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Hazardous Gas Detector in Sewer & Dump Yard

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ABSTRACT

This study investigates the concept of creating a handy, portable instrument to identify and track dangerous gas in dump yards and sewers. This study is concerned with the safety of workers in drainage systems and waste sites. These so-called sewer gases can be detected by making use of different sensor like MQ137, H2S V1.0, CCS811 CO2& MS1100 VOC which can detect carbon dioxide, volatile organic compound VOC, ammonia & hydrogen sulphide gases are interfaced with ESP32 microcontroller, LCD display & WI-FI ESP32 module can collectively produce an output which can alert the people in that area & also can inform the presence of sewer gases to the authorities through android app, thereby preventing or decreasing the chance of risk.

Keywords*: Environment, ESP32, gas detector, safety, sensors, solidworks, survey toxicity*

INTRODUCTION

Due to the endless ever growing human population, the people voluntarily or involuntarily make their surroundings unhygienic by dumping organic & inorganic materials in the drainages. This dumping results in release of sewage gases like Ammonia, Hydrogensulfide, Carbon Dioxide, Volatile Organic Compound& their components.

These gases when inhaled by people may cause some short-term effects like dizziness, loss of consciousness, suffocation & also some long-term effects like lung cancer, nausea, skin infections. Subsequently, there is also a high probability of risk of death when exposed to these gases for longer periods. Sewer gas like H2S is even explosive. Any wrong step in these areas can cause a great hazard. Hence there is a dire necessity to identify the presence of these sewer gases in the drainage systems& where all the dumping takes place.

MOST DANGEROUS GASES IN ENVIRONMENT

There are several toxic gases are coming out from sewer & dump yard which mentioned followed: -

Carbon Dioxide (CO2)

A colourless gas having a faint sharp odour& a sour taste. It is one of the most important greenhouse gases linked to global warming, but it is a minor component of Earth'satmosphere (about 3 volumes in 10,000), formed in combustion of carbon-containing materials. Carbon dioxide make up 90 to 98% of landfill gas.

Hydrogen Sulphide (H2S)

The gas hydrogen sulfide (H2S) has a rotten egg odor and is colorless, flammable, and extremely toxic. It is created spontaneously through the decomposition of organic matter, which is typically found in petroleum deposits, wetlands, volcanic gases, and natural gas.

It is also produced by human and animal waste, industrial activities, and certain chemical processes. Although hydrogen sulfide has various industrial applications, including in the production of sulfuric acid, in the mining industry, and as a precursor to metal sulfides, it is primarily known for its toxicity. Inhalation of even small amounts of hydrogen sulfide can cause respiratory irritation, nausea, headache, and dizziness. Exposure to higher concentrations can lead to loss of consciousness, respiratory paralysis, and death. Safety measures such as proper ventilation, gas detection systems, personal protective equipment, and adherence to safety regulations are crucial when working with or around hydrogen sulfide to prevent accidents and exposure to its harmful effects. Additionally, hydrogen sulfide is often monitored in environmental and occupational settings to ensure that exposure levels remain within safe limits.

Ammonia (NH3)

A compound made up of hydrogen and nitrogen atoms is called ammonia (NH3). It is a colorless gas with a distinct strong smell. Ammonia is one of the most produced and used chemicals in the world, with a wide range of uses across many industries and applications. Here are some key points about ammonia:

Production

Ammonia is primarily produced through the Haber process, which involves the reaction of nitrogen and hydrogen gases over an iron catalyst at high temperature and pressure. The process allows for the synthesis of large quantities of ammonia for industrial use.

Applications

- **Fertilizer Production:** Ammonia is a key component in the production of nitrogen-based fertilizers such as ammonium nitrate and urea, which are essential for agriculture to enhance crop yields.
- **Chemical Industry:** It serves as a precursor for various chemical compounds, including nitric acid, ammonium sulfate, and various organic nitrogen compounds.
- **Cleaning Agents:** Ammonia is commonly used in household cleaning agents, such as glass cleaners and floor cleaners, due to its ability to dissolve grease and dirt effectively.
- **Refrigeration:** Ammonia is used as a refrigerant in industrial refrigeration systems and large-scale air conditioning systems.
- **Water Treatment:** It is used in water treatment processes to neutralize acidic water and remove contaminants such as chloramines.

Toxicity

While ammonia is widely used, it can be hazardous in high concentrations. Inhalation of ammonia vapor can cause irritation of the respiratory tract, eyes, and skin. Exposure to high levels of ammonia can lead to respiratory issues, coughing, and even lung damage. Therefore, proper handling and ventilation are crucial when working with ammonia.

Environmental impact

Ammonia can also contribute to environmental issues such as eutrophication when released into water bodies in excess, leading to algal blooms and oxygen depletion. Efforts are made to minimize its release and optimize its use to mitigate environmental impacts.

Overall, ammonia is a versatile chemical with numerous industrial applications, but its proper handling and management are essential to ensure safety and minimize environmental impact.

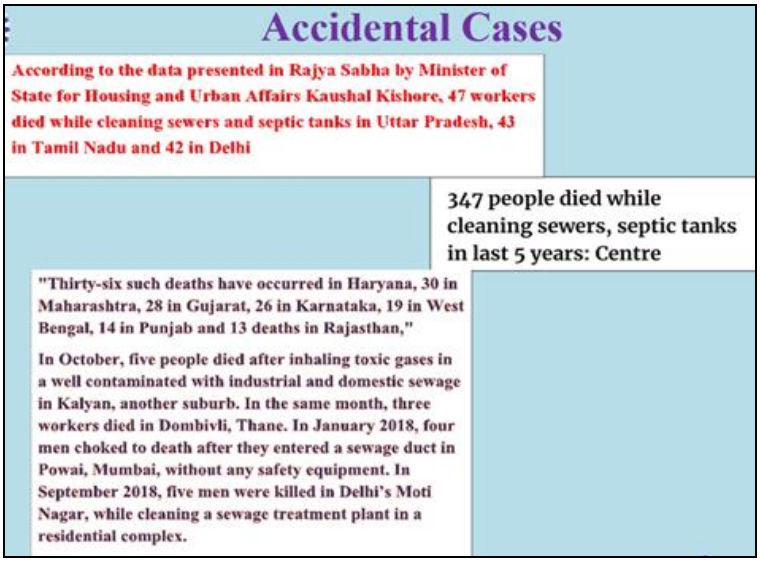
Volatile Organic Compound (VOC)

The amounts of VOCs generated at 35℃

was 28 times higher than that at 10℃ Alcohols were the most dominant VOCs emitted from food waste under 10℃. Esters became the dominator of VOCs from food waste after 24 Hours under 35℃. The bacterial community in food waste was clearly affected by the temperature. Close positive correlations were found between the VOCs & bacteria community.

Effects of Toxic Gas

With the development of city size & people to enhance environmental awareness, concerns & input of municipal government & community in on-site of the environment is growing, the establishment of an effective monitoring & warning system of municipal sewer is not only an important part of the urban environment, but also imperative requirement of modernization of municipal facilities.



LITERATURE REVIEW

N. Umapathi[1]From their research, proposed system is developed keeping in mind the safety of the workers who are casual people.

Mr. T. Siddharthan[2]Their research paper thesis helps the workers in drainage cleaning from the effect of toxic gases. The gases which can be sensed by the sensors. The sensor signal sends to the microcontroller through input ports & it should take the action by warning through the alarm indication & also sends the warning message to the registered mobile number. Mohammed Faeik Ruzaij[3]In their review, they investigate hazardous gas detection & alarm system implementation in the past 10 years.

Harsh. N. Shah [4] India Air pollution is the biggest problem of every nation, whether it is developed or developing. Health problems have been growing at faster rate especially in urban areas of developing countries where industrialization & growing number of vehicles leads to release of lot of gaseous pollutants.

RELATED WORK

Methodology

There are two types of methodologies generally used

- Continuous method in this method the sensor is always kept above the drainage water & hangingnear dump yard to transfer the readings to user
- Intermittent method in this method the sensor is programmed to give reading at specific time interval

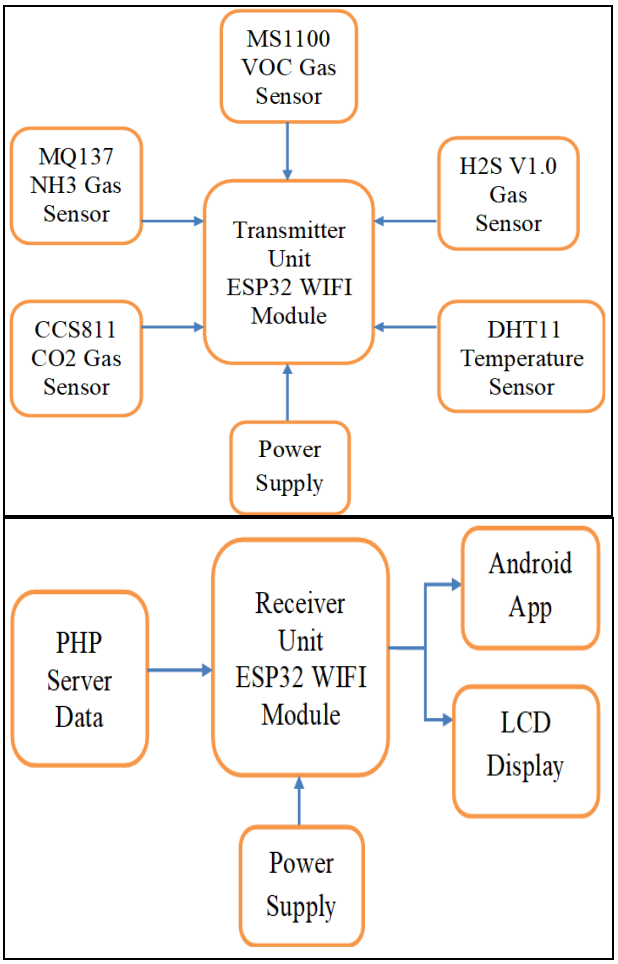
While determining the specific hazardous gases that are likely to be present in sewers &dump yards. We need to choose appropriate gas sensors capable of detecting the identified hazardous gases with high sensitivity & specificity. Select sensors that are resistant to environmental conditions present in sewers & dump yards. Calibration of these sensors ensures accurate measurement & detection of hazardous gases over time. Low cost of manufacturing. By above this methodology, we can develop a hazardous gas detector suitable for deployment in sewers & dump yards, helping to mitigate the risks associated with exposure to harmful gases in these environments.[5,6]

Internet of Things

The Internet of things is the internetworking of physical devices like vehicles, buildings, electronic or any general appliances & other connected devices embedded with sensors, network connectivity, actuators etc. which lets these devices to exchange data among themselves & perform any action as per requirement. It enables sensing & control fromremote location.

Hence, it creates a platform for integration of physical world with the network infrastructure leading to improved accuracy & efficiency with minimizing the time needed to carry out the process manually. The connectivity goes beyond the machine-to-machine communications hence lead to not only connection of servers or hosts but also the devices leading to automation in almost every field.

Working Principle



Hardware Used[7,8]

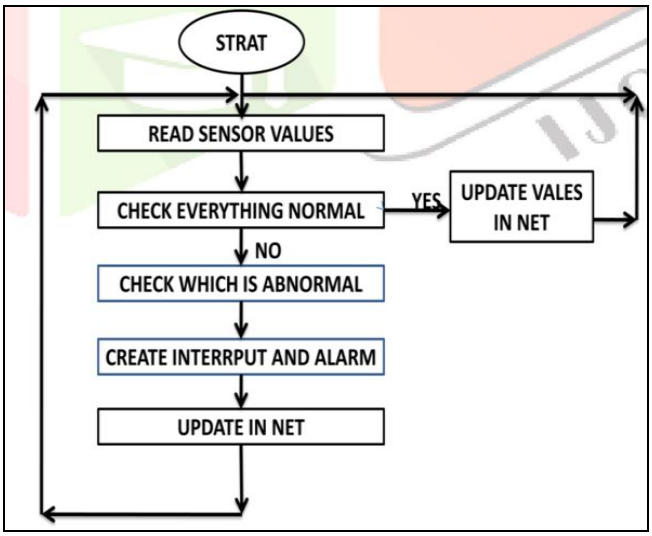
MQ137

Sensitive material of MQ137 gas sensor is SnO2, which with lower conductivity in clean air. When NH3 gas exists, the sensor's conductivity gets higher along with the gas concentration rising. Users can convert the change of conductivity to correspond output signal of gas concentration through a simple circuit. MQ137 gas sensor has high sensitivity to NH3 gas, also can monitor organic amine such as trimethylamine, cholamine well.

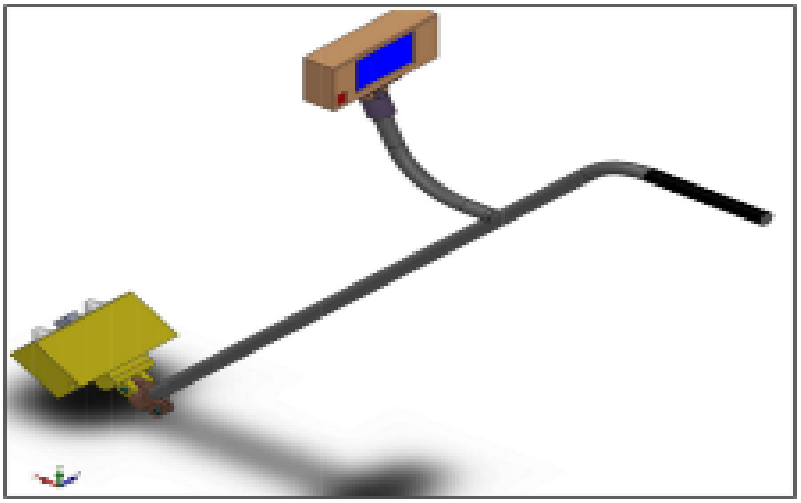
H2S V1.0 sensor

This is DFRobot Fermion MEMS Hydrogen Sulfide H2S Gas Detection Sensor (Breakout, 0.5-50ppm). Fermion: MEMS Hydrogen Sulfide H2S Gas Detection Sensor employs state-of-the-art micro-electromechanical system (MEMS) technology, endowing the sensor with compact dimensions (13x13x2.5mm), low power consumption (＜20mA), minimal heat generation, short preheating time, & swift response recovery.

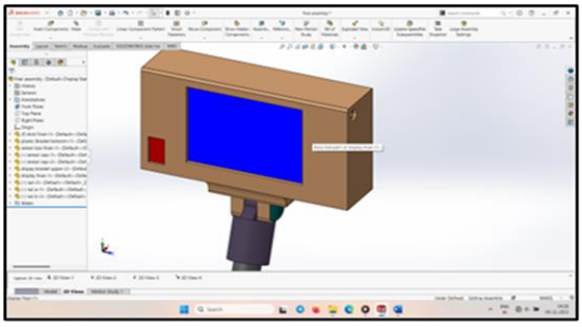
Algorithm



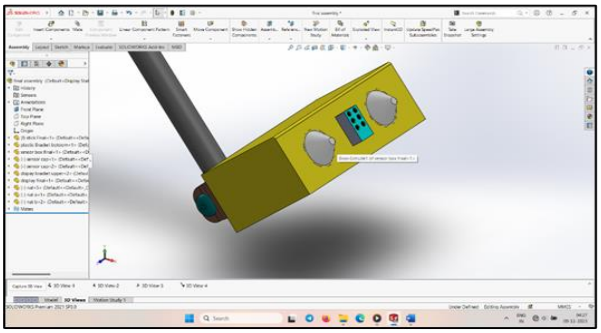
DESIGN OF GAS DETCTOR



Sketch. 3-D Model Project Product



Sketch. Display Box

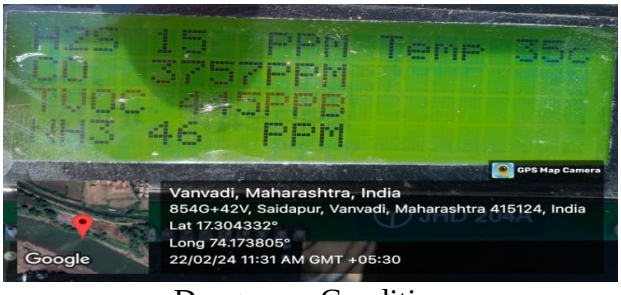


Sketch. Gas Sensor Box

The Product design was handy & portable. It can easily hang on the site of dump yard as well as implemented above sewer line.

RESULTS OR FINDING

Normal Condition



Dangerous Condition

When the threshold value is reached the warning message was sent successfully to the Server & App. The value of the sensor was displayed successfully in the LCD display. The ESP32 microcontroller was interfaced with the sensors & LCD display successfully. Hence the system was successfully designed, implemented & results were checked.

DISCUSSION

Implementing hazardous gas detectors in sewer systems and dump yards is essential for ensuring the safety of workers and the surrounding environment. These detectors continuously monitor the air for the presence of dangerous gases, providing timely warnings if concentrations reach hazardous levels. The results and discussions from using such detectors include:

Identification of Hazardous Gases

Gas detectors can identify a range of hazardous gases commonly found in sewer systems and dump yards, including hydrogen sulfide (H2S), methane (CH4), ammonia (NH3), carbon monoxide (CO), and volatile organic compounds (VOCs). By accurately detecting these gases, workers can be alerted to potential risks and take appropriate precautions.

Early Warning System

Gas detectors serve as an early warning system, alerting workers to the presence of dangerous gases before concentrations reach harmful levels. This allows workers to evacuate the area, implement safety measures, or don appropriate personal protective equipment (PPE) to mitigate exposure.

Prevention of Accidents and Injuries

By continuously monitoring for hazardous gases, gas detectors help prevent accidents and injuries caused by exposure to toxic or flammable gases. This is particularly important in confined spaces such as sewer systems, where gases can accumulate and pose serious risks to workers.

Environmental Protection

Gas detectors also play a role in environmental protection by monitoring for gases that can harm the ecosystem or contribute to air pollution. By detecting and mitigating the release of hazardous gases from dump yards, detectors help minimize the environmental impact of waste disposal activities.

Data Analysis and Trend Monitoring

The data collected by gas detectors can be analyzed to identify trends and patterns in gas concentrations over time. This information can be used to assess the effectiveness of safety measures, identify areas of concern, and implement strategies for reducing gas emissions and exposure risks.

Overall, the implementation of hazardous gas detectors in sewer systems and dump yards is crucial for ensuring the safety of workers, protecting the environment, and preventing accidents and injuries caused by exposure to hazardous gases. By providing early warnings and continuous monitoring, gas detectors play a vital role in mitigating risks and promoting a safe working environment.

CONCLUSION

Hazardous gas detection device which uses an embedded system has been implemented in this paper. The proposed system is developed keeping in mind the safety of the workers who are casual people. This system gives a great advantage of portability & also low cost of building. It is mainly directed to work towards sewage gases like Ammonia, Carbon Dioxide, VOC & Hydrogen sulfide. The system alerts the labor to identify the presence of the above stated gases & thereby decrease the risk ofDanger.

It Satisfy following Aspects

- Environmental Protection
- Enhanced Safety&Emergency Response Plan
- Data For Analysis
- Early Warning
- Reduce Health Ri

ACKNOWLEDGMENT

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