

# Detection of Hazardous Gases Using the Sensors and Passing Alerts to the Neighbourhood Though Mobile Cloud

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**Abstract**— Every year, with the increase in the population, there is a high demand for the industrial production in India. With Industry 4.0, the doors are open for many new industries to meet the demands of the growing population. Simultaneously, there is a huge expansion of Urban cities with the migrants from Rural backgrounds for education and Job requirements. It is a challenge for all the industries (like chemical, polymer, Automobile, pharmaceutical, manufacturing, etc.,) in handling the industrial wastes and poisonous gases. All most every industry will be following necessary steps, safety measures and precautions like recycling of industrial wastes and using gas detecting sensors for detection of poisonous gases and recording the oxygen levels. But, still there are quite a few tragic incidents or industrial disasters (minor or major) occurred due to human errors, example of Bhopal gas leakage and recent Vizag Gas leakage incident. The research of my paper focuses on how to capture the information from the sensors, record the nature and level of Chemical hazardous gases, prediction of the outcome and pass the information alert for safety measures and precautions to be taken using mobile cloud.

**Keywords**— Sensors, detection technique, Prediction, mobile cloud.

## I. INTRODUCTION

In 1984, [1-7] India faced a major industrial disaster, where 41 tonnes of methyl isocyanate gas was released and more than 3000 people were killed and 300,000 workers were affected with the tragic incident. In 1988, Piper Alpha disaster has occurred in North Sea with an explosion following gas leak. In 2008, Beijing gas leak at a steel plant killed around 27 people. In 2014, Kaohsiung gas explosion has occurred in Taiwanese city that killed 25 people and injured 267. In 2018, China Hebei province gas leak has occurred in Shenhua Chemical industry and recently on 7th May 2020, the Vizag gas leakage has occurred and killed at least 11 people along with few animals and effected around 1000 people. This motivated to do further research on how to alert the people to safeguard in that situations.

When the industries have started few decades back, they are at the outskirts. With the rapid increase in the growth of population, the cities are spread to many kilometers. This 21st century is the era of Industrialization due to the more demand for production. Every year new chemical, pharmaceutical, polymers, fertilizers/pesticides industries are growing to meet the demand from the people and Urbanization is also leading to the growth of population in the cities with migrant workers. Urbanization is increasing rapidly every year.

Identifying the toxic gases and spreading [1-7] the awareness to the neighbourhood is a major task or challenge, which can be achieved through Smart

Industrial Evolution working round the clock. The need for evolution of smart industries with the mobile connectivity through cloud and Internet of Things is highly required to take necessary steps to mitigate the above discussed incidents and accidents. The gas detection sensors [8] can be used to detect the toxic gases based on the temperature and radiations. Sensor Network can be formed with all the necessary sensors like toxic multiple gas detection sensor, temperature sensor, radiation sensor, etc. to provide the metrics and this metrics can be captures through a user interface application embedded in the mobile. Mobile device can be connected to the cloud for storing, retrieving, managing, analyzing and predicting the parameter readings captured from the user interface application of the mobile.

The previous research in the 19th century [7][8] itself says that, the sensing mechanism and techniques have come for detecting poisonous or toxic gases with the help of multi gas detection sensors, which are available for commercially. These multi detection sensors are working successfully in detecting various toxic gases and poisonous substances present in the atmosphere or in the air. The gas detecting sensors work efficiently by showing the readings through measurements and mapping the idle levels to changing levels. The alarm service is a better mechanism for communicating with the workers and people around in the accidental situations. Smart industrial environment can better

tackle with the mishaps to pass the immediate information alerts to the people around the neighbourhood. In this paper, section II contains the motivation, section III discusses the literature survey, Section IV depicts system design and implementation, Section V discusses the types of sensors and Section VI concludes research work with perspectives towards future directions.

## II. MOTIVATION

The utilisation of advanced sensing techniques for detecting, recording and monitoring toxic gases in industry and environment is very important for health and safety. [6][5]. There are various poisonous gases like Carbon Monoxide, Hydrogen Sulphide, Chlorine, Bromine, Hydrogen Sulphide, etc., present in the environment. If the level of these toxic gases increases then automatically the percentage of oxygen level decreases, which is warning and harm for the living beings. These hazardous gases can be identified through the toxic gas detection sensors and the alerts can be passed to the neighbourhood. Neighbourhood includes the workers in the industries, domestic houses around – that is people living in and around the industrial areas should be alerted to wear masks and take safety measures to escape from that situation, pollution control board and hospitals for immediate services.

## III. LITERATURE SURVEY

The interconnection of various physical objects [3][4], which utilizes the different kinds of sensors connected through Application Programming Interfaces (apis) works better which is the concept of Internet of Things. The advantage of Internet of Things technology requires low power, low cost, integrable and prolonged lifetime into the electronic circuits and embedded with different kinds of gas sensors to detect the temperature levels and toxic gases. A smart industrial environment can be created where the multipurpose gas surveillance robot can be used to monitor the high-performance gas sensors. When the disaster occurs, the alarm signals can be on.

In [4][5], the case study of Vizag gas leakage was articulated, where in a hazardous Chemical Styrene leaked from the LG Polymers plant in the Vishakhapatnam. The Styrene is a colourless liquid used to make polymers such as plastic and rubber, which happened due to negligence in storing the gas at proper temperatures which lead to the build-up of pressure and started the leakage.

In [5][6] the poisonous gas leakages due to the negligence or accidental in leading to the deaths of 11 people. Through industrial pollution, not only the

workers in the industries but the people outside are also exposed to the harmful pollutants released by the industries (i.e.) environmental pollution. The level of oxygen at certain metropolitan cities is decreased with industrial pollutants, these serious issues should be addressed to safeguard the health and safety of the people.

## IV. SYTEM DESIGN AND IMPLEMENTATION

The below figure depicts a broad picture of system design, where the toxic gases can be detected with the help of multi gas detection sensor, analyzing the criticality, using user interface application from the mobile to export the data and passing alert messages. The data from the cloud can be passed to various communicating device with safety measures or precautions.

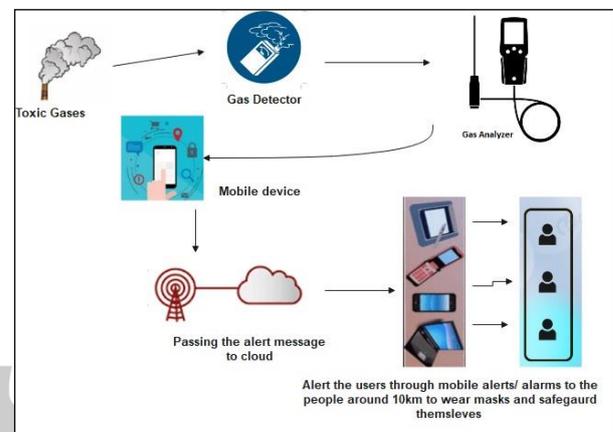


Figure 1: System Design

### Parameters:

The experimental setup considers the below parameters:

- Arduinio Uno R3 – open-source microcontroller board can be used.
- Toxic Gas Sensor – to record the level of poisonous gases present
- Radiation Sensors – metrics of the radiation level
- Alarm – to raise in the cases of flammable accidents
- Temperature Sensor – for measure the variations of temperature
- Wi-Fi unit – for connectivity of all internet enabled devices
- IoT module – transmission of sensor information from device to device
- Mobile Application to Mobile Cloud
- Alerts as a Service to the neighbourhood

### Algorithm:

- Check the experimental setup for all the idle parameter readings in the Sensors

- Read the sensor values using toxic gas detectors
- Analyze the criticality of the sensor readings using the gas analyzers
- Read the temperature sensor recording values
- Check for the abnormality conditions using the idle recording values
- If the recorded values read are normal, then start the loop from the first step
- If the abnormal values are recorded from the sensors.
- The Alarm will be raised and the values are passed to surveillance robot and mobile application.
- The mobile application will export the values and alerts to the cloud
- The mobile cloud will pass the alerts to the neighbourhood with precautions and safety measures
- Alerts as a Service from mobile cloud application can play an important role for safeguarding the health and safety of the workers in the industry as well as neighbourhood.

### V. TYPES OF SENSORS

There are various sensors [6] available for detecting poisonous gases or toxic gases. Most of the gas detecting sensors are available commercially. Example of sensors used for multi gas detection are (i) Constant potential electrolysis sensors, which detects low concentrations of toxic gases. (ii) Metal oxide Semiconductor gas sensors, which are highly sensitive devices used for detecting flammable gases. (iii) Metal Oxide Semiconductors field effect sensors, which is sensitive to hydrogen Sulphide and ammonia. (iv) Catalytic gas sensors, these sensors are highly sensitive and detects the poisonous gases which will release heat or with high temperatures. This Catalytic sensor is helpful to find the accurate measurement of gases and the heat generating from the gases.

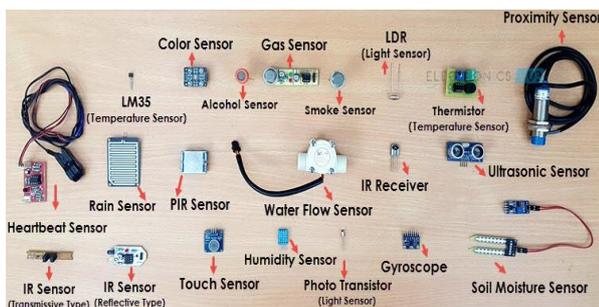


Figure 2: Types of Sensors used in IoT (Source: Electronics Hub)

The sensors used mainly in the industries are shown in Figure 3.

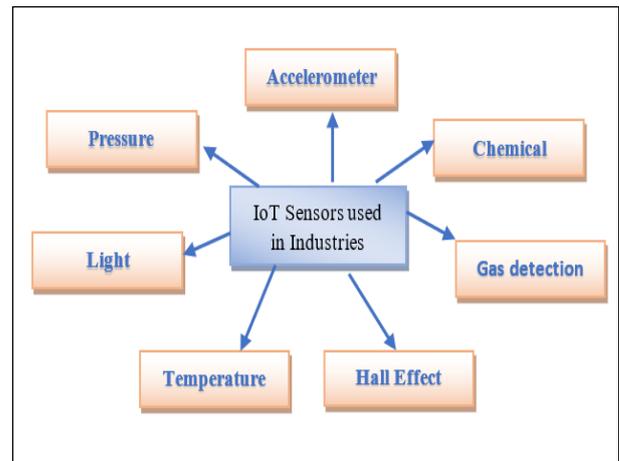


Figure 3: IoT sensors used in Industries

### VI. CONCLUSION AND FUTURE SCOPE

Hazardous gases released from the industries are very dangerous to the living beings. These poisonous gases have to be addressed and the people in and around the industries have to get awareness about the situations and they should get alerted with in a fraction of seconds in case of accidental disasters caused from the industrial pollutants. Smart industrial cloud connectivity will definitely address the problem through safety measured and precautions to mitigate the death rate. the alerts as a service from the cloud will probe as a good measure to save the people as well as animals living around the neighbourhood. The research study can give overview of need for smart industrial connectivity over cloud.

The future studies can focus on the scalability of the mobile devices and expandability of the mobile cloud application not only in the case of industrial disasters but also can be used to predict and forecast the outcome or results of hazardous gases and substances present in the environment and their levels in various areas through the application and alert the people to be safe and to take necessary precautionary measures or to migrate to the nearest safe places.

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