Manhole Detection And Monitoring System Using GSM Module And PIC Microcontroller

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Abstract- *Manhole monitoring systems are a technology used for management and maintenance of sewer systems. The system utilizes sensors installed inside manholes to collect data on various environmental and operational conditions such as temperature, humidity, gas levels, and water levels. This data is transmitted to a central monitoring system for analysis and detection of potential problems such as leaks, blockages, gas build-up, and corrosion. By preventing these issues, manhole monitoring systems improve the efficiency and safety of sewer systems, while also providing data collection for research and planning purposes. Future developments in technology such as IoT integration, predictive maintenance, and remote monitoring are expected to further enhance the capabilities of manhole monitoring system*

Keywords- Inductively Coupled Power Transfer System, Vehicle to Grid, Wireless Power Transfer, Zero voltage resonant transition, Adaptive neural fuzzy inference system.

I. INTRODUCTION

Manhole Detection and Monitoring System using GSM Module and PIC Microcontroller is an innovative system designed to reduce the frequency of manhole accidents and to monitor the environmental conditions of the manhole. Manhole accidents are a major concern for many cities and towns, with many people falling into them due to lack of visibility and poor maintenance. In addition, the gases and chemicals present in the atmosphere of the manhole can be hazardous for humans and can cause injury or death. This system provides an effective solution to these problems by automatically detecting the presence of a manhole, alerting the local authority of its presence, and monitoring the environmental conditions of the manhole.

The system consists of two components - a GSM module and a PIC microcontroller. The GSM module is responsible for sending and receiving data over the GSM network. It also has the capability to detect the presence of a manhole as well as any changes in its environmental conditions. The PIC micro-controller is used to control the system and to store the data received from the GSM module. The system is designed to work in three stages. Firstly, the GSM module is used to detect the presence of a manhole. Once a manhole is detected, the system sends a signal to the PIC microcontroller, which then triggers the alarm system. The alarm system alerts the local authority of the manhole's presence, allowing them to take appropriate action. Secondly, the GSM module monitors the environmental conditions of the manhole and sends the data to the PIC microcontroller. This data is then stored and analysed to ensure the safety of the environment within the manhole. Finally, the PIC microcontroller is used to control the system and to ensure that all data is stored correctly.

The Manhole Detection and Monitoring System using GSM Module and PIC Microcontroller is an innovative system that can help reduce the frequency of manhole accidents as well as to monitor the environmental conditions of the manhole. Its use of a GSM module and a PIC microcontroller makes it an efficient and cost-effective solution, while its ability to detect the presence of a manhole and to monitor its environmental conditions makes it an invaluable tool for local authorities. With its advanced features and user-friendly design, the Manhole Detection and Monitoring System using GSM Module and PIC Micro-controller is an essential tool for any city or town that wishes to reduce the frequency of manhole accidents and to protect its citizens from the potentially hazardous gases and chemicals present in the atmosphere of the manhole.

II. SYSTEM ANALYSIS

Manhole Monitoring System was initially proposed byS. Himanshu1 J. Bharani Kumar 2, K. Shashank3, Dr.T. Rama Swamy4 1, 2, 3UG scholar, 4Professor, ECE department, SNIST, Hyderabad.

This framework detects sewage vent blockages and water levels. It also monitors the continuous water flow rate. Temperature, mugginess, and gas leaks can all be detected with sensors. To address the issue of open drainage, most cities have implemented an underground drainage system in order to maintain the city clean, safe, and healthy. This is an

internet-based design for monitoring manholes. This model uses a regulator circuit, sensor driver circuit, microcontroller, serial communication devices, and IoT module.

Thus, we are adding an "GSM SIM900 module" to communicate the data with far devices through SMS which increase the communicating range of the monitoring system.
We are using PIC Microcontroller for the controlling the kit operations.

Then, in our module we add an cooling system by using an DC motor with fan module, Which provide air cooling to our Module.

In addition to this, we are adding two more sensors [DHT 11 (temperature & humidity sensor) and Tilt Sensor].

Temperature sensor (DHT 11), help us in finding the blockages in manhole by sensing the temperature.

Tilt sensor is attached to the manhole cover, if the manhole cover til by any chance this sensor intimates us.

III. PROPOSEDMETHODOLOGY

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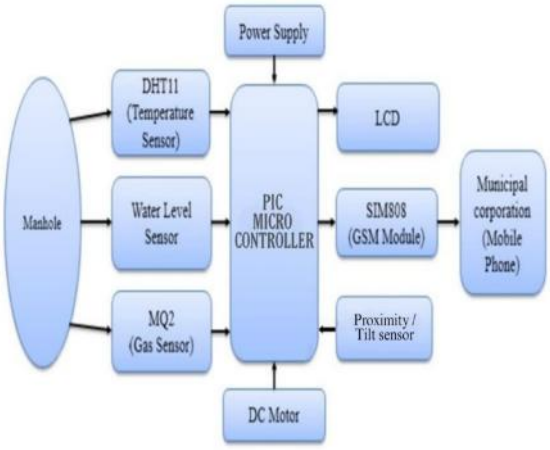

Figure1.Block Diagram

IV. SYSTEMDESIGN

Proximity Sensor:

Proximity sensors can be used in a manhole monitoring system to detect the presence of objects or people near the manhole. This can be useful for preventing accidents, such as someone falling into an open manhole or for monitoring the presence of workers inside the manhole.
The proximity sensor can be connected to a microcontroller, which can be programmed to continuously monitor the area around the manhole. The microcontroller can be set to trigger an alarm or send an alert if a person or object is detected near the manhole. This allows for early detection and rapid response to potential hazards.

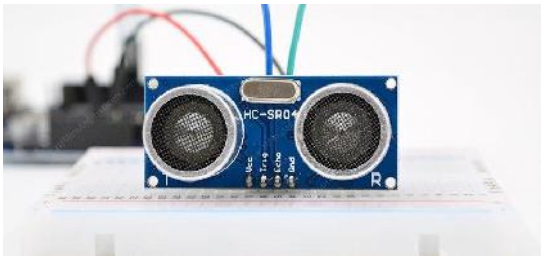

Figure.1.3 Existing System Block Diagram

Tilt sensor:

A tilt sensor is a type of Proximity sensor. This can be used in manhole monitoring to detect any changes in the orientation or angle of the manhole cover. The sensor can be placed on the manhole cover and connected to a microcontroller or data logger. The sensor can detect changes in the tilt angle, and send a signal to the microcontroller, which can then trigger an alarm or send an alert to a remote monitoring system.

Figure.1.5 Tilt Sensor

the general steps for using a tilt sensor in manhole monitoring:

Install the tilt sensor on the manhole cover. The sensor should be placed in a location where it can detect changes in the angle of the cover.

Connect the tilt sensor to a microcontroller or data logger. This can be done using wires or a wireless connection. Program the microcontroller or data logger to read the sensor's output and perform a specific action when the tilt angle exceeds a certain threshold. This can include sending an alert to a remote monitoring system or triggering an alarm.

Install the microcontroller or data logger in a weatherproof enclosure and mount it near the manhole or remotely.

Set up the monitoring system to receive alerts from the microcontroller or data logger and respond accordingly.

Test the system regularly to ensure it is working properly, and adjust the sensor's sensitivity and threshold as needed.

Temperature sensor:

Temperature sensors can be used in a manhole monitoring system to measure the temperature inside the manhole. This can be useful for detecting temperature changes that may indicate a problem with the manhole or the surrounding infrastructure. For example, a sudden increase in temperature inside a manhole can indicate a fire or a blockage in the sewer lines.

The temperature sensor can be connected to a microcontroller, which can be programmed to continuously monitor the temperature inside the manhole. The microcontroller can be set to trigger an alarm or send an alert if the temperature exceeds a certain threshold. This allows for early detection and rapid response to potential hazards.

Figure.1.4 Temperature Sensor

GSM Module:

A GSM (Global System for Mobile Communications) module can be used in a manhole monitoring system to send and receive data from remote locations. The GSM module can be connected to the microcontroller that controls the sensor data, and can be programmed to send alerts or alarms if certain conditions are met.

For example, if the microcontroller detects that the gas level inside the manhole has exceeded a certain threshold, it can trigger the GSM module to send an SMS or make a call to a specified phone number. This allows for remote monitoring and rapid response to potential hazards.

The GSM module can also be used to receive commands from a remote monitoring station, allowing for remote control of the manhole monitoring system.the remote monitoring station can send a command to the GSM module to change the threshold values or to request the latest sensor data.

Figure.1.5 GSM Module

PIC Micro controller:

A PIC microcontroller can be used in a manhole monitoring system to control and process the data from the sensors used to detect the presence and levels of gases, water and other parameters. The microcontroller can be programmed to read the sensor data and process it, comparing it to predetermined threshold values. If the sensor data exceeds a certain threshold, the microcontroller can be programmed to trigger an alarm, send an alert, or take other actions as necessary.

The PIC microcontroller can be connected to various sensors such as gas sensors, water level sensors, temperature sensors and humidity sensors, etc. The microcontroller will receive the data from these sensors, process it and make decisions based on the data received. The microcontroller can also be connected to a communication module such as GSM, Zigbee or Ethernet to send the data to a remote monitoring station, or to a cloud server.

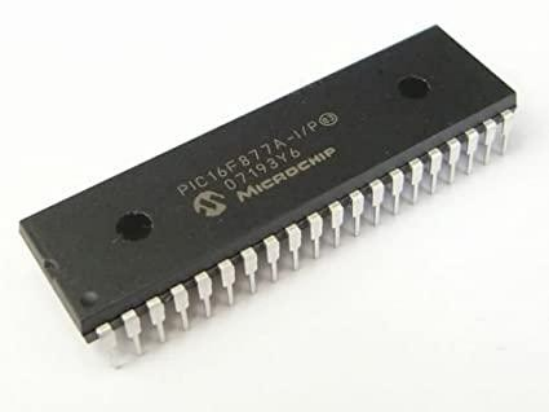

Figure.1.6 PIC Microcontroller

Gas Sensor:

Gas sensors can be used in a manhole monitoring system to detect the presence of harmful gases such as methane, carbon monoxide, and oxygen. The sensor can be placed inside the manhole and connected to a monitoring system that will continuously monitor the gas levels. The monitoring system can be set to send an alert or trigger an alarm if dangerous gas levels are detected. This allows for early detection and rapid response to potential hazards, helping to ensure the safety of workers and the public. In addition, the monitoring system can also be used to track gas levels over time and identify patterns or trends that may indicate a problem with the manhole or the surrounding infrastructure. Are typically used to detect gases such as propane and natural gas.

Gas sensors typically produce an output signal that is proportional to the concentration of the gas being detected. The output signal can be in the form of a voltage, current, or resistance, and can be used to trigger an alarm or control a process.

Figure.1.7 Gas Sensor

Gas sensors are widely used in various applications such as industrial process control, environmental monitoring, and safety systems. They can be used in buildings, vehicles, and industrial facilities to monitor air quality, detect gas leaks and prevent accidents. They are also used in industrial processes such as combustion control, catalytic converter monitoring and emission control. Gas sensors are also used in portable gas detectors for personal safety, for example, to detect dangerous levels of carbon monoxide in the home or workplace.

Water level sensor:

Water level sensors can be used in a manhole monitoring system to detect the presence and level of water in a manhole. The sensor can be placed inside the manhole and connected to a monitoring system that will continuously monitor the water level. The monitoring system can be set to send an alert or trigger an alarm if the water level reaches a certain threshold or if there is a rapid change in the water level. This allows for early detection and rapid response to potential flooding or water intrusion, which helps to prevent damage to infrastructure and potential hazards to public health and safety.

Figure.1.8 Water Level Sensor

Water level sensors typically produce an output signal that is proportional to the level of water being detected. The output signal can be in the form of a voltage, current, or resistance, and can be used to trigger an alarm or control a process.

DC Motor:

DC motors can be used to power ventilation devices in a manhole in order to ensure that the air inside the manhole is safe to breathe, or to dissipate any toxic gases that may be present.

One way to use a DC motor for ventilating a manhole is to connect it to a fan or blower. The fan or blower can be mounted inside the manhole, and the DC motor can be used to power it. The motor can be controlled by a microcontroller or microprocessor that receives data from sensors inside the manhole, such as temperature and gas sensors. The microcontroller can then adjust the speed of the motor, and thus the fan or blower, to maintain the appropriate airflow and air quality inside the manhole.

Power Source (Inverter or Battery):

An inverter or battery can be used in a manhole monitoring system to provide a reliable power source for the sensors and microcontroller. The manhole monitoring system is typically installed underground, where there is no access to a power grid, so it is important to have a reliable power source to ensure the system is always operational.

A battery can also be used to power the manhole monitoring system. The battery can be charged using a solar panel or other power source, and can be used to power the system during periods of low light or power outages. This provides a reliable power source for the system, and ensures that the system is always operational.

LCD Display:

An ICD (Integrated Control and Display) display can be used in manhole monitoring to display real-time data and status information about the manhole. The ICD display can be connected to a microcontroller or data logger that is monitoring the manhole and can be used to display various types of data such as temperature, humidity, gas level, water level, and tilt angle of the manhole cover.

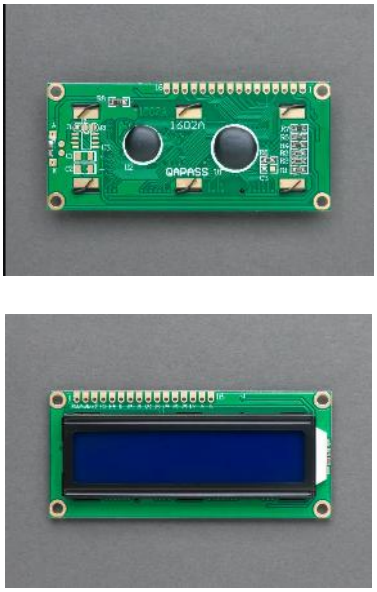

Figure.1.9 LCD Display

V. EXPERIMENTALSETUP

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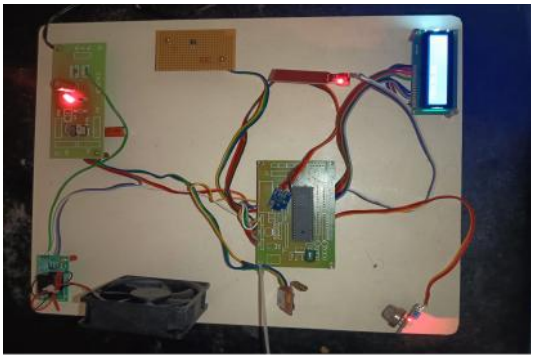

Figure2.SnapshotOfProposedHardwareKit

VI. RESULTANDDISCUSSION

As a Result of this Simulation Prototype, we had achieved a perfect operation in the expected manner. Instead of getting input from sensor, we are using power source for test purpose only.

Figure3.STATUSOFCHARGING

Manhole monitoring systems are primarily used in the management and maintenance of sewer systems. They can be used to detect and prevent problems such as:

Leaks: High water levels or pressure changes can indicate a leak in the sewer system, which can lead to costly repairs and environmental damage if not addressed.

Blockages: Sensors that monitor water levels can detect changes in the flow of water through the sewer system, indicating the presence of a blockage that needs to be cleared.

Gas build-up: Gas sensors can detect dangerous gases such as methane, carbon monoxide, and hydrogen sulphide, which can be hazardous to human health and the environment.

Overflows: Monitoring water level and pressure can help in detecting the potential for overflow which can be caused by a blockage or malfunctioning pump.

Corrosion: Temperature and humidity sensors can detect changes in the conditions inside the manhole that may indicate corrosion, which can weaken the structural integrity of the manhole and lead to collapse.

Manhole monitoring systems can also be used for data collection, this can be used for planning and design of sewer systems, and for research purposes to understand the behaviour of the systems.

VII. FUTURESCOPE

The future scope for manhole monitoring systems is quite broad and varied, as technology continues to advance and new solutions are developed. Some potential areas of growth and development for manhole monitoring systems include:

Improved sensor technology: Sensors that are more accurate, reliable, and able to detect a wider range of environmental and operational conditions are likely to be developed in the future.

IoT integration: With the increasing popularity of the Internet of Things (IoT), it is likely that manhole monitoring systems will be integrated with other IoT devices and systems, such as smart cities, to provide even more data and insights.

Predictive maintenance: With the help of advanced analytics, machine learning and AI, manhole monitoring systems could potentially predict when and where maintenance is needed, reducing downtime and improving the overall efficiency of the system.

Real-time monitoring: With the help of 5G technology, manhole monitoring systems could potentially provide real-time monitoring and alerts, allowing for faster response times and more effective problem-solving.

Remote monitoring: The use of remote monitoring technologies such as drones and robots could potentially provide more efficient and cost-effective inspection and maintenance of manholes, reducing the need for human intervention.

Environmental monitoring: With the increasing awareness of climate change and its impact on the environment, the future scope of manhole monitoring systems could also include monitoring of environmental parameters such as air quality and water quality.

Overall, the future of manhole monitoring systems is likely to see continued growth and development, with new technologies and solutions being developed to make sewer systems safer, more efficient, and more cost-effective.

VIII. CONCLUSION

In conclusion, manhole monitoring systems are an important tool for the management and maintenance of sewer systems. They use sensors to collect data on various environmental and operational conditions inside manholes, such as temperature, humidity, gas levels, and water levels. This data is analysed and used to identify potential problems, such as leaks, blockages, gas build-up, and corrosion. By detecting and preventing these problems before they become major issues, manhole monitoring systems can help to improve the efficiency and safety of sewer systems. Additionally, the data collected by these systems can be used for research and planning of the sewer systems. Overall, manhole monitoring systems are a valuable tool for ensuring the proper functioning and safety of sewer systems.

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