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Manhole Detection and Monitoring System using IoT

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Abstract: *Nowadays, manholes and its maintenance are the main problem in the metropolitan smart cities. A drainage monitoring system plays a significant role in keeping the towns and cities healthy and clean. The major challenge is to further investigate the condition of manholes on the road. In observation, most of the manhole's lids were not in the settled emplacement and are in damaged condition. Because of these damaged manholes, there are chances of occurrence of accidents on the road. These damaged manholes will be hazardous to personal safety. 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 which it alerts the officials about blockages in sewers, their exact location and about the gas explosion, increase in the water level and temperature level. The goal of this project is to create an effective accident-avoidance system by avoiding open manholes in large cities. This system includes an array of sensors for complete monitoring of the manhole cover such that many accidents can be prevented. This system reduces the work of manpower and increases the safety and speed of work. The working and implementation of this project will be very useful to take necessary actions and maintain the regularity of the municipal society.*

Keywords: Arduino Integrated Development Environment, Alert messages, Sensor nodes, Adafruit, Wi-Fi & Internet of Things

I. INTRODUCTION

An entrance to a restricted space, such as a shaft, utility vault, or massive vessel, is known as a manhole (also known as a utility hole, maintenance hole, or sewage hole). To enable system upgrades, maintenance, and inspection, manholes are frequently employed as access points for subsurface public utilities. Water, sewerage, telephone, electricity, storm drains, district heating, and gas are among the subsurface utilities that commonly include manholes

Today's situation is very critical for the Municipal party to handle this situation our project is beneficial to the municipality by this project work of the municipality make very easy and smooth Li environmental condition is not good today's sudden rain has come and the level of drainage is increased buy this some accident is orca then the system is very useful manhole detection and monitoring system using IoT by this system we detect the manhole condition and monitoring this without any man this system is based on IoT, therefore, no any physical contact with the man. A manhole detection and monitoring system using IOT is a very useful system to all of us by this we detect manhole conditions in this system. We used different components like water flow, gas, temperature, and humidity sensors. This project overcomes the demerit of paper by detecting drainage water flow speed rate by installing a water flow rate sensor at the intersection of nodes when there is a blockage in a particular road there is variation in the flow of drainage in water which when across the seat value will display the alerts in the managing station by the system. We protect the health of municipality working staff. In this system, we use different components this component is very high output and input components, and a very efficient component buys this component, and this system detects any problem that occurs in the manhole without any man.

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[1] Internet of Things for Smart Environment Applications.
Authors: Sunidhi Vashisth, Sunil Kumar Chawla, Bharti Mahjan, and Himani Chugh et al
Description: The Internet of Things (IoT) is becoming an emerging technology due to the rapid use of the internet. IoT is a kind of "universal global network" that combines different things such as mobile, laptop, notepad, etc. IoT is a smartly integrated system that interacts with other machines, environments, objects, and infrastructure that comprises intelligent machines including radio frequency identification (RFID) and sensor network technologies. In every company, people send emails and access websites, or other online means, and in most countries, the internet is available to transmit data across mobile devices and the Internet through easier, faster, and less costly systems. The main purpose of this object is to provide a detailed study of IoT along with its applications in different fields such as health, urban city, industry, transportation, and smart building.

[2] A Smart IoT-based security system for residents
Authors: Muhammad Irsyad Haziq, Ilanur Muhaini Binti Mohd Noor, and Raed Abdulla et al
Description: The main aim is to develop an IoT-based security system for resident, which include biometric authentication, plate recognition, and a movement detection system. In this proposed method, the programming platforms such as Python, and Arduino, were used to develop to demonstrate the proposed system. The performance of the developed proposed system is evaluated by testing the system with several sample tests and from there, the performance was examined. The system performed well in recognizing the different persons and is capable of returning the correct output in almost all the face samples as well as the plate number detection which can successfully extract the string information from the pictures. It is observed that the system has an overall accuracy of 77% after considering several important factors that may affect the system's performance. The proposed systems used off-the-shelf components as proof of concept. The proposed systems were validated based on: a) the range of the temperature found beneath a manhole cover, and b) the signal reconstruction under the presence and the absence of noise. The results show the decent performance of the proposed system from the power consumption point of view, as it can exceed the lifetime of similar two pumps based Jerk chaotic oscillators by almost one year for long lifetime applications such as using Li-Ion batteries. Furthermore, in comparison to PRNG output sequence monitoring MC e generated by a software algorithm used in the AIC framework in the presence of the noise, the first proposed system output sequence improved the signal reconstruction by 6.94%, while the second system improved the signal reconstruction by 17.83 %.

[3] Towards the Implementation of IoT for Environmental Condition Monitoring in Homes
Authors: Kelly S.D.T, Suryadevara, N.K, Mukhopadhyay S.C
Description: In this paper, we have reported an effective implementation of the Internet of Things used for monitoring regular domestic conditions by means of a low- cost ubiquitous sensing system. The description of the integrated network architecture and the interconnecting mechanisms for reliable measurement of parameters by smart sensors and transmission of data via the internet is being presented. The longitudinal learning system was able to provide a self-control mechanism for better operations of the devices in the monitoring stage. The framework of the monitoring system is based on the combination of pervasive distributed sensing units, an information system for data aggregation, reasoning, and context awareness. Results are encouraging as the reliability of sensing information transmission through the proposed integrated network architecture is 97%. The prototype was tested to generate real-time graphical information rather than a test bed scenario.

[4] Monitoring Smart City Applications using Raspberry PI Based on IOT
Authors: Prof. S A.Shaikh, Suvarna A. Sonawane.
Description: The Smart city's development goal is to monitor the quality of resources in the city to improve good management and faster development of the city required necessity is to upgrade healthy and safe cities that deliver real-time services and the latest facilities to implement the concept of the smart city use IoT concept by which easy wireless communication is possible. The system consists of sensors that collect different types of data from sensors and transfer them to the Raspberry Pi3 controller. The acquired output from the controller is sent to the control room through E-mail and also display on the personal computer.

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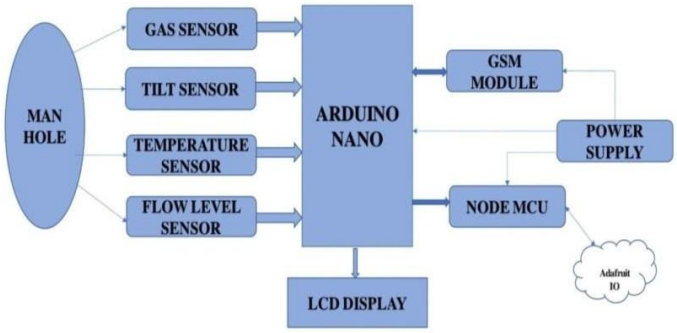
[5] The design space of wireless sensor networks, Wireless Communications
Authors: Romer, K. Mattern
Description: In the recent past, wireless sensor networks have found their way into a wide variety of applications and systems with vastly varying requirements and characteristics. As a consequence, it is becoming increasingly difficult to discuss typical requirements regarding hardware issues and software support. This is particularly problematic in a multidisciplinary research area such as wireless sensor networks, where close collaboration between users, application domain experts, hardware designers, and software developers is needed to implement efficient systems. In this paper, we discuss the consequences of this fact with regard to the design space of wireless sensor networks by considering its various dimensions. We justify our view by demonstrating that specific existing applications occupy different points in the design space.

II. PROPOSED SYSTEM DESIGN

Below diagram represents the major components of the underground drainage monitoring system.

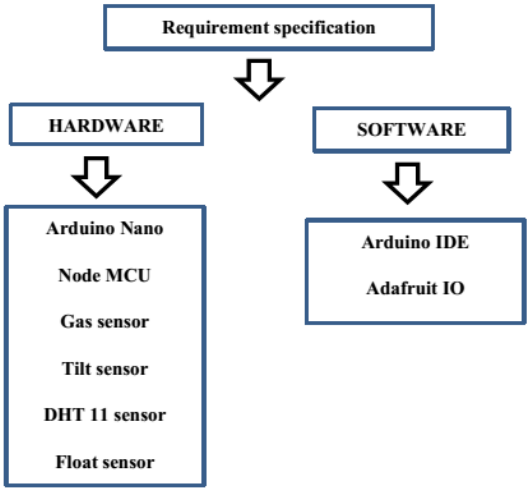
2.1 Working

An underground drainage monitoring system will not only help in maintaining the proper health and safety of the city but also in reducing the work of government personnel. Various types of sensors (flow, tilt, temperature, and gas sensors) are interfaced with the microcontroller Arduino Uno in order to make the system smart. When the respective sensors reach the threshold level, the indication of that respective value and sensor is sent to the microcontroller. Furthermore, Arduino Uno then sends the signal and location of the manhole to the municipal



corporation through GSM and the officials could easily locate which manhole is having the problem and could take appropriate steps. Also, Arduino Nano updates the live values of all the sensors in the manholes falling under the respective area using IoT. A message will also be displayed on the LCD.

2.2 Requirements Specification



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The requirements specification phase in the design of the system dictates the major requirement to develop the product as in figure 1.

2.3 Software Description

a) Arduino IDE

The Arduino Integrated Development Environment, sometimes known as the Arduino Software (IDE). It has a text editor for writing code, a message area, a text console, and a toolbar with buttons for frequently used operations. In order to upload programs and communicate, it is connected to the processor with the help of a USB cable.

b) Adafruit IO

Adafruit IO is a cloud service available on the network and with which it is possible to connect our devices, such as an Arduino board.

Its main function is to store the data acquired by one or more boards connected to sensors, to show them both in real time and subsequently, but it can also perform other interesting functions.

2.4 Hardware Description

The major components used in our projects include Arduino Nano, Node MCU, Gas sensor, Tilt sensor, DHT 11 sensor, Float sensor and GSM Module.

a) Arduino Nano

Arduino Nano has an Atmega328P microcontroller. It has 22 input/output pins in which 14 pins are digital pins and 8 analog pins. It has 6 PWM pins among the digital pins. Its operating voltage varies from 5V to 12V.

2.5 Features Specifications

- Processor: Atmega328P
- Voltage: 5V
- Clock: 16 MHz
- Current limit: 40 MILIAMPS
- Analog Pins: 8
- Digital pins: 14
- Working range: 5-12 V

b) Float Sensor

It's a device that measures the high or low level of a liquid in a fixed vessel. According to the method of liquid level measurement, there are two types of contact and non-contact.

What we call an input water level transmitter is a contact measurement, which converts the height of the liquid level into electrical signal output. It is a widely used water level transmitter at present.

c) DHT 11 Sensors

A straightforward, inexpensive digital temperature and humidity sensor is the DHT11. It measures the humidity in the air using a thermistor and a capacitive humidity sensor and outputs a digital signal on the data pin (no analog input pins needed). Although it is reasonably straightforward to operate, data detection requires precise timing. This sensor's only restriction is that you can only obtain new data from it once every two seconds.

d) MQ 135 Gas Sensors

A device that is used to detect or measure or monitor the gases like ammonia, benzene, sulfur, carbon dioxide, smoke, and other harmful gases are called as an air quality gas sensor. The MQ135 air quality sensor, which belongs to the series of MQ gas sensors, is widely used to detect harmful gases, and smoke in the fresh air. It operates at a 5V supply with 150mA consumption. Preheating of 20 seconds is required before the operation, to obtain the accurate output.

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e) Tilt Sensor

A tilt sensor has a metallic ball that is designed to move the two pins of the instrument from the 'on' to the 'off' position, and vice versa, if the sensor reaches a pre-determined angle. Tilt sensors are the environment-friendly version of a mercury switch.

Tilt sensors are devices that produce an electrical signal that varies with an angular movement. These sensors are used to measure slope and tilt within a limited range of motion. Sometimes, the tilt sensors are referred to as inclinometers because the sensors just generate a signal but inclinometers generate both readout and a signal.

f) LCD (Liquid Crystal Display)

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons:

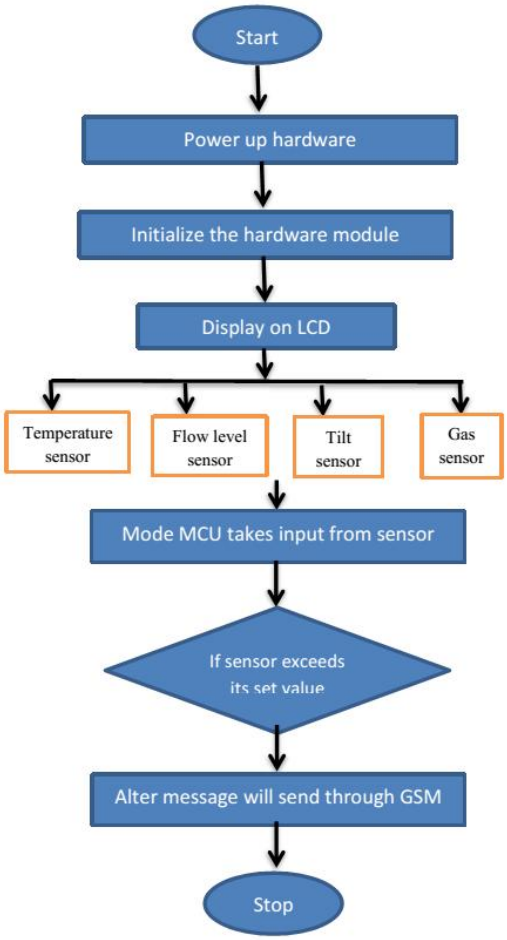
- The declining prices of LCDs.
- The ability to display numbers, characters and graphics.

This is in contrast to LEDs, which are limited to numbers and a few characters.

g) GSM Module

SIM800L GSM Module is the module that supports communication in 800MHz band. We are from India and most of the mobile network providers in this country operate in the 800 MHz band. If you are from another country, you have to check the mobile network band in your area. A majority of United States mobile networks operate in 850 MHz bands (the band is either 850 MHz or 1900 MHz). Canada operates primarily in the 1900 MHz band.

III. METHODOLOGY



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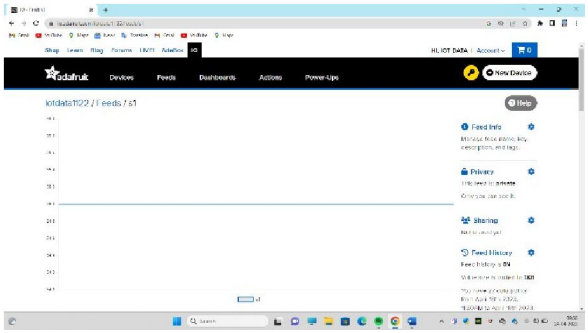
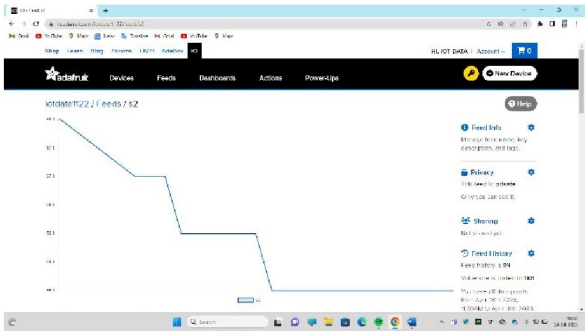
In our project, we have overcome these drawbacks by creating an edge network instead of the internet. We have constructed the manhole detection system by attaching an array of sensors like tilt sensor, gas sensor, float sensor, temperature sensor, etc., and ESP8266 with this system.

These sensors are further connected to the Arduino NANO which acts as the microcontroller. It helps to read the sensors accurately and pass the information to the NodeMCU (ESP8266). We have programmed this ESP8266 as an access point that provides its own network without the internet. If the user is present in this area, the manhole detection system automatically sends the sensor's data to the user via web or mobile alert messages without the internet and stores the information according to time basis in the IoT module. Even if a small change is detected then the system alerts the nearby person by a buzzer sound, sends an SMS to the authorized number, and stores the data on a timeline basis in the module.

The following are some key advantages of the proposed method: In this proposed method, there is no need to spend the cost on the internet. The whole system is working like a local network by edge computing. The user can use any device to get updates from the system. Not limited to use only registered devices. The user doesn't need to have internet access in his device to get updates from this manhole detection system.

IV. RESULTS AND DISCUSSION





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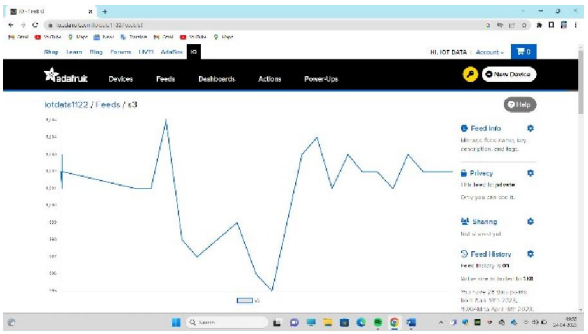

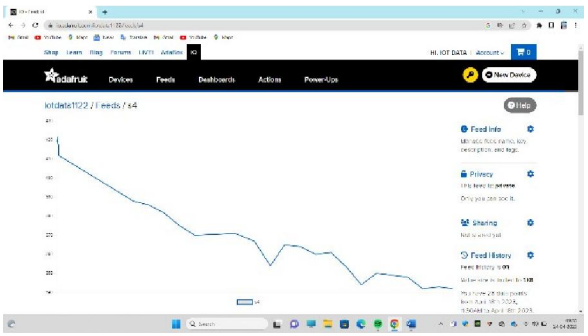

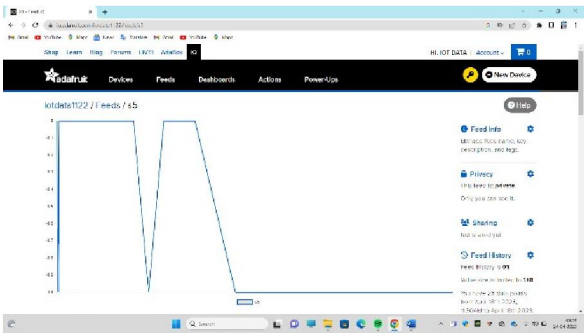

V. CONCLUSION

Underground monitoring is a challenging problem. This project proposes different methods for monitoring and managing underground drainage system. It explains various applications like underground drainage and manhole identification in real time. Various parameters like temperature, toxic gases, flow and the level of water is being monitored and updated on the internet using the Internet of Things

This enables the person in-charge to take the necessary actions regarding the same. In this way the unnecessary trips on the manholes are saved and can only be conducted as and when required. Also, real time update on the internet helps in maintaining the regularity in drainage check thus avoids the hazards.

Conflict of interest: Authors declare no competing interest.

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