use as microcontroller. It is attach to Minipid 2 HS PID sensor, Cloud via AQ3 sensor, DHT11 Temperature and Humidity Sensor, IR5500 open path infrared gas detector, ESP8266, MQ3 sensor and the WIFI Module that are able to store the real-time sensor data and transmit the alert signals to industry's safety control board. The machine learning and AI will forecast intelligently (AI). Real-time analysis of collected data. Globally accessible real-time sensor data. Poor data quality renders IoT sensors ineffective. IoT-based dangerous gas monitoring, regulating, and prediction increases with sensor error detection. Live sensor or dataset data should be carefully examine. The sensor dataset uses hybrid hidden Markov and AI algorithms to detect errors. This approach outperformed the data set gas sensor array with live data. The solution beat existing technology for dangerous gas monitoring and sensor error detection. The hybrid HMM and ANN fault detection approach produced 0.01% false positives.

(Dhanalakshmi, 2021; Alam et al., 2018) described a novel approach and technology to be used for the automatic vehicle air quality, for recognition and pollution [19]. This setup uses IoT - MQ135 and Arduino to measure vehicle emissions. Instruments display air quality and pollutants. When enough CO2, smoking, alcohol, benzene, and NH3 are in the air. The author discusses how to gather, evaluate, and blend data to assess the fog or air pollution. This data helps moving vehicle control systems avoid obstacles.

In the proposed study, a web application will give user information. The user can set up alerts for significant sensor data changes. Compared to similar systems, this proposed method is low- cost, user friendly and accurate. It's cloud-hosted and offers straightforward monitoring and the data visualization features. It is accurate and reliable after being test in a variety of settings.

1. METHODOLOGY

The Internet of Things (IoT)-based early warning of toxic gases utilising the spanning tree method is the primary purpose of this work. When the gas is detected, the state of the pin changes from 0 to 1, and the microcontroller shows the warning message before modifying the GSM settings. A warning message is transmit to the relevant authority by the GSM. When the system is turn on, the power supply is splitted from the voltage divider and distribute to the LCD, GSM, ADC, Sensors, and microcontroller.

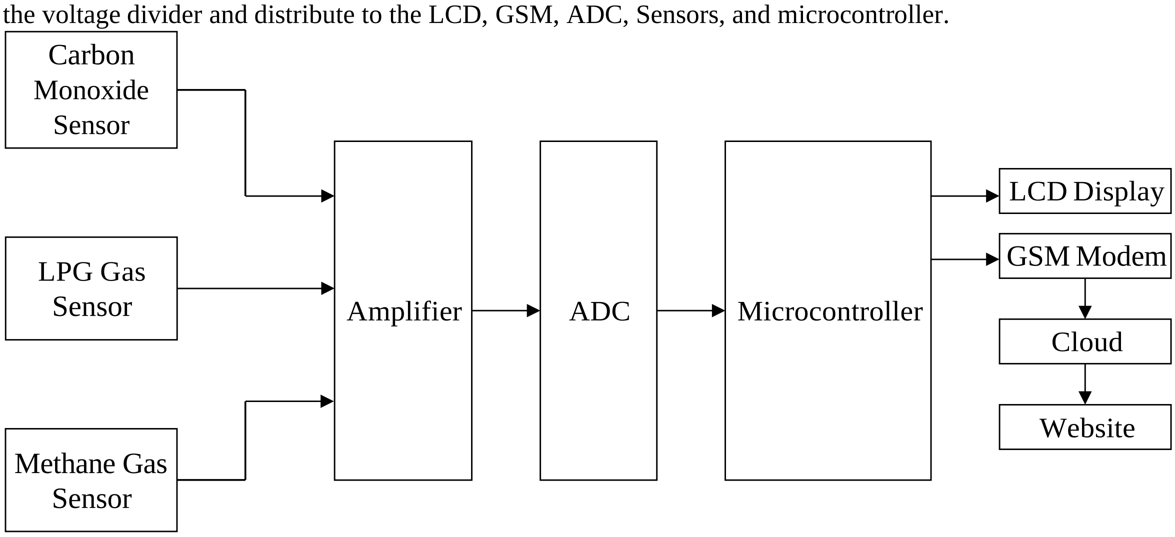

Figure 2: Block diagram of Proposed system.

The sensor reads the analogue value (gas), and then the data sent to the ADC. The analog-to-digital converter (ADC) takes this analogue data, amplifies it, and then gives it to the microcontroller. LCD displays the data, which is process by the microcontroller. At the same time, the data transfer to GSM is start, and it done so using the MAX232 to DB9 link. The GSM will then send a message to the user containing the data. Figure 2 depicts a block diagram of the proposed system. The proposed system is based on the wireless transmission of environmental variables that are spread out across an urban area. The system's storage and monitoring are linked through an internet platform. The device can be thought of as an IoT-based system for gathering data. IoT is used in the proposed system to deal with pollution in the environment in real time. Carbon monoxide sensors, LPG gas sensors, and methane gas sensors are built into this system to show pollution levels all the time and keep the environment in good shape. A central server was employed to maintain the data collecting system, which had distant nodules scattered around the cities. Amplifier, ADC, and Microcontroller are the environmental variables within the nodes that are shown via an android application and a dedicated website, respectively. Nodes will act as the hardware for this device's persistence, and software will be created to gather and wirelessly transfer data to the server. The nodes are made up of an LCD display, sound detector sensor module, and microprocessor. The device will begin to sense environmental conditions as soon as the nodules are installed in the monitoring site, and data will be collected and afterwards transferred to the web server. Each sensor will gather information and transfer it to the station server along with its location. Each time, the date as well as the current local time will be recorded, which will result in the creation of a comprehensive database. In order for front-end users to view the data that has been collected, an Android app is being built.

SENSORS: Three sensors are employ. (i) Carbon Monoxide Sensor: This sensor can identify and quantify the level of CO in the air. If the microchip finds that there is a substantial level of CO present, it will sound an alarm. (ii) LPG gas sensor: LPG gas sensors can detect leaks in homes, service stations, cars, and storage tanks. This sensor is attach to an alarm circuit to inform operators of a gas leak with a buzzer sound. (iii) Methane Gas Sensor: It is use as segment of the stationary gas detection system for monitoring and detecting the air methane as % LEL (Lower Explosive Limit) or % by volume [20]. These two measurement systems can monitor and detect (Mankotia & Shukla, 2022).

AMPLIFIER: A signal can have its voltage, current, or power amplified using a piece of electronic equipment known as an amplifier. Amplifiers can be found in a wide variety of audio equipment, including that used for the broadcasting and wireless communications. These are classify as power amplifiers or the weak-signal amplifiers, depending on their output level (Mankotia & Shukla, 2022).

ADC: ADCs, which stands for "analog-to-digital converters," are devices that used to convert analogue signals, which have a continuous and infinitely variable nature, into digital signals, which have a discrete time and amplitude [21]. In terms that are more applicable to everyday life, an analog-to-digital converter, or ADC, is a device that transforms an analogue input, such as sound being record by a microphone, into a digital signal (Pal et al., 2017).

MICROCONTROLLER: A microcontroller is a condensed version of a microcomputer that is design to manage the operations of embedded systems found in a variety of devices, such as office equipment, robotics, home appliances, motor vehicles, and a variety of other devices. A microcontroller made up of many different parts, the most significant of which is the CPU. Other parts include memory and peripherals.

LCD DISPLAY: LCDs, or liquid-crystal displays, are used to link to the microcontroller. It makes communication between the user and the electronic system relatively simple by using language that is straightforward and easy to comprehend on both sides. Reading and writing characters to an LCD display can be accomplish with any microcontroller. LCD displays the data that is being output in columns and rows. It is the most important assignment, and the most effective use of microcontrollers [5]. Think Speak is an excellent platform for prototyping because of its ability to interface LCD monitors (Praveenchandar, et al., 2022).

GSM MODEM: A GSM modem, often termed as a GSM module, is a hardware piece, which that utilizes the technology used in GSM mobile telephones in order to provide a wireless data link to a network. GSM modems are utilised in a variety of mobile devices, including mobile telephones, as well as other equipment that is capable of communicating with mobile telephone networks. They identify their devices to the network with SIM cards.

CLOUD: Individual servers provide Space in the cloud, which can be located in data centers and server farms all over the world. Server space is available for cloud computing from vendors who operate data centers and collocation facilities.

WEBSITE: A website, often represented as web site, is define as a web page collection and other information that is linked together under a single domain name, which is made available online via the publication on at least one web server. Here, the output shown in websites.

THINKSPEAK: Ruby is define as a programming language, which is utilised for creating an open-source software termed as Thing Speak. The software makes the users to interact with the internet connected gadgets. The delivery of the (API), application programming interface to the devices as well as websites of social networking, makes it is very easier to retrieve the data, access data and also to log the data.

This research made use of an algorithm known as the Spanning Tree Algorithm. A subgraph or tree of an undirected graph known as a spanning tree connects all of the vertices to one another in a way that does not use a simple cycle. In principle, several spanning trees can be construct for a same graph. For this reason, in practice, the concept of spanning tree is frequently employ to identify the shortest path or the structure with the simplest components, which leads to difficulties known as minimum spanning trees (MST). In order to calculate the MST, it is necessary to assign a weight, also known as a value that indicates how significant an aspect is, to each of the graph's edges, which are the lines that connect two of the graph's vertices [22]. After then, the Minimum Spanning Tree (MST) would be determine by comparing the total weights of each spanning tree and selecting the one that had the lowest total weight sum (Hassan et al., 2020).

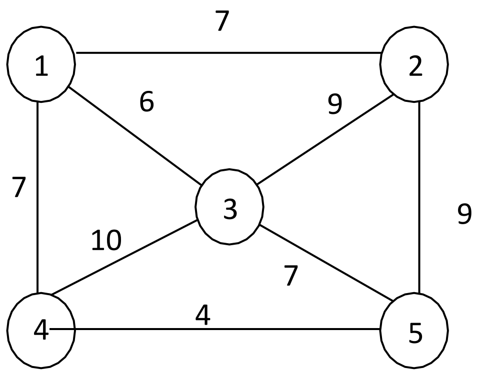

Figure 3: Spanning Tree Algorithm

Spanning tree method is use to detect poisonous gases because it is difficult to place a reader system at each source. Spanning tree connects all vertices without generating a cycle. Figure.3 illustrates the Spanning tree algorithm. A subgraph that connects every vertex in a linked and undirected graph is called a spanning tree. A single graph may contain a variety of spanning trees. Five gas ejection vertices shown in the image above. In this method, each edge is a source of gas ejection, and gas flow determines its weight. Each location forms a junction, which has vertices. Gas ejection will determine each edge's weight. Each vertex should have maximal weight by considering this vertex. Repeated vertex pairs are delete. This will reduce the number of reader installations, reducing costs and increasing efficiency.

2. RESULTS AND DISCUSSIONS

The model has been create with the help of Think Speak Software in order to monitor the presence of toxic gases and radiation with the assistance of a variety of sensors. Figure.4 illustrates the circuit simulation of the prototype model.

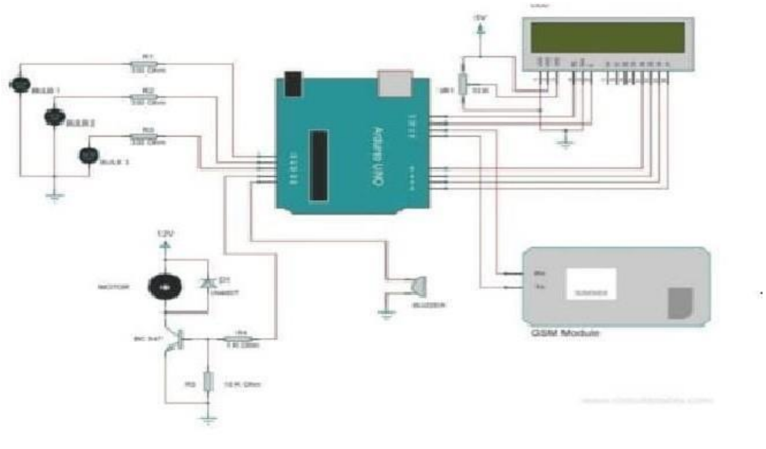

Figure 4: Circuit simulation of the prototype model

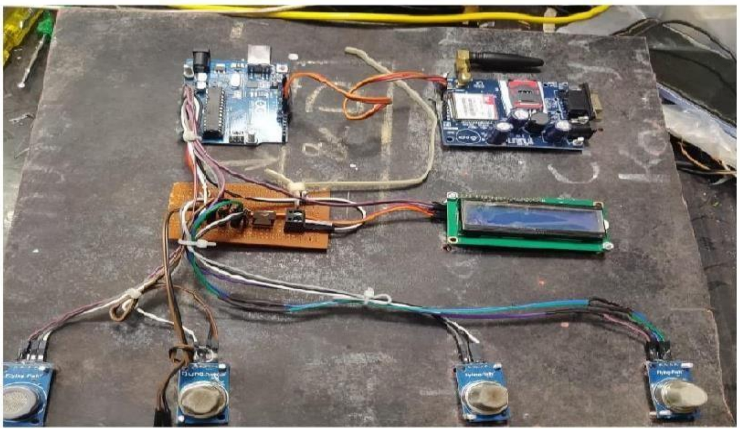

Figure 5: Hardware Implementation

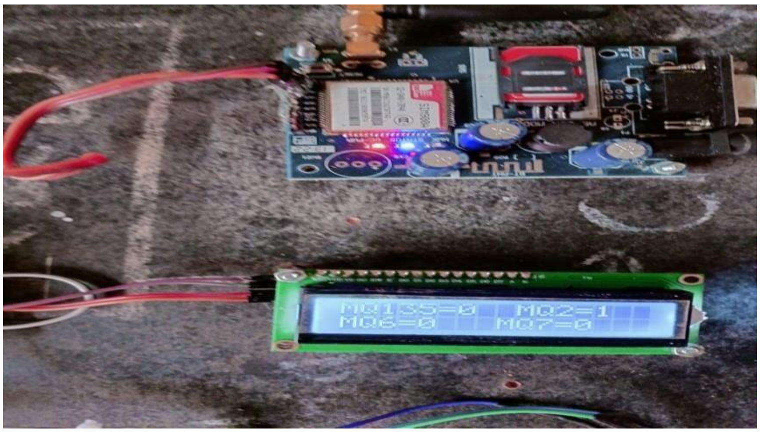

Figure 6: Hardware output

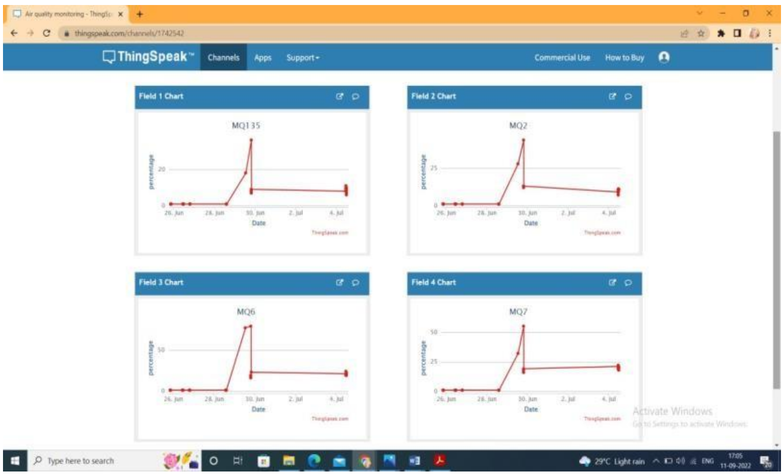

Figure 7: Final Output

Figure.5 illustrates the hardware implementation. Figure.6 illustrates the hardware output. Figure.7 illustrates the final output.The relevant sensors will recognize the change in levels of carbon monoxide, LPG gas, and methane, and its magnitude will ascertained. The circuit diagram of proposed monitoring system for air pollution based on IoT shown below.

Utilizing sensors allowed us to determine when the gas leak occurred. The information obtained from these sensors shown on an LCD screen in the form of digital values, which shown in the form of numbers and graphs. This information can also show on the laptop. The mapping was perform in the graph. Figure.8 shows a series of steps that is followed in developing the programme. In the first step, start the process and then initialize the system. Next "if CO or LPG or CH4 gas present in the atmosphere, send sms to the preset number and sound buzzer. If no means, the loop is send back to the second step (initialization).

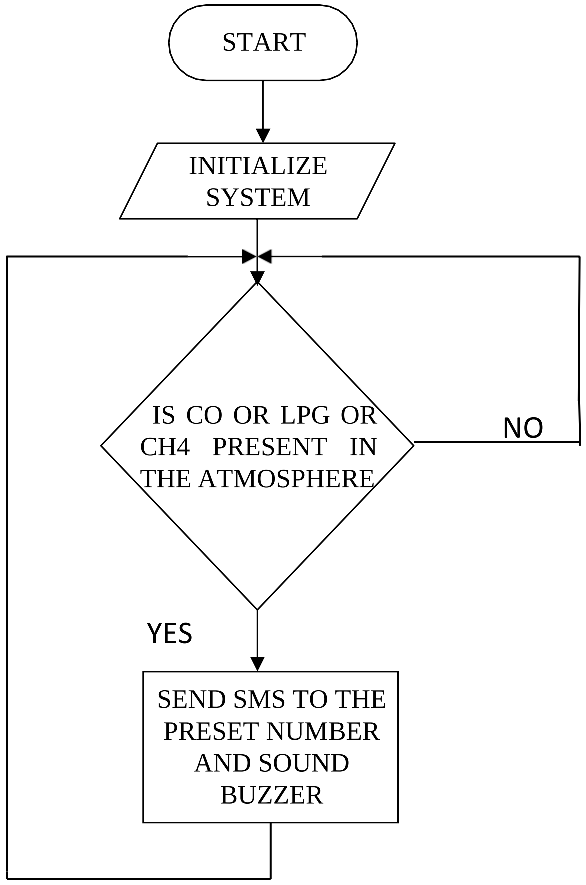

Figure.8. Flow chart of the gas leakage and detection system

3. DISCUSSIONS

Pollution was the most serious issue in smart cities and metropolitan areas. Many people had been ill as a result of the pollution. As a result, all of the studies have been concerned with pollution monitoring and eradication. It was previously stated that in order to eliminate pollution, contaminating gases in the atmosphere should be monitored. IoT technologies can be used to monitor these contaminants. IoT devices and sensors detected the harmful substances. It has been discussed that IoT sensors linked to certain places provide information to Arduino/Raspberry Pi about the air quality in that area, and the Arduino/Raspberry Pi then allows the data to be supplied to a web server by connecting directly to the internet. The air quality in that area can be easily monitored using an Android app. As a result, it was concluded that employing an IoT-based air pollution monitoring system, pollution may be easily identified [23].

4. CONCLUSION

In this research, a toxic gas monitoring system has been program. Thus, serial connectivity enables IoT and microcontroller. IoT gateway connects the wireless network to internet to run a gas monitoring system. Preventing the workers and people from safely exiting unsafe situations and saving lives avoided significant disasters. Few sensors were use. Developed an app to detect gas and radiation on laptops, Android phones, and LCDs. The hazardous gas and radiation system is design cheaply. It is a user-friendly instrument for disaster research. An algorithm called a spanning tree is utilised so that it will be simple to cut down on the number of readers that are put, which in turn will make it possible to cut costs and boost efficiency. The focus of the work that will done in the future will be on making the sensors that are utilised better, more highly sensitive sensors and improving the rate at which information can be transmit.

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Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Authors' contributions

She supervised every step of the work and provided critical review and valuable input. All authors read and approved the final manuscript.

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