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Gas Leakage Detection using Smart Internet of Things

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ABSTRACT: The Internet of Things (IoT) is a network of devices, cars, and household appliances that includes hardware, software, motors, and a network, allowing them to communicate, work together, and exchange information. IoT involves extending the Internet's network beyond standard devices like desks, workspaces, smartphones, and iPads to any variety of typically dumb or web-unaware physical objects and everyday objects. These devices are equipped with invention, allowing them to communicate and link over the Internet, as well as be monitored and managed from a distance. The convergence of numerous inventions, continuing research, Intelligence, wearable devices, and embedded structures has improved our understanding of what the Internet of Things is. The Internet of things is made more powerful by traditional areas such as established frameworks, distant sensing systems, control framework computerization(counting house and building automation), and others. The system uses an Arduino UNO to connect to an IOT platform and provide information about contaminants to the staff. Based on a microcontroller, the system employs gas sensors, temperature and fire sensor, a display, and a buzzer. Arduino UNO and gas sensors are intended to use as monitoring data and alert systems for gas leakage detection. In the present research, an gas leakage detection model is established with the help of machine learning models. Machine learning techniques such as Q-Learning applied to the dataset. A comparative analysis is performed to validate the proposed method's performance and efficiency. The Arduino UNO microcontroller provides a good platform for developing an embedded control system with Arduino UNO. It is simple and fast to alter it to fit our changing needs. Then, the target of this project is to apply the machine learning (Q-Learning) concept for the prediction and analysis of gas leakage detection levels so that we can analyze the gas leakage detection level due to the pollutant gases based on prediction analysis

KEYWORDS: Q-Learning, machine learning, Internet of Things, Home Security, Arduino, gas sensor ,

I. INTRODUCTION

LPG From 0.72% of all kitchen mishaps to 10.74% of all kitchen incidents, gas leaks have grown. It is believed that the 5-kg tiny LPG cylinder with the burner directly above it, the without using a rubber tube, is safer than the one with a rubber pipe since the latter is more likely to split, which might lead to leakage. A computer application they may use online to locate leaks and act as the pipelines' automated supervisor in distant places has been developed. The simple Gas leak detector is a gadget used to detect gas leaks. If a gas leak happens, an equivalent message is sent using a GUI screen and a buzzer, and it can also broadcast messages to stakeholders about an LPG leak using a api module.

Finding and locating leaks is one of the top worries for homeowners everywhere. A spill can be properly managed and its effects can be effectively reduced with prompt assessment and action. A number of steps have been taken to guarantee people's safety as a result of the forces of social production's continued expansion and the slow waking of people to the significance of domestic safety. Small carelessness at home can result in significant financial loses and severe environmental damage. In order to eliminate the concealed threat, many large corporations, including Sinopec and PetroChina, are pouring significant sums of money into upgrading current machinery. However, there are still some issues with data transfer, real-time tracking, and pinpointing the exact position of a leaking point in the event of a

mishap. The majority of today's equipment is built on cable networks, which makes it dated technologically and difficult to implement; similarly, the technology of data gathering in incidents is dated, making it challenging to find the leaking point. Portable sensor networks can be used to help address these issues

II LITERATURE SURVEY

According to [1] the system we have designed can display data on temperature, humidity, dust particles, and levels of polluting gases (H₂S, NH₃, CO, NO₂, and SO₂). The data read from the sensors is also sent to the ThingSpeak Cloud via the Wi-Fi module so that data can be monitored remotely. Increased levels of pollutants in the room can not only come from the penetration of pollutants from outside the room, but it can also come from pollutant sources in the room, such as cigarette smoke, smoke from the kitchen, or the use of mosquito repellent.

According to [2] an indoor air quality monitoring system (IAQMS) capable of performing real-time measurements of a wide range of ambient air parameters like CO, CO₂- equivalent (CO₂eq), EtOH, H₂, H₂S, NO₂, O₃, PM_{1.0}, PM_{2.5}, PM_{4.0}, PM₁₀, RH/T, Rn, SO₂, typical PM size, (TPS) and total VOCs (tVOCs). The data generated by the 8 detectors of the system is processed by an Arduino Mega 2560 REV3 microcontroller, sent via the ESP-01S Wi-Fi module to the Blynk server, and then displayed within the iOS/Android Blynk mobile app using three visualization techniques: line charts, gauges, and numerical values. Based on the data, stakeholders could make informed decisions regarding the necessary actions to undertake to improve their indoor air quality.

According to [3] the design and development of a low-cost, portable Internet of Things (IoT) Indoor Air Quality (IAQ) monitoring system with 30 hours of battery life. The unit is intended for the monitoring of total VOCs, CO₂, PM_{2.5}, PM₁₀, temperature, humidity and illuminance. The system can be used for both real-time measurements as well as hourly and daily averaging, in low power modes, and interfaces with a custom Blynk smartphone app, developed for easy user engagement. The device calculates a qualitative air quality index from measurements taken in-situ, based on United States Environmental Protection Agency (EPA) standards. Environmental data is used by the system to provide recommendations, such as increasing ventilation or reducing activity levels, which can help users improve their air quality. This system can be used as a node to monitor air quality in large scale networks for Smart Cities.

In [4] a system with low power and data consumption is introduced. In this article, the air quality using a Raspberry Pi4 with Grove - Air Quality Sensor v1.3, CCS811 CO₂ Air Quality Sensor, DHT 11 Temperature and Humidity Sensor were discussed. The communication between the sensor and Raspberry Pi4 will be through a serial port communication protocol and the code is implemented on the Python interface. Air pollution is a global environmental health problem many people's are dying every year due to some of the visible and invisible parameters like small particles, gases and so on. Most of the parameters of the environment to be monitored such as volume of CO, CO₂, Temp, Humidity, Gas Leakage, Smoke, temperature sensor, and etc. These parameters information can received by Rasp Pi4, Arduino Uno and process the information and transmitted to clouds where they are being continuously monitored and information will be stored in the cloud database.

According to [5] a prototype Personal Air Quality Monitor based on low-cost sensors and using low power communication by IoT devices storing data in the cloud. It also illustrates how, by combining IoT technologies, real time monitoring of the data can be achieved from any browsercapable device. A key aspect was to monitor pollution levels at a user location and use this data to create a profile of city or region to more accurately predict risks at an individual level. An alternative, cheap, IoT-based air quality monitor, which can track air pollution in real time, and transmit the relevant data rapidly through a low power wide area network. A large network of such monitors can generate a vast amount of data, which may then be processed and analyzed in the cloud in real time, and correlated with time of day, month, year or weather and other factors.

In [6] introducing a device that can continue that can take present pollutants and with the help of past pollutants, we are running an algorithm based on the machine learning to predict the future data of pollutants. The sensed data is saved inside the Excel sheet for further evaluation. These sensors are used on the Arduino Uno platform to collect the pollutant data.

In [7] In many metropolitan cities air pollution is a major challenging environmental issue. To analyze the present traffic condition of the city, local authorities can be enabled by real time monitoring of pollution data which makes appropriate decisions. Hence an early system is required for monitoring and calculating the level of AP using Air Quality (AQ) which is essential for predicting exactly the pollutant concentrations. The prediction of AQ can be improved by deploying Internet of Things (IoT) based sensor which are considerably changing the prediction of AQ dynamically. The prediction of AP discussed and estimated using many existing techniques are very expensive and have very low accuracy. The technological advancement of Machine Learning (ML) algorithm can be very fast increasing and searching almost all fields and applications whereas AP prediction has not prohibited from those fields. This paper describes about various studies of ML algorithm relating to AP prediction and monitoring based on the IoT sensor data in the context of various cities

According to [8] the show how this capability can be used for using them as a backup tool for reference analyzers providing a way to obtain meaningful data in the case reference data become unavailable due to failures. Field calibration robustness is still debated but the stream-like availability of reference data make possible to continuously update the AQMS calibration function to sensors and concept drifts so to provide optimal performances whenever needed.

According to [9] a novel low-cost sensor node that utilizes cost-effective electrochemical sensors to measure carbon monoxide (CO) and nitrogen dioxide (NO_2) concentrations and an infrared sensor to measure particulate matter (PM) levels. The node can be powered by either solar-recharged battery or mains supply. It is capable of long-range, low power communication over public or private long-range wide area network (LoRaWAN) IoT network and short-range high data rate communication over Wi-Fi. The developed sensor nodes were co-located with an accurate reference CO sensor for field calibration. The low-cost sensors' data, with offset and gain calibration, show good correlation with the data collected from the reference sensor.

In [10] system can be utilized for monitoring air pollutants of a particular area and to air quality analysis as well as forecasting the air quality. The proposed system will focus on the monitoring of air pollutants focus with the combination of IoT with a machine learning algorithm called Recurrent Neural Network more specifically Long Short Term Memory (LSTM)..

III. PROPOSED SYSTEM DESIGN

We first gathered information from various sensors, including different web applications, Gas detection data set information, and a few synthetic and real-time data sets from diverse sources. The system can detection gas by analyzing data. The synthesis of the system as well as real-time text data can be evaluated, which is taken by any application. The system has training as well as a testing phase for classification. The system uses machine learning algorithms to find gas detection. The proposed system architecture with the machine learning classifier is shown in Figure 1. Evaluate the system from the bases of accuracy and false ratio.

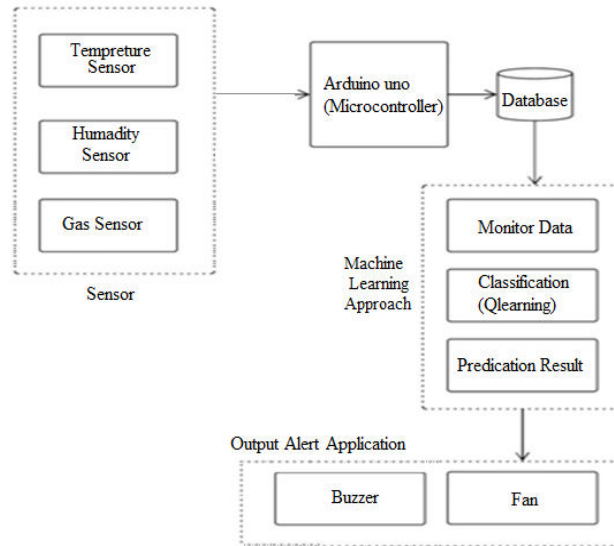


Figure 1: System Block Diagram

The proposed system is collaboration of various modules such as IoT modules, database modules and GUI modules. In below section we described each module in detail

Two phases: training and testing.

1) Training:

- Collect IOT environment data.
- Apply data mining approaches.
- Data is been saved into the database called as background knowledge, which is used at the time of testing.

2) Testing:

- First system creates the IoT-based system environment where we used minimum 3 to 4 sensor as analog devices like temperature sensor, humidity sensor, gas sensor etc.
- The system produces the IoT-based LPG Gas leakage system environment
- Link all sensors to Arduino UNO and use the batch processing method to collect data from sensors.
- Using a link-oriented architecture, all collected data is stored in a database
- In testing we read all testing as well as training data simultaneously.
- Apply detection the possible using decision making system.
- Using IOT technology we can continuously monitor changes in sensors values
- Buzzer is an audio signal device, which is used to buzz sound whenever it as needed.
- At last, a sms (short message service) or mail is sends to a phone

IV. ALGORITHM DESIGN

Q- Learning Algorithm

Input: inp[1...n] all input parameters which is generated by sensors, Threshold group TMin[1...n] and TMax[1...n] for all sensor, Desired Threshold Th.

Output: Trigger executed for output device as lable.

Step 1 : Read all records from database (R into DB)

Step 2: Parts [] \leftarrow Split(R)

Step 3:

$$CVal = \sum_{k=0}^n \text{Parts}[k]$$

Step 4: check (Cval with Respective threshold of TMin[1...n] and TMax[1...n])

Step 5: if (Cval > Threshold)

 Read all measure of for penalty TP and reward FN

Else continue. Tot++

Step 6: calculate penalty score = (TP *100 / Tot)

Step 7: if (score >= Th)

 Generate event

End for

V. ADVANTAGES

- Enhancing the controlling and observing components. Using less number of sensors with better outcomes.
- The manual system eliminates the measurement and monitoring process.
- All the parameters are embedded in a single system which is easy to handle by a normal person.

VI. OBJECTIVES

- To study and analysis of various machine learning algorithm models for Gas leakage detection.
- To design and implement the Reinforcement Learning algorithm like Q-Learning base on reward along with policy basis.
- To design and develop a LPG Gas leakage monitoring & alert system using Arduino.
- To display the leakage alarm on a display board and send an alarm notification on SMS to any predefine mobile number

VII. RESULT

The implementation process was completed in a Java open-source setting. The device operates on the Java 3-tier analytics platform with a distributed INTEL 3.0 GHz i5 CPU and 4 GB RAM. We have performed experiment analysis on ensemble machine implementation to verify the outcomes.

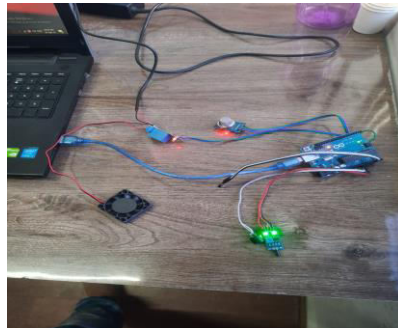


Figure 2: IOT System Connection

VIII. CONCLUSION

The advantage of this simple gas leak detector is its simplicity and its ability to warn about the leakage of the LPG gas. This system uses alert message technique to send alert message to respective person if no one is there in the house and then gas leaks occurs, alert message module is there to send immediate messages to the respective person regarding the gas leak. The main advantage of this system is that it off the regulator knob of the cylinder automatically when gas leakage detected. In this Research we illustrate Air quality monitoring system prediction using IOT and machine learning technology. The module has high efficiency and accuracy in fetching the live data of temperature, Fire sensor and MQ6 Sensor etc. The main advantage of this ubiquitous system is that we can identify the air quality. The proposed machine learning module provides over accuracy in different gas leak samples, which is most effective that other supervised learning algorithms. This research we have done with limited gas leak detection samples data due to some hardware dependency, to utilize multiple hardware resources and get maximum gas leak detection properties to predict the machine classification will be the interesting work for future direction.

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