SMART REAL TIME MANHOLE MONITORING SYSTEM

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Abstract – *A smart city is the future goal to have cleaner and better amenities for the society. Smart underground infrastructure is an important feature to be considered while implementing a smart city. Drainage system monitoring plays a vital role in keeping the city clean and healthy. Since manual monitoring is incompetent, this leads to slow handling of problems in drainage and consumes more time to solve. To mitigate all these issues, the system using a wireless sensor network, consisting of sensor nodes is designed. The proposed system is low cost, low maintenance, IoT based real time which alerts the managing station through an email when any manhole crosses its threshold values. This system reduces the death risk of manual scavengers who clean the underground drainage and also benefits the public.*

Key Words- Smart underground, Drainage system monitoring, wireless sensor network, low cost.

1. INTRODUCTION

An integral part of any drainage system is the access points into it when it comes to cleaning, clearing, and inspection. Metropolitan cities have adopted underground drainage system and the city's municipal corporation must maintain its cleanliness. If the sewage maintenance is not proper, ground water gets contaminated causing infectious diseases. Blockages in drains during monsoon season, causes problems in the routine of the public. Hence, there should be a facility in the city's corporation, which alerts the officials about blockages in sewers, their exact location and also if the manhole lid is open automatically. Underground drainage consists of sewage system, gas pipeline network, water pipelines, and manholes. Temperature sensors are used to monitor electric power lines that are installed underground. Pressure sensors are deployed to avoid manhole explosions due to chemical release and electrical energy.

Paper [1] represents the implementation and design function of and Underground Drainage and Manhole Monitoring System (UDMS) with separate transmitter and receiver models. The vital considerations of this design are low cost, low maintenance, fast deployment, and a high number of sensors, long life-time and high quality of service. Paper [2] mainly acknowledges in the field of alerting the people about the gas explosion, increase in the water level and the opened lid. It uses IoT to make the drainage monitoring system in a highly automotive by using sensor for detecting and sending alerts through audible alarms with glowing of LED light and messages via Wi-Fi module to the authorities, storing the data in the cloud and displaying the details in the web browser.

This project overcomes the demerits of paper [1] by detecting drainage water blockage by installing water flow rate sensors at the intersection of nodes. When there is a blockage in a particular node, there is variation in the flow of drainage water which when cross the set value will display the alert in the managing station. Also demerits of paper [2] are solved by detecting temperature variations inside the manhole and alerting the same to the managing station through automatic mail. Also, flow rate sensors are used to detect the over flow of the drainage water and alerting the same to the managing station through automatic mail.

So, the main focus of this project is to provide a system which monitors water level, atmospheric temperature, water flow and toxic gases. If drainage gets blocked and sewage water overflows, manhole lid opens, it is sensed by the sensors and this data is sent to the corresponding managing station via transmitter located in that area. Maintenance of manholes manually is tedious and dangerous due to the poor environmental conditions inside. It is, therefore dangerous to go inside the manholes for inspection of its current state. To solve all the problems related to underground sanitation, a remote alarm system is necessary for transmitting data collected by the sensors set inside the manhole to the managing station. This project uses Wireless Sensor Networks (WSN) to implement this system. These nodes are composed of controller, memory, transceiver and battery to supply power.

Fig 1a: Manual scavenger clearing blockage in a manhole

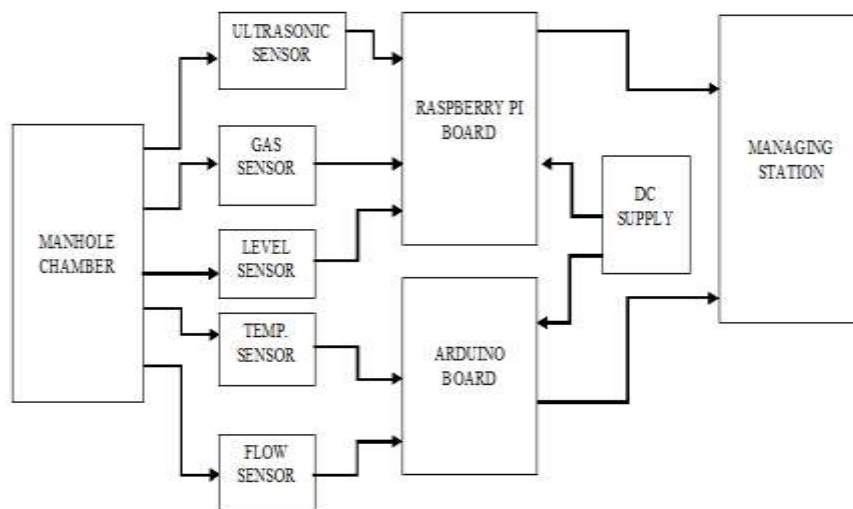Fig 1b: Sensors embedded

2. METHODOLOGY

Fig 2. Functional block diagram

The functional block diagram describes the monitoring of manhole in underground drainage system. Any blockages, rise in temperature, explosion due to toxic gases, overflow, manhole lid left open is detected by the sensors. The signals from the sensors are fed to the controller, which is programmed to generate alerts.

In this we use sensors to detect blockage, floods, and gases. The sensors will identify the clogging inside the drainage system and will give information about the location and further actions will be taken care by the municipal. This system consists of

2.1 Sensor network

2. 2 Transmission station

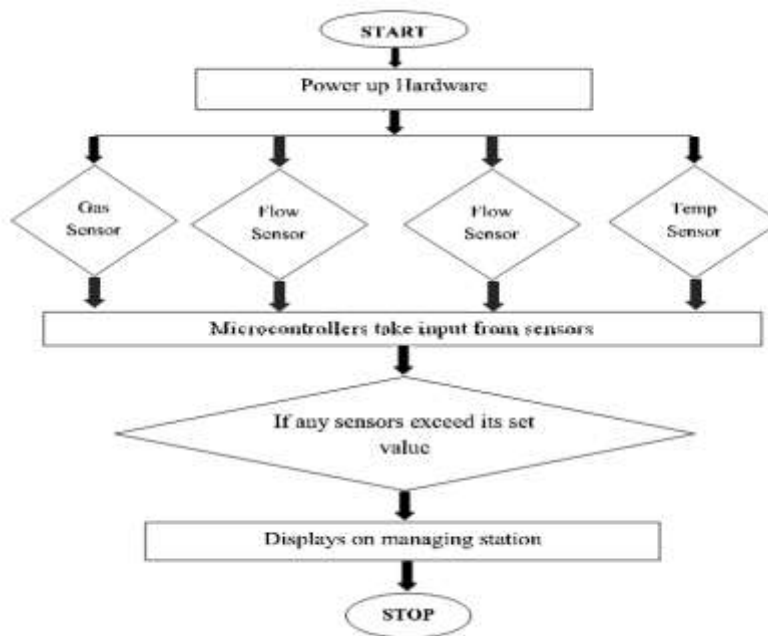**2.1 Sensor Network**

Sensor Network consists of:

    i.   Flow Sensor- YF-S201: Flow sensors are mainly used to measure the quantity or the rate of flow of liquids or gases. We are using it to detect overflow.
    ii.   Float horizontal sensor- FSH-01: Float sensor is used to detect the level of water in the system. This can turn on to be as a pump, alarm and indicator. We are using it to detect blockages in drainage.
    iii.   Temperature sensor-LM35: Temperature sensor is a device used to measure the hotness or coldness of an object. We are using this sensor to obtain the temperature underground.
    iv.   Ultrasonic sensor-HC-SR04: Ultrasonic detection is most commonly used in industrial applications to detect hidden tracks etc. We are using it to detect the opening and closing of lid of manhole.
    v.   Gas Sensor-MQ2: MQ2 Gas sensor detects combustible gasses and smoke.

2.2 Transmission Station

This station helps to send signals from sensors. This station consists of Raspberry Pi model B and Arduino Uno which are the two microcontrollers that are interfaced. The signals received by the Arduino from the sensors is converted from analog signals to digital signals with the help of ADC located in the Arduino board and further is processed and sent to the cloud and Raspberry Pi ,takes this as input data. An alert is displayed in the managing station and an email is sent to the respective authority.

3. FLOW CHART

The working of the whole unit can be explained by using the following flowchart as shown below.

4. PROPOSED SYSTEM

In the proposed method, development of IoT based drainage and manhole monitoring system is designed. This system monitors atmospheric temperature, release of toxic gases, blockages, overflow in drains and manhole lid position. Maximum levels are set and sensors keep monitoring the changing conditions. As the levels reach a maximum set point the sensors detect and send the signal to controller, where it commands the IoT network to generate alerts to the municipal corporation.

Fig 4a. Model of smart city

Fig 4b. Experimental setup

5. RESULT

This system detects the blockages and water level in the manhole. It also monitors the continuous water flow rate. With the help of sensors temperature, humidity and gas leakage can be identified. The system also informs whether the manhole lid is open or closed by using the ultrasonic sensor.

When a particular sensor reaches the respective threshold level, then that respective value of the sensor will be sent to the microcontroller. Microcontroller updates the live values of all the sensors using IoT. If any problem arises in the manhole, sensor senses it and sends that information to the microcontroller. Furthermore, the microcontroller sends the signal and the exact location of the manhole through IoT to the managing station. Then, an automatic mail is sent by Raspberry Pi. This alerts the person-in-charge to take the required actions regarding the problem occurring inside the manhole.
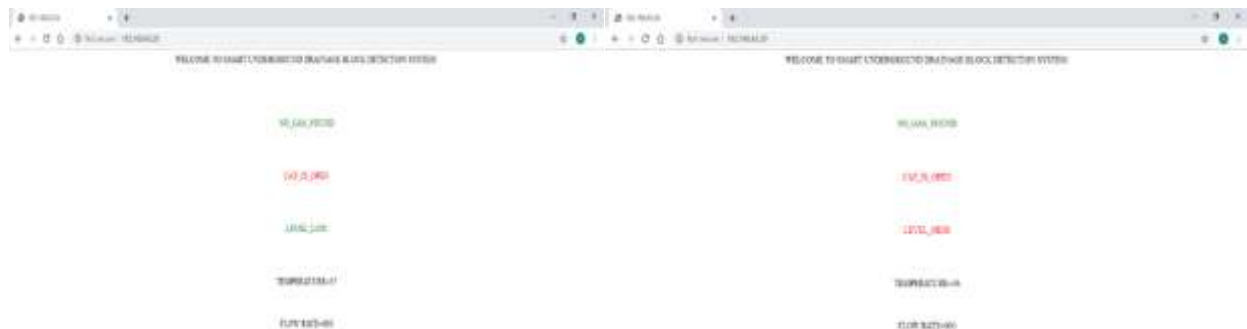

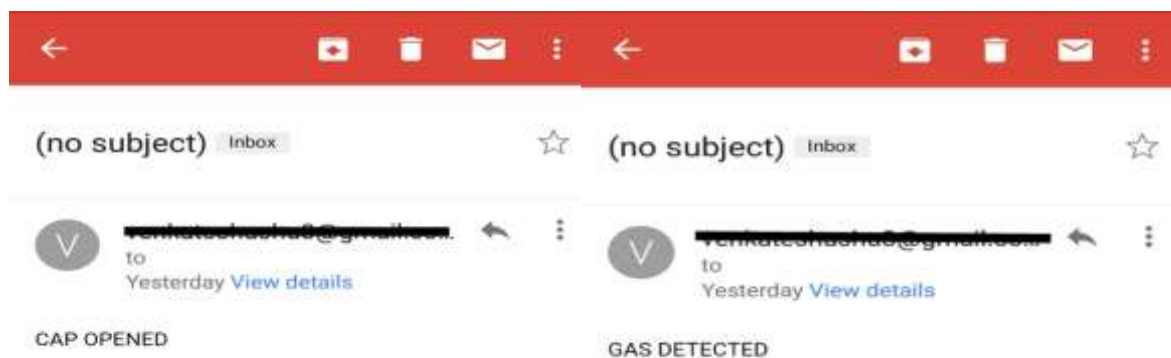Fig 5a. Alerts displayed in the managing station

Fig 5b. Alerts sent through email

6. CONCLUSION

Sensor unit automatically senses and updates the live values of the physical parameters like temperature, humidity, water level and flow rate, blockages, and manhole cap is open or closed through IoT. This makes the system smart and automated. The deployment of Wireless Sensor Networks (WSN), helps in the implementation of the Smart cities in a developing countries. This WSN can also be useful in designing of environmental monitoring systems, which helps in monitoring of volcanic activities, flood detectors and other system. By a small modification in the implementation, this project can be used in agriculture fields or other environmental fields to monitor and control the systems.

In future, Smart cities infrastructure could be modified for intelligent communication and management of traffic signals, street lights, transit applications, active lanes, and so on. With the integration of smart devices in a city infrastructure can makes life in a city a lot easier. Also further by using PLC controller and SCADA systems, drainage water can be controlled, monitored and also this water can be used to irrigate plants, clean toilets, etc. This PLC and SCADA systems can be used as a treatment system for drainage water. Primarily, PLC controls the process of sewage treatment plant and SCADA is a remote terminal unit, which monitors and controls the entire area.

7. REFERENCES

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