Ideation Phase
Literature Survey

Date	01 September 2022
Team ID	PNT2022TMID17850
Project Name	Gas Leakage Monitoring & Alerting System for Industries

Literature Survey :

1. *Smart Gas Level Monitoring, Booking & Gas Leakage Detector over IoT*

This project proposed the most common problem experienced in our day- to- day lives that is regarding GAS container going empty. We bring this paper to create awareness about the reducing weight of the gas in the container, and to place a gas order using IOT. The gas booking/order is being done with the help IOT and that the continuous weight measurement is done using a load cell which is interfaced with a Microcontroller (to compare with an ideal value). For ease it is even has been added with an RF TX & Rx modules which will give the same information. When it comes it to security of the kit as well as gas container we have an MQ-2(gas sensor), LM 35(temperature sensor), which will detect the surrounding environment for any chance of error. Whenever any change is subjected in any of the sensors (load cell, LM35, Mq-2) a siren (60db) is triggered.[1]s

A. *LM 35 (temp. sensor)*

For the sensors, if any fire is to be happened then the temperature sensor will sense an high change(positive change) in temperature and will send an pulse to microcontroller which intern will send an update to the internet through IoT, and as well it will trigger an siren alarm in the RF Rx kit(sub board)[2].

B. *MQ-2 (Gas Sensor)*

MQ 2 sensor is basically an LPG (liquefied petroleum gas) which is composed of propane & butane, so when a gas leakage is sensed by the sensor it will send an high pulse to the Mc which will update it in the IoT, and even[5] an buzzer is heard in the RF Rx kit. And the problem can be sorted & solved. Thus the overall components & sensors play role in the paper as explained above.

2. *Gas Leak Detection and Localization System through Wireless Sensor Networks*

In this project we proposed a prototype of a Wireless Sensor Network (WSN) to monitor and locate gas leaks of a complex indoor environment. Specifically, a mobile node is moving inside a building to monitor any leakage of carbon dioxide (CO2), supporting and displaying the level and the location of the leakage. Throughout the demonstration, the technological advantages of cognitive networking along with multichip routing are explored.

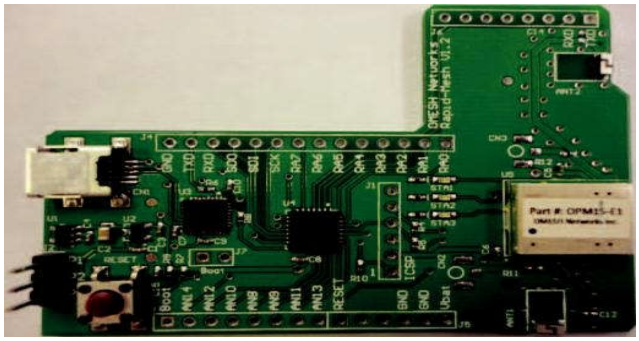

Fig. 1: RapidMesh board

Fig. 2: Stationary Node

3. *Cloud Connected Smart Gas Leakage Detection and Safety Precaution System*

The project design and develop a cloud connected smart LPG gas cylinder platform, acting as a safety device for detecting LPG gas leak at low levels to avoid any possible accidents. It is also capable of sensing fire breakout in the area and weight of the gas in order to provide real time monitoring and alert over Internet. If an abnormal condition is detected, the device sends an alert to the smartphone app of the user and also generates an alert e-mail to other authorities. In addition to this upon detecting a gas leakage or a fire breakout, the device automatically takes safety precautionary measures, like gas valve closing, ventilation opening, fire sprinkler activation and home electrical power supply cut-off. The device connects to the internet via Wi-Fi and thus increasing the mobility of the platform within the premises of the house. A Wi-Fi capable ARM Cortex-M4 microcontroller is used to implement the system. This device offers a complete, low cost, powerful and user friendly way of real-time monitoring and remote control of gas leakages and prevention mechanisms in household and industrial areas.[2]

Features of system hardware:

a) Live-Monitoring and Control

The smartphone app can show the amount of LPG gas remaining, present room temperature other device status. These data are updated every few seconds providing real-time live monitoring. In addition to this, the actuators connected on the device can be controlled from the smartphone app giving additional benefits for the user.

b) On-Demand Automatic Reordering Facility

If the device is configured in automatic reordering mode, whenever the gas level comes below a certain threshold, the device automatically sends a gas cylinder requesting e-mail to the gas vendor or

gas distributor. The user must save the e-mail address of the gas distributor before enabling this feature.

c) Low Weight Alert

Every time when a new gas cylinder is delivered, the user must press a button on the device which starts the process of measuring the weight of the cylinder and if it detects low weight cylinder, which means a low fuel content, it will immediately alert the user smartphone app about this as well as send an e-mail alert to the gas agency company to register this case. This is a useful application in finding and avoiding a low weight gas cylinder at the time of delivery.

d) Actuators

A servo motor is used to control the gas valve position, whereas DC fan motor mechanism acts like a ventilation/exhaust fan [4]. Another DC electrical motor will do the work of a fire sprinkler motor. All these motors are controlled using appropriate PWM signal generation. An AC relay circuitry is used cut-off the mains electrical supply.

e) Local Audio Alarm

A loud beep alarm sound is generated intermittently to alert the neighbouring people.

f) Device User Interface

Notification LED's are used to indicate Wi-Fi provisioning and cloud server connection status.[3]

4. *Gas Leakage Detection and Smart Alerting and Prediction Using IoT*

IoT is an expanding network of physical devices that are linked with different types of sensors and with the help of connectivity to the internet; they are able to exchange data. Through IoT, internet has now extended its roots to almost every possible thing present around us and is no more limited to our personal computers and mobile phones. Safety, the elementary concern of any project, has not been left untouched by IoT. Gas Leakages in open or closed areas can prove to be dangerous and lethal. The traditional Gas Leakage Detector Systems though have great precision, fail to acknowledge a few factors in the field of alerting the people about the leakage. Therefore we have used the IoT technology to make a Gas Leakage Detector having Smart Alerting techniques involving calling, sending text message and an e-mail to the concerned authority and an ability to predict hazardous situation so that people could be made aware in advance by performing data analytics on sensor readings.

Internet of Things is being used everywhere in order to ease our daily tasks and improve the quality of life. There are innumerable modules that could be thought of for smart homes and cities and one of them are discussed below:

A. Gas Detection Systems

This is the system which has been discussed in this paper.

The versatile nature of this system comes because of the fact that the same system with a change in the type and number of sensors can be used in different places. They can be used at homes, buildings, industries for detecting LPG, Propane, Methane or any other harmful gas leakages (discussed in this paper) and with some changes could be used in cities for detecting air pollution and performing analytics on the sensor readings to predict and prevent dangerous situations.

5. *Applications of Wireless Sensor Networks in the Oil, Gas and Resources Industries*

The paper provides a study on the use of Wireless Sensor Networks (WSNs) in refineries, petrochemicals, underwater development facilities, and oil and gas platforms. The work focuses on networks that monitor the production process, to either prevent or detect health and safety issues or to enhance production. WSN applications offer great opportunities for production optimization where the use of wired counterparts may prove to be prohibitive. They can be used to remotely monitor pipelines, natural gas leaks, corrosion, H2S, equipment condition, and real-time reservoir status. Data gathered by such devices enables new insights into plant operation and innovative solutions that aids the oil, gas and resources industries in improving platform safety, optimizing operations, preventing problems, tolerating errors, and reducing operating costs. In this paper, we survey a number of WSN applications in oil, gas and resources industry operations.[5]

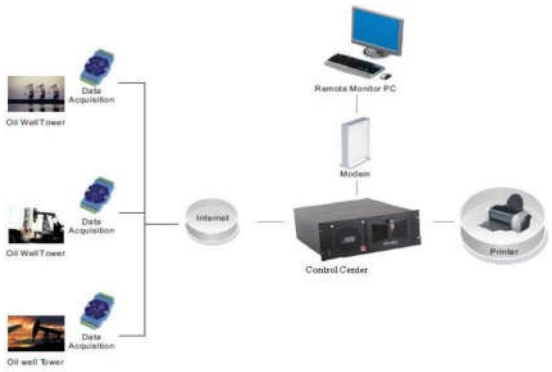

Fig 3: The principles of Local Monitoring System

6. *Gsm Based Gas Leakage Detection System*

Gas leakage is a major problem with industrial sector, residential premises and gas powered vehicles like CNG (compressed natural gas) buses, cars. One of the preventive methods to stop accident associated with the gas leakage is to install gas leakage detection kit at vulnerable places. The aim of this paper is to present such a design that can automatically detect and stop gas leakage in vulnerable premises. In particular gas sensor has been used which has high sensitivity for propane (C_3H_8) and butane (C_4H_{10}). Gas leakage system consists of GSM (Global System for mobile communications) module, which warns by sending SMS. However, the former gas leakage system cannot react in time. This project provides the design approach on both software and hardware.

Gas leakage detection is not only important but stopping leakage is equally essential. This paper provides a cost effective and highly accurate system, which not only detect gas leakage but also alert (Beep) and turn off main power and gas supplies, and send an SMS. GSM module is used which alert the user by sending an SMS. In order to provide high accuracy gas sensor MQ-6 has been used.

7. A UAV System for Autonomous Target Detection and Gas Sensing

Monitoring of environmental gases is a demanding task that can require long periods of observation and large numbers of sensors. Unmanned Aerial Vehicles (UAVs) presently represent a suitable alternative to monitor large, remote, and difficult to access areas. Due to the wide range and diversity of shape and size, UAVs now possess the capability of carrying specialized sensor modules that can accurately monitor gas concentrations. This project describes the design and flight testing of a UAV which carries an on-board camera and a carbon dioxide gas sensor and is capable of autonomous gas sensing while simultaneously visually detecting predefined targets placed at locations inside a room. The detection system autonomously navigates around the flight area using a waypoint navigation system and hovers for 10 seconds once the target has been visually[6] identified taking Air Quality (AQ) samples as it does so. Laboratory, bench and field test results demonstrate the capability of the UAV to detect targets placed in a room and analyse the air quality of samples taken during flight above the target. The data collected during the flight is transmitted, in real time, back to a Ground Control Station (GCS) for visualisation and analysis, where 3D mapping of the target location and gas concentration is presented via a web interface. Test cases verify the capability of the subsystem's integration and the operation of the UAV system as a whole. The image processing algorithm used for the target detection, based on a cascade method, proved to be dependent on the frame transmission rates, which can make the software considerably slower. The developed system provides an effective monitoring system and can be used in a wide range of applications such as gas leaks, fires, and mining applications and if converted for use in an outdoor environment, applications such as agriculture biomass burning emissions and chemical and biological agent detection studies. The system could be used in conjunction with ground sensors and integrated into an extensive gas monitoring system.

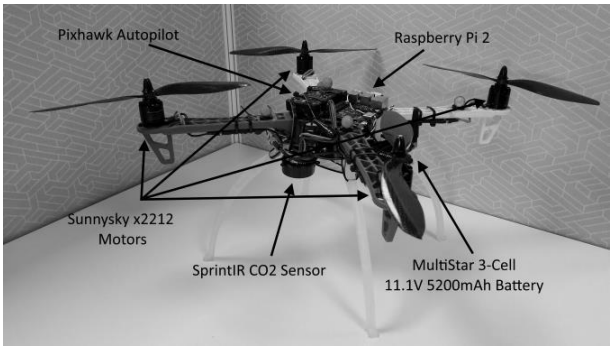

Fig 4: AMAQ UAV

8. Context-Adaptive Multimodal Wireless Sensor Network for Energy-Efficient Gas Monitoring

We proposed a wireless sensor network (WSN) for monitoring indoor air quality, which is crucial for people's com-fort, health, and safety because they spend a large percentage of time in indoor environments. A major concern in such networks is energy efficiency because gas sensors are power-hungry, and the sensor node must operate unattended for several years on a battery power supply. A system with aggressive energy management at the sensor level, node level, and network level is presented. The node is designed with very low sleep current consumption (only 8 μA), and it contains a metal oxide semiconductor gas sensor and a pyroelectric infrared (PIR) sensor. Furthermore, the network is multimodal; it exploits information from auxiliary sensors, such as PIR sensors about the

presence of people and from the neighbour nodes about gas concentration to modify the behaviour of the node and the measuring frequency of the gas concentration. In this way, we reduce the nodes' activity and energy requirements, while simultaneously providing a reliable service. To evaluate our approach and the benefits of the context-aware adaptive sampling, we simulate an application scenario which demonstrates a significant lifetime extension (several years) compared to the continuously-driven gas sensor. In March 2012, we deployed the WSN with 36 nodes in a four-story building and by now the performance has confirmed models and expectations.

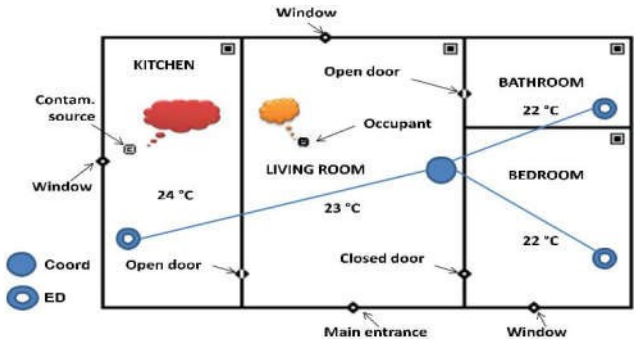

Fig. 5. Smart gas sensor network deployment used in CONTAM simulations.

9. *The Application of a Continuous Leak Detection System to Pipelines and Associated Equipment*

In recent year the problem of leak detection in pipelines, tanks, and process vessels has been the focus of many man-hours of effort. Some examples of leaks occurring in pipelines, an overview of classical leak detection systems, and the engineering basis of a new type of detector system are examined. This system is a flexible hydrocarbon sensing cable that can be installed dong pipelines, in double containment tanks and piping, or in trenches to detect and locate leaks of common industrial hydrocarbon solvents or fuels while ignoring the presence of water. The simple electrical circuit is also described, which locates and detects a leak anywhere along the length of the sensor.

The current major method of leak detection is the compensated volume balance method. This method essentially measures the "volume in" and subtracts the "volume out". There are meters that are guaranteed repeatable to within -05 percent.

An alarm will sound when there is a significant difference in volume. The pump station management will determine if the difference in the two measured volumes is the result of an operational change or if the pipe is leaking. Operational changes can result from a change in product grade, change of pumps or pumping pressure, or a change in temperature because of storage tank changes[9].

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