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Sewer Hole Monitoring System

K Murali , U. Jagadeesh , V. Vignesh Ashik , S. Jagadeesh , U. Sunny Kumar

Department of Electronics and Communication Engineering, Narayana Engineering College, Nellore, Andhra Pradesh, India

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ABSTRACT

The issue of poor sanitation and inadequate sewage management has been a significant concern in many cities, leading to serious health problems and diseases. In response to this challenge, the Sewer Hole Monitoring System has been developed as an innovative and efficient solution to address these problems. The system aims to manage the manholes in cities by monitoring the water level, Sewer hole lid, and toxic gases. The project's primary objective is to provide a safe and effective way to manage sewer holes, which are often in a degraded state. The system uses sensors to detect blockages, overflow of sewage water, and the opening of manhole lids. Once detected, this data is transmitted to the corresponding managing station via a transmitter located in the area. By monitoring the sewer holes in this way, the system can alert the authorities to any issues that require attention, such as the need for cleaning or repairs. This helps to prevent the spread of diseases caused by poor sanitation and promotes a clean and healthy environment in the cities. In conclusion, the Sewer Hole Monitoring System is a crucial step towards ensuring good hygiene and sanitation in cities. The system's innovative design and efficient functioning provide a safe and reliable solution for managing the sewage system and help to prevent health problems caused by poor sanitation.

KEYWORDS: Sewer Hole Monitoring System, Sanitation, Sensors, Water Level

1. INTRODUCTION

Sewage system plays a very important role in big city where millions of people live. Sewage system in known as the base for and dryness from the excess and unused water, rain water and waste water. Monitoring of drainage manually is not possible. The irregular monitoring has contribution on the blocking of the drainage that imply to the salutation which trigger flooding in the neighborhoods manual monitoring is also incompetent. It needs a lot of dedicated persons who are only able to record limited report with low accuracy. The problem arises in such drainage lines can cause serious issues to the daily routing of the city. Problem such as blockage due to waste material, sudden increase in the water level as well as various harmful gases can be produced if the proper cleaning actions are not taken time to time.

Today's Drainage system is not computerized due to which it is hard to identify if blockage has occurred location. Also, sometimes due to the waste in those drainage lines can produce various gases like methane(CH4), carbon monoxide(CO), etc. which are harmful and can cause serious problem if inhaled by humans in large amount and these faced by the drainage workers which leads to loss of life. Also, there won't be any early alert of the blockage of rise in amount of those gases or

the increases in the water level. Hence detection and repairing of the blockage becomes time consuming and hectic. There are Realtime examples through which can do analysis of lack of Sewage system. In 2019 in Bangalore roads, drains and even houses in some areas were flooded, causing tremendous inconvenience to moment unprecedented growth of the unprecedented growth of Bangalore unaccompanied by the necessary infrastructure has participated problem of a large magnitude.

So, the 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.

2. LITERATURE SURVEY

Muragesh S. K1 and Santhosh Rao [1] proposed a model that provides a system for monitoring the water level and atmospheric temperature and pressure inside a manhole and to check whether a manhole lid is open. It also monitors underground installed electric power lines. 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. The Internet of Things (IoT) consists of real-life objects, communication devices attached to sensor networks in order to provide communication and automated actions between real world and information world. IoT came into existence because, without human interaction, computers were able to access data from objects and devices, but it was aimed at, to overcome the limiting factors of human entered data, and to achieve cost, accuracy, and generality factors. Sensor Network is a key enabler for IoT paradigm. It represents the implementation and design function of an Underground Drainage and Manhole Monitoring System (UDMS) for IoT applications.

Prof.S A. Shaikh 1, Suvarna A. Sonawane [2] proposed the system for the Smart cities for the development goal to monitor the quality of resource in the city to improve good management and faster development of the city required necessity is to upgrade healthy and safe cities that delivering real time services and latest facility to implement the concept of smart city use IoT concept by which easy wireless communication is possible. Different type of data is collected from the sensors and transferred to Raspberry Pi3 Controller in the system. The acquired output from the controller is sent to the control room through the E-mail and display on the personal computer.

Yash Narale, Apurva Jogal, Himani Chaudhari, S.P Bhosale [3] introduced the underground drainage monitoring system that will not only help in maintaining the proper health and safety of the city but additionally in reducing the work of government personnel numerous varieties of sensors (flow, level, temperature, and gas sensors) are interfaced with microcontroller ARM7 so as to form the system smart. Once the various sensors reach the threshold level, the indication of that respective worth and sensor is being sent to the microcontroller. Furthermore, ARM7 then sends the signal and location of the manhole to the municipal corporation through GSM and GPS and the officials could easily locate which manhole is having the problem and could take appropriate step.

G. Gowthaman, K. Hari Haran proposed [4] system to simply monitoring the level, it generates alarm signals via complaints to the required departments through mail and SMS regarding prior to overflow.

MS T. Deepiga [5] introduced the Smart water monitoring system using wireless sensor network. The system consists of a sensible sensing unit that detects and controls the home electrical appliances used for daily activities by following totally different tariff rates.

3. METHODOLOGY

As most of the cities in India have adopted Sewerhole monitoring system, it is very important that this system should work in a proper manner to keep the city clean, safe and healthy. If It fail to maintain the drainage system the pure water may get contaminated with drainage water and can spread infectious diseases. So different kind of work has been done to detect, maintain and manage these underground systems.

Also, leaks and bursts are unavoidable aspects of water distribution system management and can account for significant water loss within a distribution network if left undetected for long period. This project represents the implementation and design functions 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.

In this system ultrasonic sensor, gas sensor, temperature sensor, tilt sensor and flow rate sensor are used. All these sensors are interfaced with Arduino UNO. Based on the sensor parameters an alert or message will be sent to the authorized person. Ultrasonic sensor is used to detect the overflow of water from drainage. Gas sensor will detect any harmful gas leakage from underground pipelines.

Tilt sensor is used to detect whether lid on manhole is open or not. If any one of the above sensors detects abnormality, a message will be sent to the authorized person with the location where problem occurred. And all these sensor values are updated in the webpage by using Wi-Fi module. There are numerous benefits to using embedded systems in various applications. One of the key advantages of embedded systems is their ability to perform specific tasks with a high degree of efficiency and reliability. Because these systems are designed for a specific purpose, it can be optimized to deliver the required functionality using minimal resources. This makes them ideal for applications that require real-time performance, low power consumption, and small form factors.

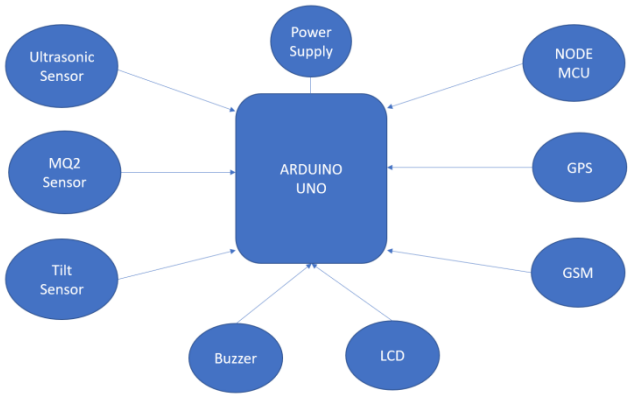

Fig 1: Block Diagram of Proposed Model

4. HARDWARE REQUIREMENTS

A. ARDUINO UNO BOARD:

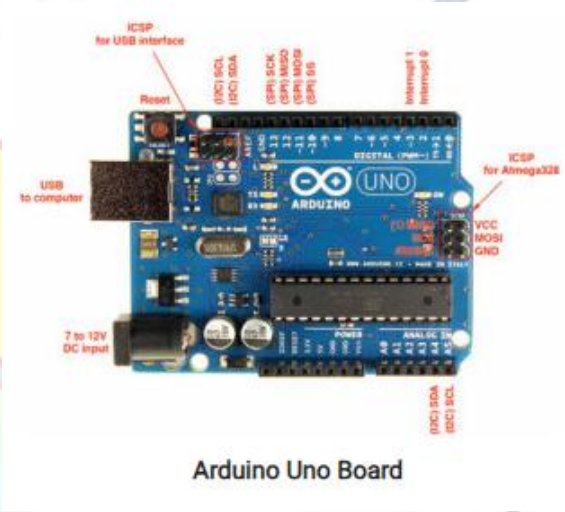

Fig 2: ARDUINO UNO BOARD

Arduino Uno is an open-source microcontroller board based on the ATmega328P microcontroller. It is a popular choice for beginners and advanced users alike due to its simplicity and versatility. The board has 14 digital input/output pins, 6 analog input pins, a 16 MHz quartz crystal, a USB connection, and a power jack. These features make it easy to control various devices, including sensors, motors, and lights. The board can be programmed using the Arduino Integrated Development Environment (IDE), which is a simple and user-friendly programming environment.

One of the biggest advantages of the Arduino Uno is its versatility. It can be used for a wide range of applications, from robotics to home automation to art installations. It is also highly expandable, thanks to many compatible shields and modules. Shields are

add-on boards that provide additional functionality, such as wireless communication, display, and motor control. Modules are smaller boards that can be connected directly to the Uno to add specific features, such as Bluetooth or GPS. In addition, the Arduino community is very active, and there are many tutorials and examples available online to help users get started and explore the possibilities of the board.

B. LIQUID CRYSTAL DISPLAY:

A 16x2 LCD display is a common type of alphanumeric display that can display 16 characters in each of its 2 rows. The display uses a matrix of 16x2 dots to form each character, with each dot representing a pixel. The display is commonly used in various electronic devices such as calculators, digital clocks, and small embedded systems. The LCD display is controlled by a microcontroller using a set of pins that connect to the display. These pins include the data pins, which are used to send the characters to the display, and control pins, which are used to control the display's various functions such as clearing the display, setting the cursor position, and turning on/off the backlight.

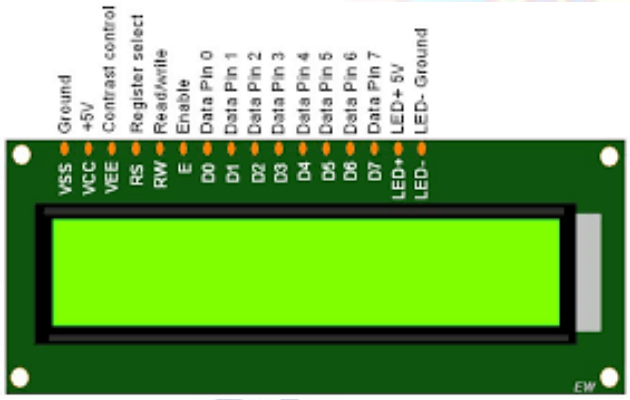

Fig 3: 16 x 2 LCD Display

The 16x2 LCD display is simple to use and provides an inexpensive way to display alphanumeric characters in various projects. It has a low power consumption and is easy to interface with various microcontrollers, making it a popular choice among hobbyists and electronics enthusiasts. Additionally, the display is available in various colors and can be customized to suit the requirements of different projects. However, it is important to note that the display has limited functionality and cannot display graphics or images.

C. NodeMCU:

NodeMCU is an open-source platform based on the ESP8266 System-on-a-Chip (SoC) that provides Wi-Fi connectivity. It is essentially a microcontroller that can be programmed using the Lua programming language or the Arduino Integrated Development Environment (IDE) to perform various tasks such as controlling electronic components, collecting data from sensors, and communicating with other devices over Wi-Fi. NodeMCU is a compact and cost-effective solution for Internet of Things (IoT) projects that require wireless connectivity.

NodeMCU offers a wide range of features that make it a popular choice for IoT projects. It has a built-in Wi-Fi module that supports the 802.11 b/g/n wireless standards and can operate in both client and access point modes. It also has a 32-bit microcontroller with 4MB of flash memory that can run at up to 80MHz, providing plenty of processing power for most applications. Additionally, NodeMCU has a USB interface for programming and power supply, making it easy to connect to a computer and start developing projects.

Fig 4: NodeMCU

D. Global System for Mobile Communications:

Fig 5: GPS Module

GSM stands for Global System for Mobile Communications. It is a standard for digital cellular networks used for voice and data communication. GSM technology is widely used in mobile phones and is also used in many other applications, including remote monitoring and control systems such as Sewerhole monitoring systems.

A Sewerhole monitoring system uses sensors placed in Sewerhole to monitor various parameters such as water level, temperature, and flow rate. These sensors collect data and transmit it to a central control unit, which processes the data and makes decisions based on it. In order to transmit this data, the system needs a communication channel. This is where GSM comes in.

GSM provides a wireless communication channel between the sensors and the central control unit. The sensors use GSM modules to transmit data to the control unit over the GSM network. The data is transmitted in the form of SMS messages or through a GPRS connection, depending on the configuration of the system. GSM technology is ideal for Sewerhole monitoring systems because it provides reliable and secure communication over long distances. The system can be configured to send alerts to the control unit if any parameters exceed predefined thresholds. This allows the control unit to take corrective action quickly, minimizing the risk of damage to the sewer system or the environment.

E. Global Positioning System:

GPS, or Global Positioning System, is a satellite-based navigation system that can provide location and time information in all weather conditions and at anytime, anywhere on or near the Earth's surface.

Fig 6: GPS Module

In a SEWERHOLE MONITORING SYSTEM, GPS can be used to track the location of the monitoring device or sensor that is placed inside the sewer pipes. The GPS receiver in the device can obtain signals from multiple GPS satellites to determine its precise location, which can then be transmitted to a central control unit or a data logging system.

This location data can be used to map the sewer system and monitor the movement of the monitoring device as it flows through the pipes. The data collected from the device can help identify problem areas in the sewer system, such as blockages or leaks, and enable quick and efficient repairs before they cause more significant problems.

GPS receivers are generally used in smartphones, fleet management system, military etc. for tracking or finding location. Global Positioning System (GPS) is a satellite-based system that uses satellites and ground stations to measure and compute its position on Earth. GPS is also known as Navigation System with Time and Ranging (NAVSTAR) GPS. GPS receiver needs to receive data from at least 4 satellites for accuracy purpose. GPS receiver does not transmit any information to the satellites.

GPS receiver uses a constellation of satellites and ground stations to calculate accurate location wherever it is located. These GPS satellites transmit information signal over radio frequency (1.1 to 1.5 GHz) to the receiver. With the help of this received information, a ground station or GPS module can compute its position and time.

F. Ultrasonic Sensor

An ultrasonic sensor is a type of sensor that uses sound waves with frequencies above the upper audible limit of human hearing, typically around 40 kHz, to detect and measure distance to objects. Ultrasonic sensors are commonly used in various applications such as obstacle detection, distance measurement, and object detection.

One of the applications of ultrasonic sensors is in sewer hole monitoring systems. Sewer systems are an essential part of infrastructure, and their proper

maintenance is critical to public health and safety. Ultrasonic sensors can be used to monitor the level of sewage in sewer holes and provide early warning of potential overflow, allowing maintenance teams to take timely action and prevent costly damage and health hazards. Ultrasonic sensors are preferred in this application because they are non-contact sensors and do not get affected by the properties of sewage, such as color and turbidity, which can affect other types of sensors.

Fig 7: Ultrasonic Sensor

G. Tilt Sensor:

Fig 8: Tilt sensor

Tilt sensors, also known as inclinometers, are devices that measure the angle of inclination or tilt of an object relative to the force of gravity. They typically use accelerometers or gyroscopes to detect changes in orientation and provide feedback on the degree of tilt. Tilt sensors have a wide range of applications, including in robotics, construction, aviation, and gaming. In robotics, tilt sensors are used to detect changes in orientation and adjust the position of a robot arm or other moving parts. In construction, they can be used to monitor the stability of buildings or other structures. Tilt sensors are also used in aviation to measure the pitch and roll of aircraft, and in gaming to provide motion control in devices such as Nintendo Wii controllers.

Tilt sensors are commonly used in sewer hole monitoring systems. They work by measuring the angle of inclination or tilt of an object relative to the force of gravity. In the context of a sewer hole monitoring system, a tilt sensor can be used to detect changes in the angle of the sewer hole due to factors such as settling, erosion, or movement of the ground. This information can then be used to alert maintenance crews to potential issues or hazards in the sewer system. Unlike ultrasonic sensors, which use sound waves to detect objects, tilt sensors rely on the physical orientation of the sensor itself to provide data on the angle of the object being monitored.

H. MQ2 Sensor:

The MQ2 sensor is a gas sensor that detects various gases, including smoke, propane, methane, and alcohol. While it is not typically used for measuring distance like the ultrasonic sensor, it has a range of applications in detecting the presence of gases in different environments.

Fig 9: MQ2 Sensor

One potential use of the MQ2 sensor is in a sewer hole monitoring system. Sewer holes or manholes are essential components of sewage systems, but they can also be hazardous for workers who need to enter them for maintenance or repair. Toxic gases can accumulate in these confined spaces, leading to serious health risks for workers. By installing MQ2 sensors in the sewer holes, the system can continuously monitor the air quality.

5. RESULT

This System will provide a range of benefits, including:

A. Accurate measurement of wastewater levels: Tilt and ultrasonic sensors can be used to measure the level of wastewater in the sewer hole accurately. This information can be used to optimize the flow of wastewater through the system and prevent overflows.

B. Detection of blockages and clogs: By monitoring the flow of wastewater through the system, the

sensors can detect any blockages or clogs that may occur. This information can be used to alert maintenance personnel and prevent backups and overflows.

C. Monitoring of air quality: MQ2 sensors can be used to monitor the air quality in the sewer hole, detecting the presence of harmful gases such as carbon monoxide, methane, and other volatile organic compounds. This information can be used to ensure the safety of workers who may need to access the sewer system.

D. Real-time data analysis: The data collected by the sensors can be analyzed in real-time using advanced algorithms and machine learning techniques. This can help to identify patterns and trends in the data.

Fig 10 : LCD Showing GPS Location

Fig 11: LCD Showing Sensor Values

The LCD Display will show the Sensors value and the GPS location which will help the government employees or the authorized person to locate the Sewerhole which underwent changes.

ThingSpeak is an IoT platform that allows users to collect, analyze, and act on data from sensors and other devices. If you are using ThingSpeak to monitor your sewerhole monitoring system, you can make various changes to your account to improve your system's performance and functionality.

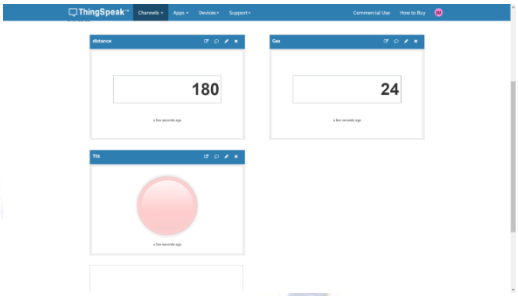

Fig 12: Thingspeak Account

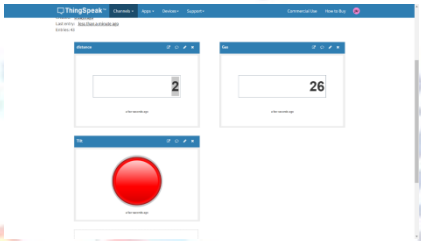

Fig 13: Changes in Thingspeak Account

6. CONCLUSION

A sewer hole monitoring system is an important tool for maintaining the safety and efficiency of a sewer system. By using a combination of sensors, including tilt sensors, pressure sensors, and flow sensors, the system can detect and alert to potential issues such as blockages, leaks, and security breaches.

The data collected by the monitoring system can be used to improve maintenance schedules, optimize flow rates, and prevent accidents. Additionally, the system can provide real-time information to operators, allowing for quick response times to any issues that arise.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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