

Gas Leakage Monitoring and Alerting System for Industries

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Abstract:

In recent years, gas leakage of any kind has been a problem, whether it occurs in a home, a place of business, a cafe, or a canteen. The construction of a gas waste monitoring, leakage detection, and warning system using the Internet of Things is suggested in this study. This essay elaborates on the design of an accident-prevention system that will help save petrol. The system and the cooker must be interconnected. Ultrasonic sensors built into the technology determine whether or not the cooker is being used for cooking. The gas supply is shut off automatically by the system if it is determined that the cooker is not in use. Users will be notified via SMS via GSM the instant a gas leak is likely to be detected, allowing them to address the problem as soon as feasible. Through a flame sensor, the system will keep an eye on fire and flame. The buzzer starts to buzz when a fire is discovered. In addition to that, the system also supports cloud storage. This cloud storage option allows for the tracking of each user's daily gas consumption. Ultimately, this process will help in determining natural gas usage per user. The system has been tested, and it can track gas leakage and wasting while also sending the user an SMS. The performance that followed shown its ability to save a sizable amount of the gas wasted in household.

Introduction:

Gas leakage causes a variety of accidents that result in both material loss and human injuries. The risk of explosion, fire, and suffocation is determined by physical properties such as toxicity, flammability, and so on. The number of deaths caused by gas cylinder explosions has been rising in recent years.

Substandard cylinders, old valves, worn out regulators, and a lack of awareness in handling gas cylinders are the causes of such explosions. LPG or propane is a flammable mixture of hydrocarbon gases that is used as fuel in many applications such as homes, hostels, industries, automobiles, and vehicles due to its desirable properties such as high calorific value, less smoke, less soot, and minimal environmental impact. Natural gas is another popular home fuel.

Now a days the home safety detection system plays the important role for the security of people. Since all the people from the home goes to work on daily bases, it makes impossible to check on the appliances available at home specially LPG gas cylinder, wired circuits, Etc. Since last three years there is a tremendous hike in the demands of liquefied petroleum gas (LPG) and natural gas. To meet this access amount of demand for energy and replace oil or coal due to their environmental disadvantage, LPG and natural gas are preferred. These gases are mostly used on large scale in industry, heating, home appliances and motor fuel. So as to track this leakage gas, the system includes MQ6 gas sensor. This sensor senses the amount of leak gas present in the surrounding atmosphere. Through this, explosion or getting affected by the leakage of gas could be avoided.

The number of deaths has risen in recent years as a result of LPG explosions. To avoid this problem, a system to detect LPG leakage is required. The process of detecting potentially hazardous gas leaks using various sensors is known as gas leak detection.

Objective:

The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed. This is an affordable, less power using, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for detecting gas. Gas leakage detection will not only provide us with significance in the health department but it will also lead to raise our economy, because when gas leaks it not only contaminates the atmosphere, but also wastage of gases will hurt our economy. The need for ensuring safety in workplaces is expected to be the key driving force for the market over the coming years.

Problem Formulation:

Gas leakage is nothing but the leak of any gaseous molecule from a stove, or a pipeline, or cylinder etc. This can occur either purposefully or even unintendedly. As we are aware that these kinds of leaks are dangerous to our health, and when it becomes explosive it could cause great danger to the people, home, workplace, industry and the environment.

Few of the major incidents that took place due to gas leakage include the Bhopal Disaster and the Vizag Gas leak. The Bhopal disaster is known to be the worst industrial accident ever. Approximately 45 tons of Methyl Isocyanate was leaked from this insecticide plant. Methyl Isocyanate is an organic compound and a chemical that could come from the carbamate pesticides. This colorless, poisonous and flammable liquid is something that human beings have to be away from.

Vizag Gas leak was a resultant of the escape of styrene that were unattended for a long period. This colorless oily liquid can spread in fumes. So, a detector must be made in such a way that could detect any kind of gas, fume, leak, smoke etc. However harmful and dangerous it can be, the detector could be attached with certain parameters that could help to prevent the issue.

List of Components:

Sno	Name of the Component	Quantity
1.	Arduino UNO R3	1
2.	Breadboard	1
3.	LED	2
4.	Resistors	5
5.	Piezo	1
6.	Gas Sensors	1
7.	LCD 16*2	1

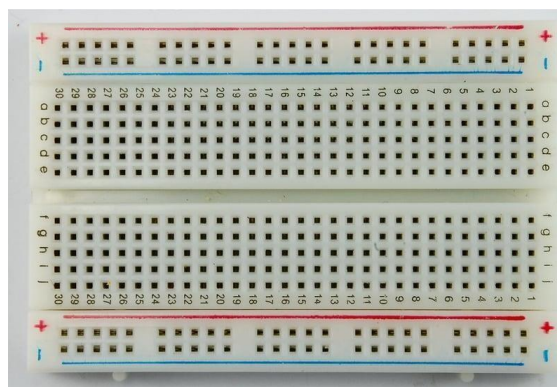
Arduino UNO R3:



The ATmega328P-based Arduino Uno is a microcontroller board (datasheet). It has 14 digital input/output pins, 6 analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header, and a reset button. It comes with everything you need to support the microcontroller; simply connect it to a computer via USB or power it via an AC-to-DC adapter or battery to get started.

The term Uno means “one” in the language of “Italian” and was selected for marking the release of Arduino’s IDE 1.0 software. The R3 Arduino Uno is the 3rd as well as most recent modification of the Arduino Uno. Arduino board and IDE software are the reference versions of Arduino and currently progressed to new releases. The Uno-board is the primary in a sequence of USB-Arduino Board, & the reference model designed for the Arduino platform.

Breadboard:

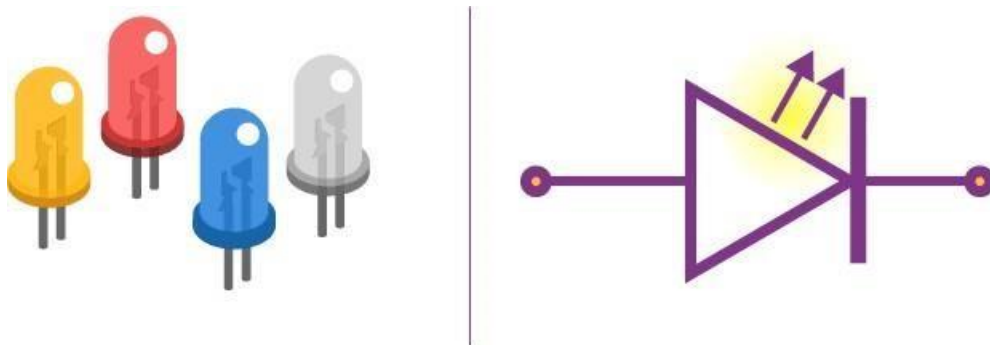


A breadboard is a simple device that allows you to build circuits without the use of solder. They are available in a variety of sizes and designs. In recent years, almost all entry-level electronics projects have included the use of an

Arduino or a Raspberry Pi. While there are many things you can do with a Raspberry Pi that don't require any external components, things get interesting when you start combining microcontrollers with DIY circuits. The Blink sketch for Arduino, which is commonly used by beginners, can be modified to use an actual LED and resistor combination on a breadboard.

A breadboard is a widely used tool to design and test circuit. You do not need to solder wires and components to make a circuit while using a bread board. It is easier to mount components & reuse them. Since, components are not soldered you can change your circuit design at any point without any hassle. It consist of an array of conductive metal clips encased in a box made of white ABS plastic, where each clip is insulated with another clips. There are a number of holes on the plastic box, arranged in a particular fashion. A typical bread board layout consists of two types of region also called strips. Bus strips and socket strips. Bus strips are usually used to provide power supply to the circuit. It consists of two columns, one for power voltage and other for ground. Socket strips are used to hold most of the components in a circuit. Generally it consists of two sections each with 5 rows and 64 columns. Every column is electrically connected from inside.

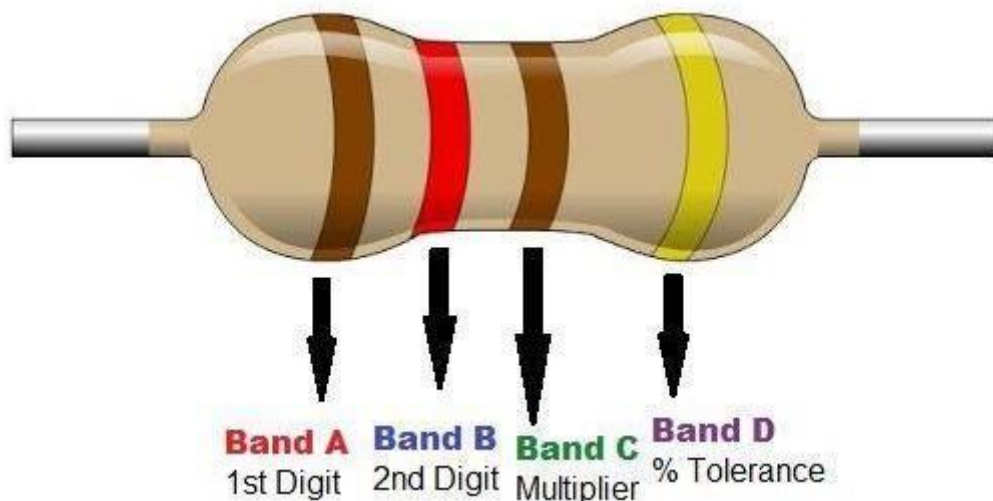
LED:



LED (Light Emitting Diode) is an optoelectronic device which works on the principle of electro-luminance. Electro-luminance is the property of the material to convert electrical energy into light energy and later it radiates this light energy. In the same way, the semiconductor in LED emits light under the influence of electric field. The symbol of LED is formed by merging the symbol of P-N Junction diode and outward arrows. These outward arrows symbolise the light radiated by the light emitting diode.

When an electric current flows through a light-emitting diode (LED), the device emits light. When current flows through an LED, electrons recombine with holes, resulting in the emission of light. LEDs allow current to flow in one direction but prevent it from flowing in the opposite direction. Light-emitting diodes are p-n junctions that have been heavily doped. When forward biased, an LED will emit coloured light at a specific spectral wavelength depending on the semiconductor material used and the amount of doping. An LED is encapsulated with a transparent cover, as shown in the figure, so that the emitted light can be seen.

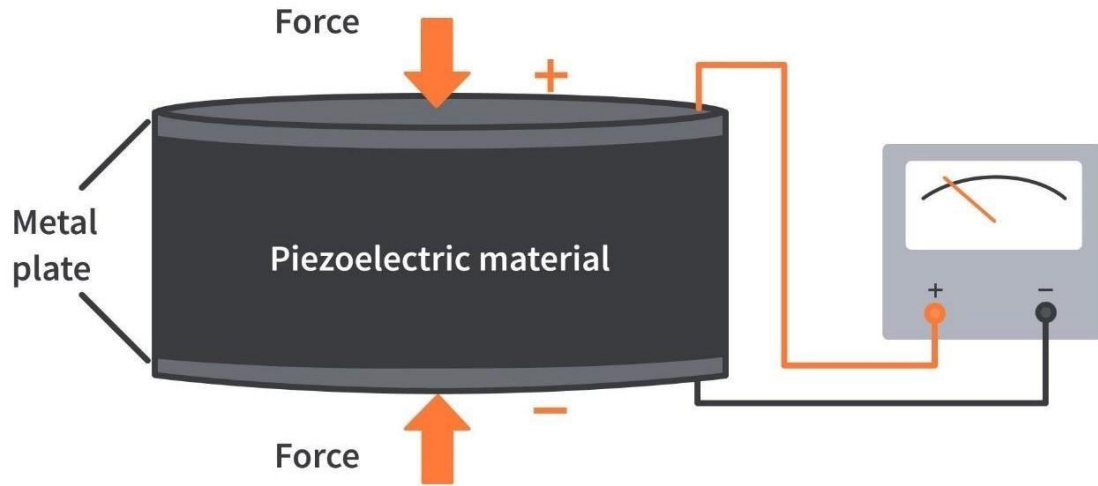
Resistors:



A resistor is a passive electrical component that creates resistance in the flow of current. They can be found in almost all electrical networks and electronic circuits. The resistance is expressed in ohms (Ω). An ohm is the resistance that occurs when a current of one ampere (A) flows through a resistor with a voltage drop of one volt (V) across its terminals. The voltage across the terminal ends determines the current. Ohm's law represents this ratio. Resistors serve a variety of functions. Limiting electric current, voltage division, heat generation, matching and loading circuits, gain control, and setting time constants are a few examples. They are commercially available with resistance values ranging from less than one order of magnitude to more than nine orders of magnitude.

They can be used as electric brakes to dissipate kinetic energy from trains, or be smaller than a square millimeter for electronics.

Piezo:



A piezo is a device that generates a voltage when force is applied or becomes deformed when voltage is supplied. In 1880, two French scientists, Jacques and Pierre Curie, discovered piezoelectricity. They discovered piezoelectricity after discovering that applying pressure to quartz or even certain crystals generates an electrical charge in that material. The strange and scientific phenomenon was later dubbed the piezoelectric effect. The inverse piezoelectric effect was quickly discovered by the Curie brothers. They discovered that when an electric field was applied to crystal leads, it caused malformation or disorder, which is now known as the inverse piezoelectric effect. Piezoelectricity is derived from the Greek word piezo, which means to squeeze or press. Interestingly, the word "electric" in Greek means "amber."

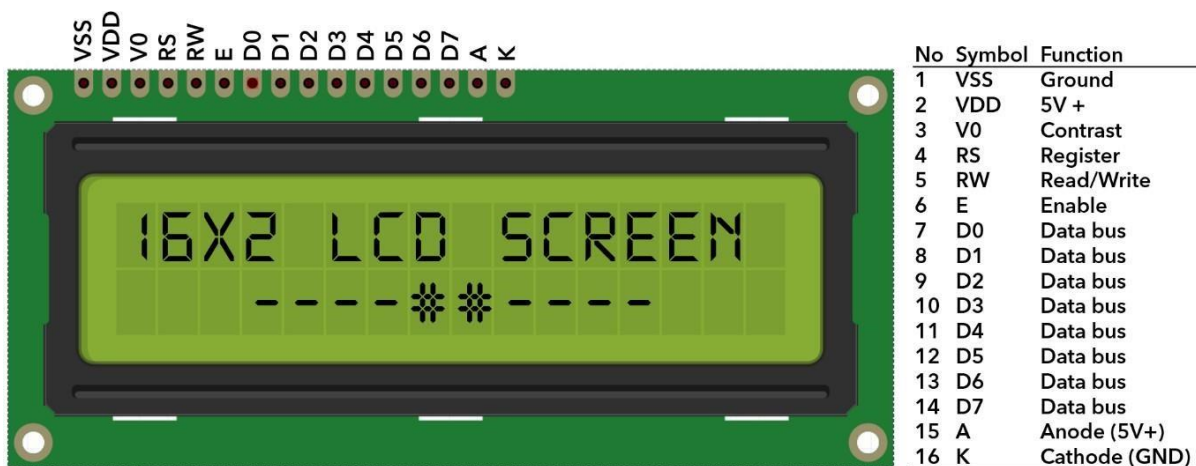
Gas Sensor:



Gas sensors (also called gas detectors) are electronic devices that detect and identify various types of gases. They are commonly used to detect and measure the concentration of toxic or explosive gases. Gas sensors are used in factories and manufacturing facilities to detect gas leaks, as well as in homes to detect smoke and carbon monoxide. The size (portable and fixed), range, and sensing ability of gas sensors vary greatly. They are typically connected to an audible alarm or interface and are often part of a larger embedded system, such as hazmat and security systems. Because gas sensors are constantly in contact with air and other gases, they require more frequent calibration than many other types of sensors.

The physical makeup and sensing process of sensors can differ significantly depending on their intended environments and functions. The metal oxide-based gas sensor is one of the most commonly used gas sensors for toxic identification and smoke detection. A chemiresistor comes into contact with and reacts with target gases in this type of sensor. When metal oxide gas sensors come into contact with gases such as carbon monoxide, hydrogen, methane, and butane, their electrical resistance increases. The majority of home-based smoke detection systems use oxide-based sensors.

LCD 16*2 :



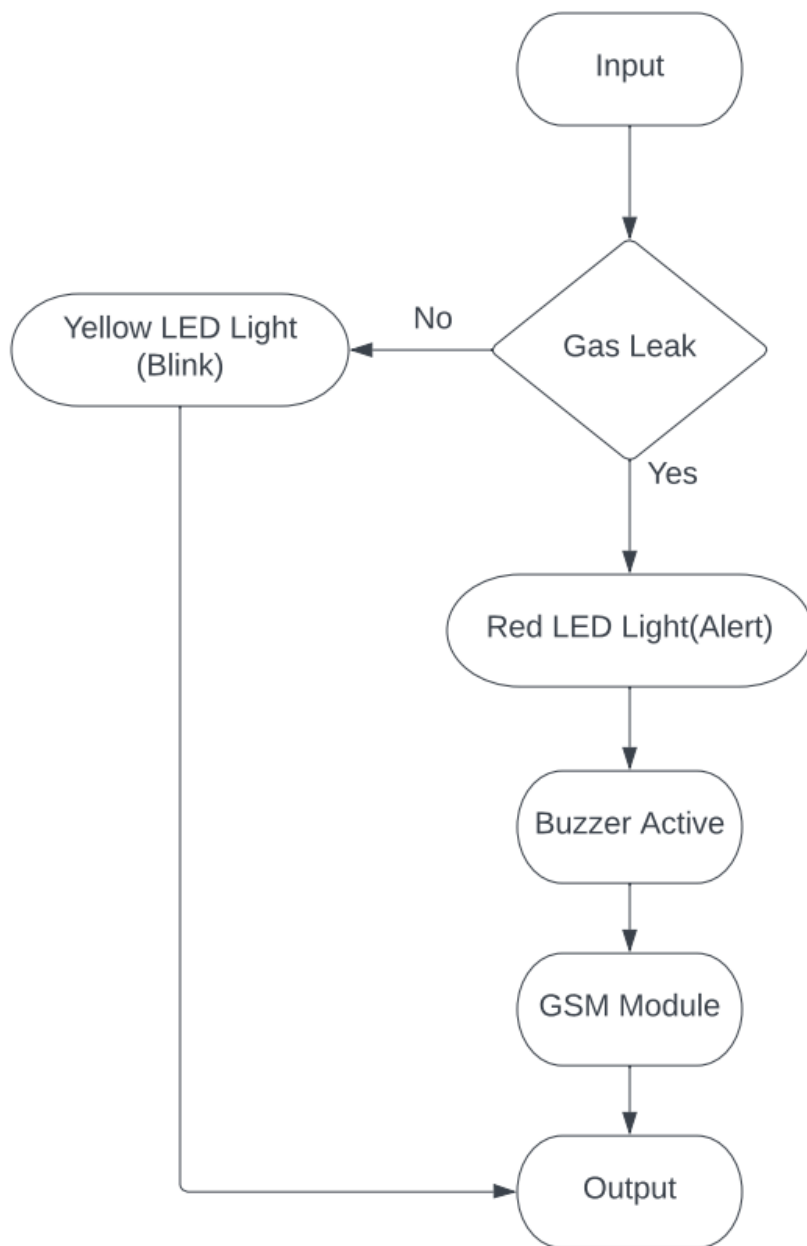
LCD is an abbreviation for liquid crystal display. It is a type of electronic display module that is used in a wide range of applications such as various circuits and devices such as mobile phones, calculators, computers, TV sets, and so on. These displays are mostly used for light-emitting diodes with multiple segments

and seven segments. The main advantages of using this module are that it is inexpensive, easily programmable, has no limitations for displaying custom characters, special and even animations, and so on.

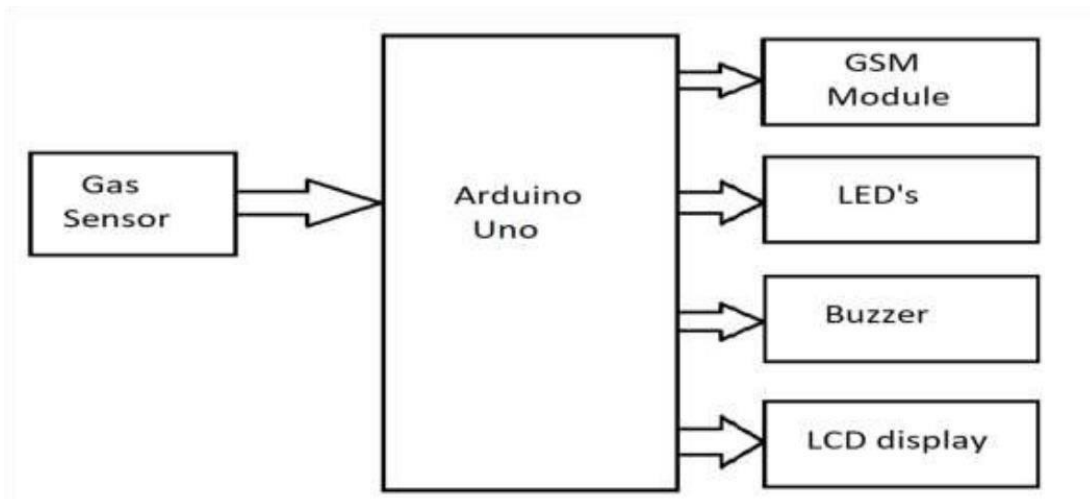
16×2 LCD is one kind of electronic device used to display the message and data. The term LCD full form is Liquid Crystal Display. The display is named 16×2 LCD because it has 16 Columns and 2 Rows. it can be displayed (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dots. These displays are mainly based on multi-segment light emitting diodes. There are a lot of combinations of display available in the market like 8×1, 8×2, 10×2, 16×1, etc. but the 16×2 LCD is widely used. These LCD modules are low cost, and programmer-friendly, therefore, is used in various DIY circuits, devices, and embedded projects.

Proposed Method:

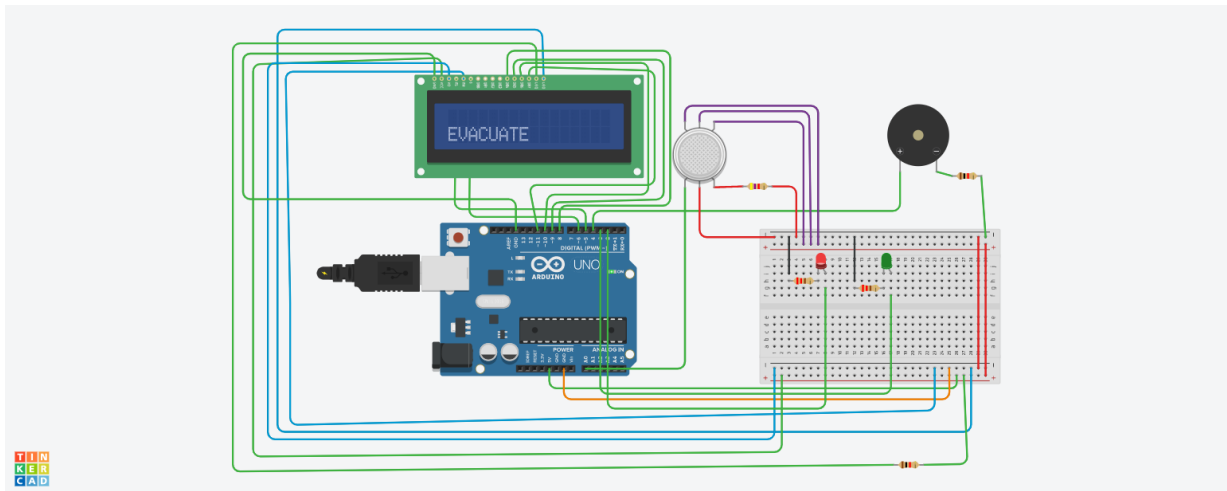
Arduino UNO (Atmega-328) is the main unit of the system which performs the following tasks. A signal conditioning of the Arduino UNO is done by output signal of the sensor, provided input to Arduino. The detection results displayed on LCD. Indicates the people of danger in work place, factory, home. Buzzer activity with beep(siren) sound is made. Also send alert SMS to the in charge of the plant whose number is saved in SIM card by using GSM modem. The SMS received depends upon the leak of gas in the detection area of the sensor.



GAS LEAKAGE MONITORING AND ALERTING SYSTEM



Circuit Diagram:



Solution Statement:

The system can be taken as a small attempt in connecting the existing primary gas detection methods to a mobile platform integrated with IoT platforms. The gases are sensed in an area of 1m radius of the rover and the sensor output datas are continuously transferred to the local server. The accuracy of sensors are not upto the mark thus stray gases are also detected which creates an amount of error in the outputs of the sensors, especially in case of methane. Further the availability and storage of toxic gases like hydrogen sulphide also creates problems for testing the assembled hardware. As the system operates outside the pipeline, the complication of system maintenance and material selection of the system in case of corrosive gases is reduced. Thus the system at this stage can only be used as a primary indicator of leakage inside a plant.

Conclusion:

After this project performance, can conclude that detection of the LPG gas leakage is incredible in the project system. Applicable usefully in the industrial and domestic purpose. In danger situations we are able to save the life by using this system. An alert is indicated by the GSM module. A sensor node senses gas like CO₂, oxygen, propane. The estimated range of transmission and consumption of power is obtained. The simple procedures and Arduino UNO Micro controller area used to build the sensor.