A Robotic Platform to Identify Gas Pipe Leakage Using IOT

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Abstract. Gas pipes play a very vital role in cities as well as industries thus directly related to the growing economy of our country. Gas leakages in our present day world lead to many fire accidents and pose a greater threat. To place sensors at each section of the pipe is difficult as well as time taking and costly. So, we are proposing an innovative robot that clings to the outer surface of a gas pipe and moves along the pipe to detect gas leakages. The robot keeps on moving along the pipe surface and will monitor any gas leakage, when it detects it will send the transmit location using an interface GPS sensor to the IOT login system, we use a software called UBIDOTS to display the gas leakage position and it also sends alert messages over IOT. At last, we design a robot which is automated and has an insect like structure that moves along the gas pipe and it detects the gas leakages at a very low cost.

Keywords— Internet of Things, Gas detection Sensors, Smart Alerting Techniques, Prediction, Data Analytics.

1. Introduction

Internet of Things aims towards making life simpler by automating every small task around us. The Internet of things (IOT) is between frameworks organization of physical contraptions, vehicles (in like manner suggested as "related devices" and "splendid devices"), structures, and distinctive things—embedded with equipment, programming, sensors, actuators, and framework arrange that engage these articles to assemble and exchange data. Safety has always been an important criteria while designing homes, buildings, industries as well as cities. The increased concentration of certain gases in the atmosphere can prove to be extremely dangerous. These gases might be flammable at certain temperatures as well as in some specific humidity conditions, after exceeding the specified concentration limits or even a supplementary factor in the air pollution of an area leads to problems such as smog and reduced visibility which can in turn cause severe accidents and also have adverse effect on the health of people.

In order to achieve this, we are implementing a robotic Platform for gas pipe leakage detection in industries. The heart of the system is Raspberry Pi which uses Raspbian Os which functions like a mini CPU. Various gas sensors such as Co2, Methane-MQ2, H2S and GPS Sensor are
used. We attach the Raspberry Pi equipment to a Motor Driver which supplies additional voltage than the inbuilt voltage which helps in the better functioning of Dc Motors. Raspberry Pi also uses cloud technology to display alert messages and to store the values for future reference. This system not only alerts us through audio but it also gives us the video coverage, giving us the exact location of leakage.

2. Literature Survey

Dedy Rahman Wijeya & Riyanarto Sarno in their paper discussed about the concept of Mobile Electronic Nose (MoLen) which is very promising for Sensing as a Service (S2aaS) applications. In Internet of Things (IoT) era, MoLen can be implemented in many real-world applications such as food quality assessment, medical applications, gas leakage detection, home or automotive safety system, environment monitoring, etc.

Akihiro Shibata & Masami Konishi in their research analysed and mitigated the industry, for example, oil refinery industry, there may happen different sorts of security issues for pipelines matured after its developments. To acknowledge preventive support of pipelines, there are substantial requirements for the determination innovation of gas spillage. In this examination, gas spillage sounds created from the splits of channels are broke down and attempted to be utilized for location of the gas spillage. Sound information, for investigation are produced and gathered in the plant where foundation commotion isn't insignificant.

Pushpendu Kar, in his research paper used three different models which have been developed to detect the flaws in a gas pipeline network, which is one of the significant weaknesses towards the sheltered gas appropriation among the end clients. Along these lines, it is huge to find the flaws in a pipeline framework. In this work, a novel sensor based blame confinement conspires, FLoGPN is proposed for recognition and restriction of flaws in a gas conveyance arrange. Here hole in gas pipeline organize is considered as blame.

According to José A. Ramos, another way to deal with gas spillage identification in high weight gaseous petrol transportation systems. The pipeline is demonstrated as a Linear Parameter Varying (LPV) System driven by the source hub mass stream with the gas stock variety in the pipe (line pack variety, relative to the weight variety) as the planning parameter. The mass stream at the off take hub is taken as the framework yield.

Gas Detectors have been in the market for a very long time and have been vastly used. They have broad assortment of employments and can be found in mechanical plants, refineries pharmaceutical gathering, paper crush processing plants, flying machine and ship building facilities, wastewater treatment workplaces, vehicles, indoor air quality testing and homes. We can detect gas pipe leakages through various gas detectors and they are characterized on the basis of the gas which
they detect it also involves the technology behind the making of the sensor, even the components also reflect. Gas Detectors are classified into two types. They are Fixed and portable.

2.1. GSM Technique

This designed project proposes an economical, automatic LPG booking, spillage discovery and constant gas observing framework. In this particular frame, LPG Gas Spillage is detected with the help of sensor and this data is sent to the assigned client via SMS and also alarms the client with the help of a GSM module. Then again this framework persistently screens the level of LPG exhibit in the chamber with the assistance of load sensor. The Gas client can supplant the old chamber with new one in time and naturally book the barrel utilizing a GSM module. This model uses conventional method for GSM and which is somewhat intense for uneducated individuals to get it.

2.2. GSM with no secure block

Presently a day's each one need an office which decreases their endeavours, time and give a way to do their work effortlessly. For cooking sustenance we as a whole utilize LPG gas. It is generally utilized as local fuel, modern fuel and car fuel. In INDIA numerous wholesalers utilize IVRS, SMS or ONLINE reserving for LPG which are time taking procedures in quick running life. It is badly designed for both Educated and additionally uneducated individuals because of absence of time and absence of information separately and Safety is likewise a critical concern. As we as a whole realize that numerous mishaps occur because of gas spillages. So to stay away from these challenges we are building up a paper. We plan a paper by considering wellbeing issues and furthermore give an Easy method to LPG booking. In the paper MQ-6 gas sensor is utilized to detect the spillage gas. Once the spillage is distinguished, it will close the controller and send the SMS to the client through GSM. This model is very new but it has some drawbacks like heat-up of motor (easily) maybe in the case of an accident, and even more to make use of the GSM model.

2.3. Amprobe GSD600 Gas Leak Detector

This is a portable gas detector for detecting gases such as methane and butane. It has a stainless steel probe. The probe allows the user to get into the hard-to-reach places. It was designed for detecting gas within closed piping system and it has an audible alarm [4].
2.4. Analox Sensor Technology

Ensuring Campus Safety in lab environment, canteens or any other place where there is a chance of gas leakage. To detect the gas leakage several devices have been used such as O2NE+, A50 etc. These are provided by ANALOX Sensor Technology many other equipments as such are being manufactured by several other manufacturers all over the world. Other devices like First Alert CO615,Kidde KN-COPP-B-LPM,KN-COEG-3 Nighthawk,PNG2000A Natural Gas Detector Pen, Safe-T-Alert 30 Series and many more, to name only a few are available in the market for gas detection purpose.

These are a few of the mostly used devices and all of them have a very high precision. Their price range from 30$ to 180$-200$. These devices are mostly battery operated and alarms) and visual (digital or LED) techniques. Our IoT based model for gas leakage detection is taking this traditional approach a notch up by adding the feature of immediately intimating the concerned authorities and also updating the sensor readings regularly to the cloud.

2.5. Handheld EGD01

This Handheld EGD01 conveys high-affectability, and is effortlessly movable for identifying a wide assortment of burnable gases, including methane, propane, and butane. It is utilized by building investigators [4]. As the name of the item recommends, it is a convenient gadget and thus battery worked. It has both sound and light alert.

2.6. LM35 Temperature Sensor

The LM35 can be associated successfully correspondingly as the other joined circuit temperature sensors. It can be adhered or built up to a surface and its temperature will be around 0.01°C of the surface temperature. This presumes the enveloping air temperature is about the same as the surface temperature, if the air temperature were fundamentally higher or lower than the surface temperature, the genuine temperature of the LM35 would be at a centre temperature between the surface temperature and the air temperature.

3. Gas Leakage Detectors

Types of equipments are used for various purposes in our day to day life and most of them have the capability of emitting some kind of gases or some compounds in the air while in use. It is very
important to keep a check on the concentration levels of the gases and other compounds as some of them, after exceeding the safe concentration level, are flammable under the room temperature and humidity condition.

Blends of scattered ignitable materials, (for example, vaporous or vaporized energizes, a few cleans) and air will consume just if the fuel fixation exists in very much characterized lower and upper limits decided tentatively, alluded to as combustibility points of confinement or hazardous cut off points. Ignition can run in savagery from deflagration, through explosion, to blast [10].

A customary gas recognition framework checks for the fixation levels and cautions individuals about the spillage through sound and visual alerts. The IOT based model of the customary gas spillage recognition framework does caution individuals by sound caution as well as endeavours to alarm the concerned work force through a call and instant message on their telephone so that even if no one is show in the territory of spillage, they are made mindful of the circumstance.

Alongside this the model additionally sends the points of interest containing sensor readings recorded when the caution got impelled which could be utilized by an individual or an association to settle on choice about what kind of consideration is required in the territory of gas spillage.

Another most significant feature of this prototype is that it can record the sensor readings and maintain a database of these readings of concentrations of gases at different timestamps. This data could be utilized for carrying out analytics on it. The analysis of the sensor readings can help in understanding the usual conditions of the area, under what conditions do the readings of the sensor usually go up and when does it actually start getting dangerous and needs attention. This will increase the precision of the system, reducing the false alarms and hence actually becoming a very reliable system within a span of a few days. Along with all these features, this system also comes with a power cut off option.

In case the concentration of flammable gases is about to reach their lower explosive limit (LEL) the system trips the main switch which causes a complete power cut off of the building or office or her ever the system is installed. This will serve two purpose that is one, it will prevent any disaster due to electricity or power and two, in case the leakage is being caused by any such device turning off will prevent any further leakage, this purpose will be served by the power cut off feature. Description about the components used and the preparation steps involved are explained in detail.

3.1. Components

The main components used in the making of this prototype are as follows:
3.1.1. **RasperryPI** :

The Raspberry Pi is a movement of minimal single-board PCs made in the United Kingdom by the Raspberry Pi Foundation to propel the teaching of fundamental programming designing in schools and in making countries. The main model wound up significantly more unmistakable than anticipated, offering outside its target advertise for uses, for instance, mechanical self-rule. It excludes peripherals, (for instance, consoles, mice and cases).

3.1.2 **CO2 Sensor**:

A carbon dioxide sensor or CO2 sensor is an instrument utilized for estimating carbon-dioxide gas. The most normal standards for CO2 sensors are infrared gas sensors (NDIR) and synthetic gas sensors. Measuring carbon dioxide is critical in observing indoor air quality, the capacity of the lungs as a capnograph gadget, and numerous mechanical procedures.

3.1.3. **RASPBIAN OS**:

Raspbian Stretch and Raspbian Jessie. Since 2015 it has been formally given by the Raspberry Pi Foundation as the fundamental working structure for the gathering of Raspberry Pi single-board PCs. Raspbian was made by Mike Thompson and Peter Green as a self-governing endeavour. The basic frame was done in June 2012. The working system is still under powerful headway. Raspbian is significantly upgraded for the Raspberry Pi line's low-execution ARMCPUs.

3.1.4 **Methane Sensor**:

Methane gas sensor recognizes the gathering of methane gas and sends its examining as a straightforward voltage. MQ-4 gas sensor has high affectability to Methane, furthermore to Propane and Butane. The sensor could be used to recognize different ignitable gas, especially Methane, it is low in cost and fitting for different applications.

3.1.5 **Hydrogen Sulphate Sensor(H2s Sensor)**:

Hydrogen sulphate sensor detects the concentration of hydrogen sulphide gas. It is used to accurately monitor the areas where this gas can be very hazardous such as iron smelters, breweries, food processing plants. It has an abundant importance in the nuclear industry because nuclear reactors use a lot of uranium which in turn gives a lot of H2S gas as a wastage into the atmosphere. The farming industry also uses H2S as a agricultural disinfectant which is highly flammable and toxic in nature, It can be detected using the H2S sensor.
3.2. Block Diagram

![Block Diagram](image)

**Processing Steps:**

1. The MQ-2 gas sensor of the MQ-x family detects the gases. In order to stabilize the sensor it is important to pre heat it.
2. When the MQ-2 sensor is exposed to the gases it will detect and then it could send the response to the Raspberry Pi.
3. The concentration of other gases such as CO2, H2S can also be detected by CO2 and H2S sensors respectively.
4. Every value recorded by the sensors is checked against a threshold value. This threshold value is decided based upon the nature of the gases and the behaviour of the sensors.
5. We also attach a GPS Sensor to the Raspberry Pi which can detect the exact location of the leakage.
6. The various gas concentrations when recorded by the sensors are sent to the cloud storage for analysing the conditions of the place. where the leakage took place at the same time alert messages are sent to the registered devices.
7. An email about the focus level of gases is sent to the concerned expert as readings all the time.
8. The sensor readings that are uploaded to the cloud can be used for Data Analytics. The average reading of 24 hours can be calculated, every day since the day of deployment.
9. We also use a motor driver for additional voltage to run the dc engines which are associated with the Raspberry Pi.

4. Conclusion

Hence, from the above discussion we can conclude that the paper (Gas pipe leakage detection using IoT) is absolutely ethical for application by the users who work in a gaseous industry. It not only
helps in making the work easier but also plays a major role in the security avoidance of accidents to the industry and helps in leading a easy life. The implementation of interface between GSM module and Gas detection sensor is executed zestfully. The interfacing is properly done without a little collision among GSM and the sensor. The design and realization of interface between GSM modem and GSM network for data transmission is done successfully. Thus, the robot is monitored time to time with the help of the sensors and also a SMS is sent to the registered user whenever gases are present around the pipe. The designed system provides a real time and low cost solution to the gas leakage problem and prevents many accidents.

5. Future Work

We can further extend this project by adding some more features which can make it more efficient and security oriented. The camcorder can also be used to track all the activities of the unknown intruders. An emergency Alert can also be made to police and fire brigade as well. The complexity of the algorithm of the system can be increased by introducing number of sensors to make the system more efficient.

Analytics could be performed on the sensor readings. The readings from sensors could be used for forming predictions of situations where there can be a mishap. Instead of straightaway alarming when the concentrations have gone high, algorithms could be worked upon which could determine such situations prior to their occurrence.

A dedicated mobile application could be made for the system. The features of the application would be: Getting the details of the concentration levels of the gas pipe within a tap of a button. Since it is a safety device it is important for it to be perfectly calibrated and maintained at all times. The app can make sure to send reminders about getting the system checked every once in a while. The user can add or remove the recipients who will receive the information of leakage whenever they require.

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