Essential Advance Gas Detection & Prevention System

Tanusree Debnath[1] , Prof. Sathisha G[2]
[1]Dept of Computer Science and Engineering
[2]Assistant Professor, Dept of Computer Science and Engineering
[1, 2] Atria Institute Of Technology, Bangalore

Abstract- *Gas leakage detection and prevention systems are mainly necessary for health reasons. Combustible gases can start fires and cause a very dangerous explosion in homes and workplaces.Gas Leaks are hazardous to our health, safety and society. Some gases are fraught with danger because they work as silent killer. Now a days we are facing a very big problem "Global Warming" which is caused by emission of greenhouse gases .This is the greatest environment problem.*

So advanced gas detection and prevention system is very important .We all should aware of new technologies which are used now a day to detect gas leakage.

In this paper we are concerned about different new advance technologies and techniques for gas leakage detection and prevention by using smart object and IOT. First is Gas leakage detection and prevention by thermo-graphic camera .Second one is different types of gas leakage detection and prevention System using intelligent Drone having a special type of MiniGas sensor to sense different gases .

Keywords- Internet of things (IoT), MiniGas sensor, Arduino , thermo-graphic camera, Unmanned Aerial Vehicle (UAV) etc.

I. INTRODUCTION

Global Warming make changes in everything like environment conditions, agricultural production, animals and humans health and safety, increase worldwide temperature, gradual increase in sea levels and melting icebergs. Pollute air quality in environment causes mainly respiratory related problems like asthma, bronchitis etc. We are able to get control over these kinds of disease by controlling excess of CO2, H2S and other hazardous gases in the environment .This is possible only when we detect the leakage of gas accurately.

Liquid Petroleum Gas (LPG) may leak as a gas or as a liquid. But the liquid evaporate quickly and since it is heavier than air, form a relatively large Cloud of gas which will drop to the ground ,these vapour can run for a long distance along the ground and when meets a source of ignition it can explode very badly. Exposure toxic gases like carbon monoxide, chlorine, nitrogen, sulphur oxides, hydrogen cyanide are present in workplace and also in homes. This toxic gases can cause serious health problems and also have the ability to start fire.We can minimize these kinds of problem only by detecting the presence of gases accurately in faster manner. So advance gas detection system is very important and is possible with the help of IoT.

IoT is a system which interrelate computing devices, digital, mechanical machines, objects, animals , humans that are provided with unique identifiers (UIDS) which have ability to transfer data all over the network without using human-human or human-computer interaction.

A thermo-graphic camera is a device which used to form heat zone images using inferred radiation. It's advantage is very easy to use and is like a normal camera . Using thermo-graphic camera we can easily detect which component is heating up in a circuit and then remove that particular component from the circuit to prevent the complete circuit before burning the complete circuits and emits different poisonous gases which can effect our environment.

An unmanned aerial Vehicle(UAV) is an aerial vehicle that fly without human pilot which mainly have two parts-UAV itself and UAV ground control system. This paper provides the information how UAV technology is implement in advance gas detection system to detect different types of gas leakage at a time. An UAV(i.e Drone) equipped with MiniGas **sensors** flies over the suspected area at a set height is used to detect gas leakage and it update the data to the UAV ground Control System .

This paper discuss about Essential advance technologies& techniques for Gas leakage detection and prevention, also examining different types of gases at a time by using a Single Advance Intelligent System.

II. LITERATURE SURVEY

Gas leaks can cause major incidents which results in both human injuries and financial losses. Therefore, to avoid

such situations, a considerable amount reliable techniques developed for detecting gas leakage.

Some papers were published on topic but as we know is not enough to launch a corrective action, some of the leak detection techniques were designed which allow the possibility of locating the leak.

They discussed about different gas sensors like MQ2 gas sensor,MQ6-gas sensor with C2000 piccolo MCU , LCD. But each sensor can detect some of particular gas**.**

III. PROPOSED SYSTEMS

The Essential advance Gas Detection and Prevention System mainly focus on different technologies and techniques to examine different types of gases at a time .

Discuss both thermo-graphic camera and UAV technique with MiniGas sensor so that this paper should be useful for everyone.

Every objects emit a certain amount of black body radiation as a function of their temperature and whenobject's temperature is high, then infrared radiation is emitted more as black-body radiation. This special camera can detect this radiation .Thermo-graphic camera is also used as a flame detector which indirectly helps in gas detecting.

The advance UAV gas detection system is controlled by UAV ground control System having an special type of sensor MiniGas Sensor.

This sensors is able to detect different types of gases like CO2,H2O,O3 etc .

The device also includes a high-sensitivity Edingburgh laser diode sensor for better performance in gas detection and prevention.

IV. METHODOLOGYOF PROPOSED SYSTEMS

Methodology of thermo-graphic camera:

- Infrared energy is just one part of the electromagnetic spectrum whichable to includesradiationfrom ultraviolet, microwaves,x-rays,gamma rays, radio waves etc. All of them are related and differentiated in the length of their wave (wavelength). As a function of their temperature,all objects emit a certain amount of black body radiation .

- In simple words ,the higher an object's temperature, the more infrared radiation is emitted as black-body radiation. A special camera is used to detect these radiations in a way similar to the way an ordinary camera detects visible light. It's advantage is to work even in total darkness.It is because ambient light level does not matter for this type of camera which makes it useful for rescue operations in smoky burning buildings or objects in underground.

- The focusing lenses of this camera cannot made up of same optical camera lenses glasses because these glass blocks long-wave infrared light. Generally spectral range of thermal radiation is from 7 to 14 μm. It uses special materials like Germanium, crystalline silicon,newly developed special type of chalcogenide glasses. All these materials are quite hard and have high refractive index for which from uncoated surfaces very high Fresnel reflection occure . For this reason most of the lenses for thermal cameras have antireflective coatings.


Flame detector type regions
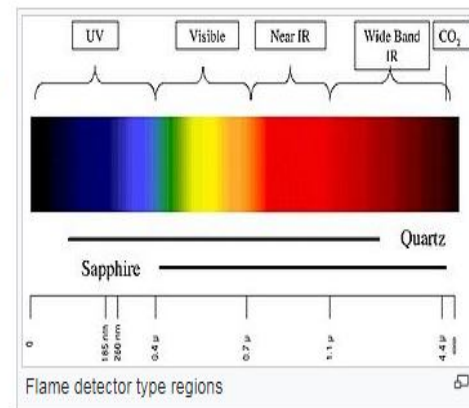
- Most important application of thermo-graphic camera is used as a flame detector which indirectly helps in gas detecting.

- In Infrared(IR)flame detector monitor the infrared spectral band of specific patterns given by hot gases. These are sensed using a specialized fire-fighting thermal imaging camera (TIC)which is a type of thermo-graphic camera.

- Sometimes False alarms can be caused by other hot surfaces and background thermal radiation in the area.A special frequency range from 4.3 to 4.4 μm is used asa resonance frequency for CO_2. During burning of hydrocarbons heat and CO_2 is released. The hot CO_2 emits so much energy with resonance frequency greater than or equal to 4.3 μm. So a peak occure in the total radiation emission which can be well detected.

- This camera are very sensitive to heat radiation caused by hot component (or equipment) of the machinery. Then an alarm starts ringingso we will be alert and easily remove that hot component to prevent the whole machinery from large a damage . Otherwisethe whole machinery brust and emits some hazardous gases and creates environment pollution.
- The usual response time of an Infrareddetector is 3 to 5 seconds.
- *Forward-looking infrared (FLIR)* camera is used on military and civilian aircraft sector which isan advance thermographic-camera use to detect infrared radiation .
- It can be used to help pilots and drivers to drive their vehicles at night and in fog, or to detect warm objects against an dark cooler background environment. The infrared that thermal imaging cameras detectwavelength range from 3 to 12 μm and differs significantly from night vision, which operates in the visible light and near-infrared ranges .

Advantages of thermo-graphic camera:

- It is contact-free and non-harmful inspection device.
- An easy, safe and advance method of gas detection and prevention system.
- It allowing thermal anomalies to be easily detected at any condition useful in both day and night.
- Easy to inspect live electrical equipment which can brust and emits poisonous gases.

Flow diagram of the model:
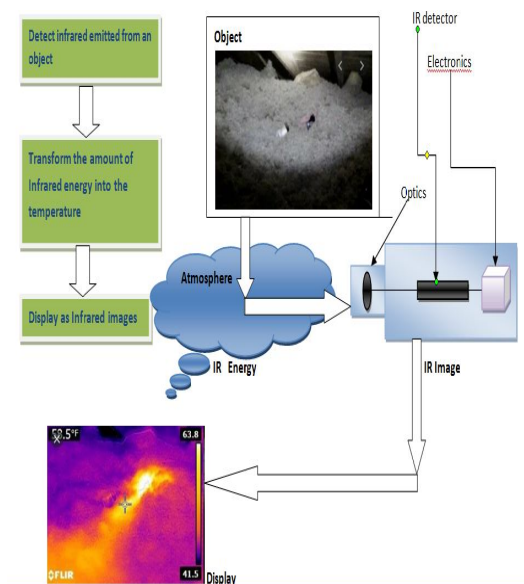
**Methodology of proposed Unmanned Aerial Vehicle:**

Remote controlled flying vehicles Drones use even numbers of rotors for propulsion and Spinning blades push air. All forces come in pairs, which means that as the rotor pushes down on the air, the air pushes up on the rotor.

Drone can move in the vertical motion, forwards and sideways.

Vertical motions are:-

1.Hover(i.e. stay in same height).
2.Climb(i.e. move in upward direction).
3.Descend(i.e. move in downward direction).

To hover, the net thrust of rotors pushing the drone up must be equal to the gravitational force.For climbingincrease the thrust (i.e. nothing but speed) of the rotors so that there is a non-zero upward force that is greater than the weight of it. For descend decrease the thrust a little bit, but remember now three forces on the drone: weight, thrust, and air drag.
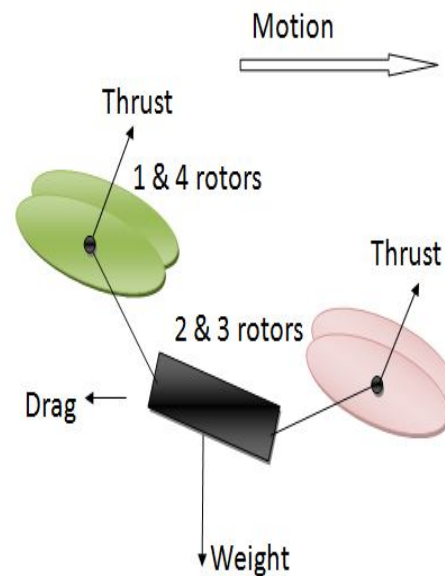

In the figure we used four rotors to understand how drone move in sideway by increasing the rotation rate of rotors 3 and 4 and decrease the rate of rotors 1 and 2.

But everything is controlled by UAV ground control system (i.e by Computer).Full advance UAV gas detection and prevention system is further implemented by IoT technology .One can understand it in better way by knowing the components and equipments' working details.

Flow Diagram of UAV technology for gas detection and prevention:
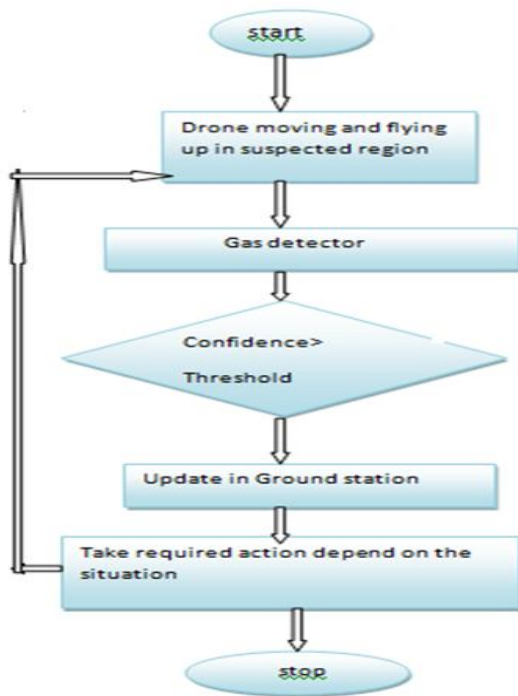
System design:
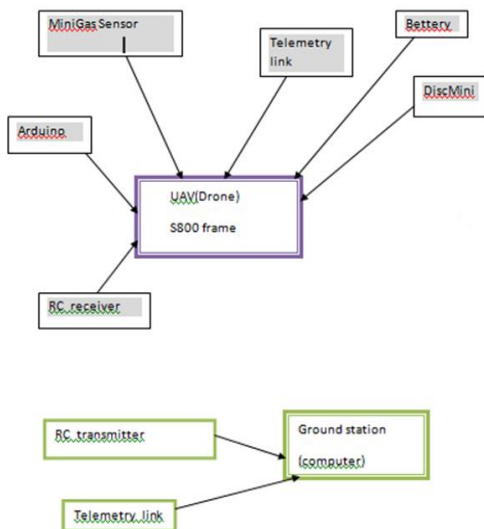
Below discuss about components details:-

Arduino:

- Arduino boards are equipped with sets of digital and analog input/output (I/O) pins, microprocessors and controllers and other circuits.

- The boards use as serial communications interfaces. But in some models Universal Serial Bus (USB) is included,which are also used for loading different programs from computers.
- Microcontrollers are programmed by using programming languages. The All Arduino projects are very useful because they provides an integrated development environment (IDE) which are based on the Processing language project.

Telemetry link:

- Telemetry is used as a retriever.It retrieve the information of your drone on your UAV ground control system(i.e. computer) .Alsohelps in radiocontrolto follow several parameters of your aircraft which are controlled by the UAV ground.It works as datalink.
- Generally UAV System requirefor the datalink is 115200 bps for a serial connection. The normal data throughput of the system for downlink 4000 bytes/s and for uplink 1000 bytes/s. The datalink should ideally ensure delivery speeds.

RC recriver:

- Radio control (RC) useto control signals that transmitted by radio to remotely control a device (i.e. drone).
- Military and scientific research organizations make use of radio-controlled vehicles. RC also use for controlling model vehicles from a hand-held radio transmitter
- In Unmanned Aerial Vehicles, RC receiver is use to receive radio signals send by the UAV ground computers.

S800 frame:

- The S800 frame is aStrong, Rigid Frame Structure which has a new strengthened structure design, that has greatly enhanced the rigidity and stability of the entire system.
- The arms of S800 EVO have embedded silicone rubber wires ,with an integrated designthat makes setup simple and neat.

MiniGAS Sensors:

- The miniGAS sensor was developed for detecting Carbon dioxide (CO_2),Hydrogen Sulfide($H2S$) and

Sulfur dioxide(SO2) but later is enhanced to include sensor options for detecting methane(CH4) and Ozone(O3).

- The device includes a high-sensitivity by using Edingburgh laser diode sensor and four electro-chemical sensors. One more advantage o is Sensors can be customized to fulfill user's specifications for species .

- Sulphur hexafluoride is not organic, , odourless, non-flammable gas and also colorless and agreat example of excellent electrical insulator. Since this gas is extremely potent greenhouse gas therefore very important to minimize leaks of it to save the environment. MiniGAS sensor which is embedded in the drone can easily detect these gases.

DISCmini:

- The DISCmini or MiniDisc (i.e. MD) is a magneto-optical disc-based data storage device that offer a capacity of 80 minutes of digitized audio or 1 gigabyte of Hi-MD.

- MD is similar to a floppy disk,but can hold almost 100 times more data than ordinary floppy disk.

- The audio files were storage in the ATRAC ,audio data in compression format ,but default format is changed to the linear PCM digital recording for better quality and for better storage.

RC transmitter:

- RC (radio control)transmitter can control through radio waves which sends a signal over a frequency to the receiver ofthe drone. It present with UAV ground control system .

- Generally The transmitter has a power source, that provides the power for the controls and transmission of the signal.

Ground station computer:

- A ground station is generally a software application that running on a ground-based computer, to communicates withUAV (Unmanned Aerial Vehicle)via wireless telemetry.

- It displays real-time data of the UAVs performance and position and can works as *virtual cockpit*.

- It have the ability of uploading new mission commands and setting parameters and also used to monitor the live video streams from a UAV's cameras.

Advantages of UAV gas detection:

- Automated update reporting details of gas leakage without physically presence of humanbeing in that place.

- Every oil and gas transmission pipelines require monitoring for maintenance and safety so that they can prevent equipment failure and as a result no accidents.UAV technology for gas detection can be used as monitoring systems which works fast and give a proper accurate data.

- Natural gas leaks can be extremely dangerous. Such leaks may be the cause of fire or explosions and the gas itself is extremely toxic when inhaled. The main risk is *naturally* odorless and cannot be detected by smell. In the case of an underground leak, the odorant may gradually become weaker and the gas may undetect ,in that case advance UAV Gas Detection System is very useful .

- When natural gas burns, carbon dioxide, monoxide, and other carbon compounds are emitted in the atmosphere and contributing to the greenhouse effect ,although is cleaner than other fossil fuels byproducts but hazardous to the environment because natural gas leaks methane is 21 times more dangerous than carbon dioxide. Main advantage of UAV gas detecting system with MiniGas sensors is that it can detect all of these main gases accurately.

V. FUTURE SCOPES

Future Scope of thermo-graphic camera:

- Thermo-graphic camera will used in police cases by allowing to check areas of heat through smoke, darkness, or heat-permeable barriers.

- It will be useful in Astronomy in telescopes such as UKIRT, the James Webb Space Telescope which planned to launch on March -30- 2021.But because of the current situation all over World due to Corona launching date can be postponed.

- Pollutant comes from of chemical substances or energy which can be either foreign substances or naturally occurring substances. Researches is going on for easily detect pollutant by thermo-graphic camera, so that we use it efficiently, and easily in any weather condition .

Future scope of UAV technology:

- More use of UAV for gas detection in gas plants (or gas-powered plants) and pipelines for human safety.

- According to emission control areas (ECAs) with a global reduction planned for the beginning of 2020 the Sulphur content of a ship's fuel is limitted . By using an unmanned system equipped i.e UAV with gas analysers, to ensure their emission within law rate. It also enables the instant detection of sulphur levels to an accuracy level and comfortably get the proper updated data .

- Some sites require gas storage in different shapes and sizes.Different types of gases used in different industrial and commercial companies.A leak in any of the gas tank which are in different shapes can cause a very serious health problem and can cause of fire. In that place we can use UAV technology for gas detection and prevent and alert people from hazardous and dangerous situation.

VI. CONCLUSION

IoT technology is an integrated of various technologies to enable different devices and objects interact with each other automatically by using different network topologies. The proposed system provides better , effective and faster way to detect various gases which are not only harmful to the environment but also sometimes cause of a great fire.

This prototype is helpful for everyone because thermo-graphic camera is affordable and by using it one can protect the home appliances before fire ignition . They also get to know toxic gases rate in home and office sector.

Unmanned Arial vehicle (UAV) for gas detection is little expensive and need a proper physical components interaction using IoT, but very useful in industrial gas plants , Firefighters.This UAV provides great benefit to emergency responders who might want an immediate overview of an incident, for controlling a warehouse fire or a chemical spill.

REFERENCES

[1] Dr. M. Newlin Rajkumar, Sruthi M. S, Dr. V. Venkatesa Kumar Volume 2| Issue 2|ISSN:2456-3307| March-April-2017| www.ijsrcseit.com|"IOT Based Smart System for Controlling CO2 Emission.''

[2] Brown, Eric (13-September-2016).
"Who needs the Internet of Things?"

[3] "Internet of things Global Standers Initiative"|Retrieved 26 June 2015|ITU.

[4] https://www.webmantra.net/services/iot/