IOT Based Flammable Gas Monitoring System Using ESP32 for Underground Environment

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Abstract : Our environment is prone to various hazards and pollutions. Lots of waste is usually dumped each day or a week without any proper waste management. This also affects the underground environment. The sewage and manholes nearby our areas are also dumped with wastes and garbage. Various kinds of harmful flammable or combustible gases may get created inside the sewage or manhole. The Municipal Authority in charge of the affected areas does not have the prior knowledge about the underground environment. The flammable gases concentration may lead to explosion and other life threatening issues. The proposed system uses ESP32s NodeMCU controller with MQ-5 gas sensor module. The sensor will continuously monitor the concentration of flammable gas in the underground environment. The live data will be viewed by the authority through the IoT platform. This will help to tackle the dangerous situation well before its occurrence or well before the explosion.

Keywords: ESP32s(NodeMCU),MQ-5,IoT,Gas Monitoring.

I. INTRODUCTION

The pollution is increasing to a greater extent from last decade. The sewage and manholes nearby our areas are also dumped with wastes and garbage. Various kinds of harmful flammable or combustible gases may get created inside the sewage or manhole. Sewage gases can be very dangerous for living creatures.

Sewer gas is typically restricted from entering buildings through plumbing traps that create a water seal at potential points of entry. In addition, plumbing vents allow sewer gases to be exhausted outdoors. Infrequently used plumbing fixtures may allow sewer gas to enter a home due to evaporation of water in the trap, especially in warm weather. The result is the most common means of sewer gas entering buildings and can be solved easily by using the fixtures regularly or adding water to their drains. One of the most common traps to dry out are floor drains such as those typically placed near home furnaces, water heaters and rooms with underfloor heating. Infrequently used utility sinks, tubs, showers, and restrooms also are common culprits. Trap primers are available that automatically add water to remote or little used traps such as these. Blocked plumbing vents, typically at the roof, also can cause water seals to fail via siphoning of the water.

Exposure to sewer gas also can happen if the gas seeps in via a leaking plumbing drain or vent pipe, or even through cracks in a building's foundation. Sewer gas is typically denser than atmospheric gases and may accumulate in basements.Individuals who work in sanitation industries or on farms might be exposed on the job if they clean or maintain municipal sewers, manure storage tanks, or septic tanks.

In buildings with HVAC air handlers that admit outside air for ventilation, plumbing vents placed too closely to air intakes or windows can be a source of sewer gas odors. In some cases airflow around buildings and wind effects may contribute to sewer gas odor problems even with appropriately separated vents and air intakes. Increasing vent heights, adding vent pipe filters, or providing powered dilution and exhaust can help reduce occurrences.

II. LITERATURE REVIEW

With the aim to develop a smart Iot based monitoring system,various authors proposed their works.Some of the literature surveys are as follows:

Yash Narale et.al[1] proposed a system for monitoring and managing underground drainage system with different approaches. It also gives a description of water wise system and detection method to detect leakage defects in sewer pipeline. Also, some part of condition rating model for underground Infrastructure Sustainable Water Mains and Intelligent system for underground pipeline assessment, rehabilitation and management were explained.ARM7 was used and the system was not that cost effective.

Komal Pokalekar et. al. [2] proposed a IOT based garbage monitoring System. The dustbins are interfaced with Arduino base system having ultrasonic sensor along with central system showing the current status of garbage on display and web browser HTML page with Wi-Fi module.The system uses Arduino UNO which requires additional circuitry for IOT applications.
Naren Vasantakumaar et.al [3] proposed an intelligent gas leakage detection system with IOT using ESP8266 module. The main objective of the project was to build a Gas leakage detector using LPG gas sensor and also connect it with IoT using ESP module for safety and security. Arduino is used as the main controller. The final output of the project is used to detect leakage if gas leaks from cylinders and also notify the user by connecting via IoT software.

S. Anandhakrishnan et.al [4] proposed leak detection techniques to allow the possibility of locating the leak. The main aim was to propose the design and construction of an SMS based Gas Leakage Alert System. Gas sensor were used to detect gas leakages in a kitchen. With the help of an infrared sensor the issue of gas wastage is also monitored. An alarm goes off whenever the sensor doesn't detect any vessel over the burner beyond a particular time period.

III. Block Diagram of Proposed system

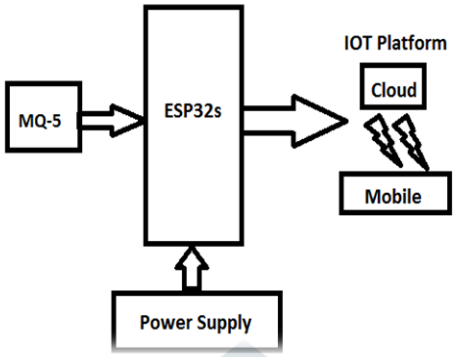

Fig.1:Block Diagram of Proposed System

The Block Diagram Consist of:
1)ESP32s (Node MCU)
2)MQ-5(Gas Leakage Detector Sensor
3)Power Supply
4)IOT Platform/Cloud

The ESP32s is the main block of the system.It receives a constant power from the power supply.MQ-5 is the gas leakage detector sensor connected to the ESP32s.The continous monitoring results of the sensor will be viewed on a mobile through an IOT platform or a cloud.

IV. System Prototype and working

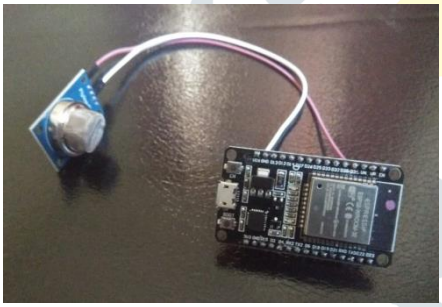

Fig.2: Open System

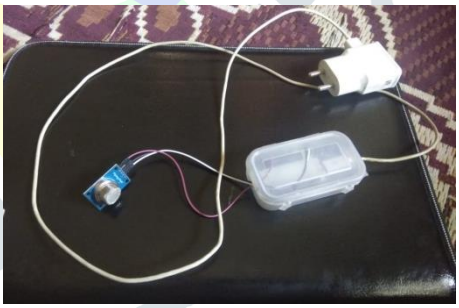

Fig.3:.Actual Prototype

Working:

Suppose our system is implanted in underground environment like sewage, manhole,etc of a particular area.The system consist of ESP32 as the main hardware along with sensor MQ-5.The system will get connected to the nearby wifi provider whose password is already fed in the program.The system continuously monitors the concentration of gases in the underground environment.MQ-5 generally senses flammable gases and combustible gases. The higher values or concentration observed will indicate the danger. These values/concentration can be continuously monitored and displayed on a mobile app called as "Blynk" through IOT platform.The Concerned authority who views the data can take necessary action for safety and precaution.

V. System Testing and results

Fig.4: System Testing for LPG Leakage

The Images above shows the system prototype and testing. The mobile charger adapter is used for power supply. LPG lighter and Burning Candle in closed glass was used for detecting gases like LPG and CO under normal environment. The practicle or actual implementation can vary if needed according to conditions.

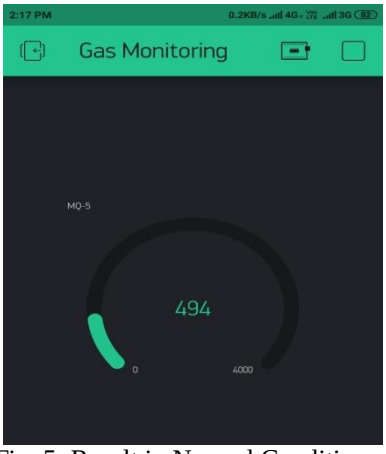

Fig..5: Result in Normal Condition

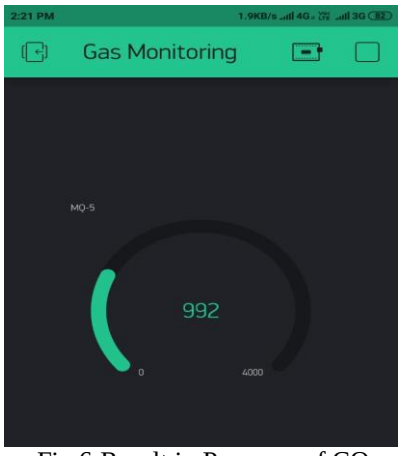

Fig.6:Result in Presence of CO

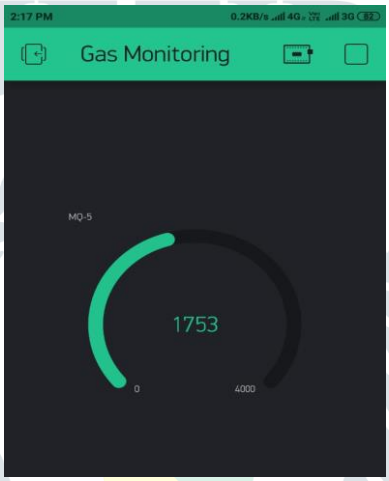

Fig.7: Result in presence of LPG Gas

VI. Future Scope

Lots of improvement can be made in the future on the developed system. With the increase in urbanization and need of healthy environment, the scope of improvement in IOT based systems in our country is immense. The robustness and durability of our system can be improved by using advanced polymers and resins. The lifespan of battery could be extended. More gas sensor can be connected to the system so that more gases can be continuously monitored.The maximum values of particular gases can be fed in the system. The alarming facility can also be added with the slurry level detection too.

Different HTML pages or apps can also be developed for viewing the data of the sensor.The scope of a universal module could be increased from urban sector to industrial sector.

VII. Conclusion

The system can continuously monitor CO and other flammable gases in the underground environment. The real time data results can be continuously viewed on Blynk application. The system is cost effective.

The concerned authority can view the details of the particular gas and take necessary action on it. This will provide safety indication well before to the people living nearby the affected areas and also to the manhole cleaner.

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