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Underground Water Supply Lines Monitoring System Using-IOT

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ABSTRACT: This paper presents an IoT-based Underground Water Supply Monitoring System designed to optimize water infrastructure management. The system incorporates multiple sensors, including two flow sensors at the system's start and end points, a temperature sensor, and a turbidity sensor, all interfaced with a PIC microcontroller (PIC-16F877). The collected data is transmitted through a GPRS (IoT) module, enabling real-time remote monitoring and control. The two flow sensors play a critical role in measuring the flow rates at the system's initiation and termination points. By continuously monitoring water flow, the system can promptly identify and address leaks, blockages, or irregularities in the network, contributing to efficient resource utilization. Deviations from the expected temperature range can indicate potential issues such as contamination or degradation of the pipe material, enabling proactive maintenance and safeguarding water quality. The inclusion of a turbidity sensor allows for the assessment of water clarity, providing insights into overall water quality. The PIC microcontroller serves as the central processing unit, collecting and analyzing data from the sensors. The GPRS module facilitates seamless communication with a remote server, enabling stakeholders to monitor the system in real-time. An integrated alarm system provides immediate notifications in the event of anomalies, while a local LCD display offers on-site information, ensuring a swift response to any detected issues. This IoT-based monitoring system offers a comprehensive solution for efficient water resource management, providing real-time insights into the underground water supply network to minimize water wastage, contamination risks, and infrastructure damage.... The management and conservation of water resources have become paramount due to increasing global demands and the challenges posed by climate change. Underground water supply systems play a crucial role in providing.

This abstract presents an innovative Underground Water Supply Lines Monitoring System (UWSLMS) leveraging the Internet of Things (IoT) technology to address these challenges.

I. INTRODUCTION

Water is a finite and vital resource essential for sustaining life, agriculture, and industrial activities. Efficient management of water resources is paramount to ensure sustainable development and meet the increasing demands of a growing population. In this context, the focus on underground water supply and drainage systems is crucial due to their widespread use and significance in urban and rural settings. The effective monitoring of these systems is essential to prevent water wastage, address potential contamination issues, and ensure the longevity of the infrastructure. The Underground Water Supply Lines Monitoring System utilizing Internet of Things (IoT) technology represents a groundbreaking approach to managing and safeguarding our critical water infrastructure. As urbanization accelerates and water scarcity becomes an increasingly pressing global issue, the need for efficient and reliable water supply systems is paramount. This innovative system aims to address these challenges by providing real-time monitoring and intelligent management of underground water supply networks. At its core, the system employs a network of IoT-enabled sensors strategically embedded along the underground water pipelines. These sensors are equipped with various capabilities, including pressure, flow rate, and temperature monitoring. By leveraging IoT connectivity, the system enables swift identification of these problems, minimizing water wastage and preventing potential infrastructure damage moreover. An Underground Water Supply Lines Monitoring System using Internet of Things (IoT) technology represents a significant advancement in the management and conservation of water resources. Water is a vital natural resource essential for various human activities, and its efficient utilization and conservation are paramount. Traditional methods of monitoring underground water supply lines often involve manual inspections, which are time-consuming,

labor-intensive, and prone to errors.

The IoT-based monitoring system revolutionizes this process by integrating sensors, communication devices, and data analytics capabilities. These sensors are deployed along the underground water supply lines to continuously monitor various parameters such as water flow rate, pressure, temperature, and water quality in real-time. The collected data is transmitted wirelessly to a central server or cloud-based platform where it is analyzed and interpreted.

This real-time monitoring and analysis enable early detection of leaks, bursts, or other anomalies in the water supply lines, facilitating prompt intervention and repair. Additionally, the system provides valuable insights into the usage patterns and trends, aiding in the optimization of water distribution and conservation efforts. Overall, the Underground Water Supply Lines Monitoring System using IoT technology offers a cost-effective, efficient, and sustainable solution for ensuring the reliable and efficient supply of water while minimizing wastage and environmental impact.

II. AREA OF INTEREST

Our area of interest lies in developing a sophisticated Underground Water Supply and Drainage Monitoring System using Internet of Things (IoT) technology. The system integrates various sensors to capture essential parameters, such as flow rates, temperature, and turbidity, providing a comprehensive view of the water infrastructure's health. By concentrating on underground systems, we aim to address the challenges associated with these concealed networks, ensuring their resilience and sustainability. The implementation of an Underground Water Supply Lines Monitoring System using IoT (Internet of Things) presents a crucial advancement in water management, ensuring efficient resource utilization and minimizing environmental impact. In urban and rural areas alike, water supply networks often extend beneath the surface, making real-time monitoring challenging. The integration of IoT technology into water supply systems revolutionizes traditional methods by providing continuous, remote monitoring capabilities. Sensors embedded in the underground pipelines gather data on water flow, pressure, and temperature. This information is then transmitted wirelessly to a centralized control system, enabling authorities to monitor the system's status in real time. The IoT-enabled monitoring system offers several advantages.

III. OBJECTIVES OF THE PROJECT

The primary objective is to enhance the efficiency of water resource management by implementing a real-time monitoring system. This involves accurately measuring the flow rates at the initiation and termination points of the underground network to identify and rectify leaks or blockages promptly. Ensuring water quality is a critical goal. The integration of sensors, particularly a turbidity sensor, allows for continuous assessment of water clarity. Timely detection of impurities or suspended particles supports quick decision-making for water treatment processes, safeguarding public health. Leveraging IoT technology, the system facilitates remote monitoring and control. This objective aims to provide water utility managers, authorities, and relevant stakeholders with real-time insights into the status of the underground water supply and drainage network, enabling swift response to emerging issues. The system is designed to enable predictive and preventive maintenance. By continuously monitoring the temperature of the water within the pipes, potential risks such as contamination or material degradation can be identified early, allowing for proactive maintenance measures. In summary, our project addresses the critical need for advanced monitoring in the domain of underground water supply and drainage systems. The proposed IoT-based solution aims to contribute to efficient water resource management, ensuring sustainability, and minimizing the environmental and economic impact of water-related challenges.

IV. PROPOSED SYSTEM

Our proposed Underground Water Supply and Drainage Monitoring System integrates cutting-edge technology to create a robust and intelligent infrastructure for efficient water resource management. The system incorporates a variety of sensors and a PIC microcontroller (PIC-16F877), providing a comprehensive solution to address the challenges associated with underground water networks.

1) Sensor Integration: The system incorporates two flow sensors positioned strategically at the start and end points of the underground network. These sensors continuously measure flow rates, enabling the early detection of leaks, blockages, or irregularities in the water supply and drainage system. Additionally, a temperature sensor monitors the water temperature within the pipes, while a turbidity sensor assesses water clarity, providing crucial insights into water

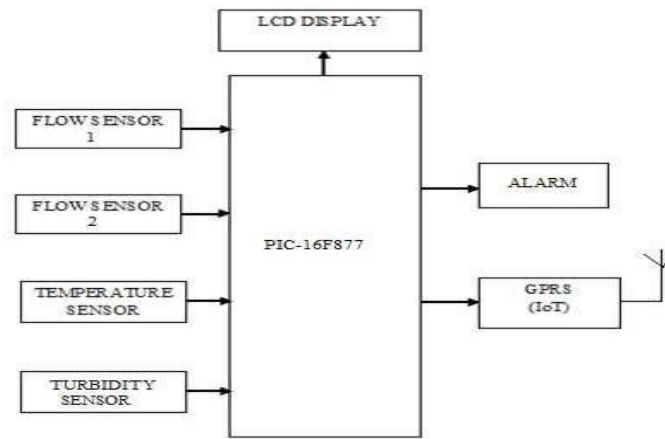


quality.

2) Microcontroller Processing: A PIC microcontroller (PIC-16F877) serves as the central processing unit, collecting, processing, and analyzing data from the integrated sensors. This microcontroller plays a pivotal role in ensuring real-time decision-making and control over the monitoring system.

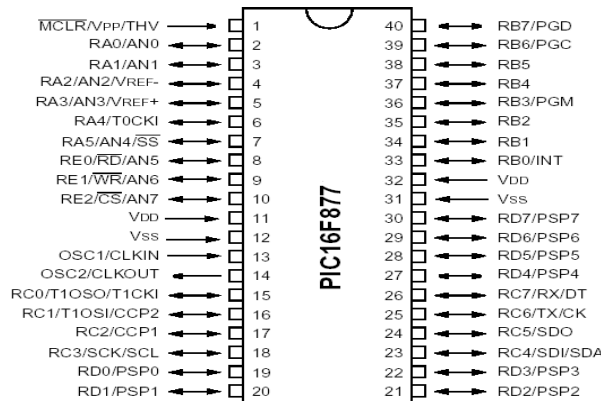
3) Communication via GPRS (IoT): The system leverages the Global System for Mobile Communications (GSM) network through a GPRS module, establishing an Internet of Things (IoT) connection. This enables the seamless transfer of sensor data to a remote server, allowing stakeholders to monitor the water supply and drainage network in real-time. Remote monitoring ensures prompt responses to any anomalies detected within the system.

4) Alarm System and Local Display: To enhance responsiveness, an alarm system is integrated to provide immediate notifications in the event of abnormal conditions such as leaks, high turbidity, or extreme temperature variations. Simultaneously, a local LCD display provides on-site information about the current status of the water infrastructure, allowing personnel to quickly assess the situation without remote access.



- This proposed system aims to revolutionize the management of underground water supply and drainage networks by offering a comprehensive and technologically advanced solution.
- Through the integration of sensors, microcontrollers, and IoT connectivity, the system provides real-time insights, enabling efficient resource utilization, timely preventive maintenance, and enhanced overall sustainability of water infrastructure.

Block diagram of Proposed Method.



Pin Diagram Of PIC 16F877

Hardware Requirements

Pin Diagram Of PIC 16F877 MICRO CONTROLLER:

An underground water supply lines monitoring system utilizing the Internet of Things (IoT) and the PIC 16F877 microcontroller offers a sophisticated solution for efficient water management. This system integrates sensor technology, communication protocols, and microcontroller intelligence to enable real-time monitoring and control of underground water infrastructure. The PIC 16F877 microcontroller serves as the brain of the system, orchestrating the collection and processing of data from various sensors. These sensors, strategically placed along the water supply lines, measure parameters such as water flow, pressure, and temperature. The microcontroller then analyzes this data to gain insights into the status of the water distribution network. IoT connectivity plays a pivotal role in this system, enabling seamless communication between the underground sensors and a central monitoring station. Wireless communication protocols like MQTT or HTTP are implemented to transmit data securely and efficiently. This real-time data transmission allows authorities or system administrators to receive instant updates on the water supply network's performance. One of the key advantages of this monitoring system is its ability to detect leaks or anomalies in the water infrastructure. Anomalies such as sudden drops in pressure or irregular flow patterns trigger alerts, enabling swift response to potential issues. This proactive approach not only aids in minimizing water loss but also contributes to the conservation of this precious resource.

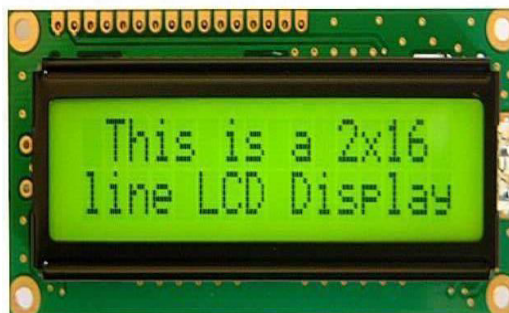
LCD Display:

Materials used in liquid crystal displays (LCDs) combine the characteristics of crystals and fluid. Instead of having a melting point, they have a range of temperatures where the molecules are nearly as mobile as they would be in a liquid yet are arranged in a crystal-like structure. An LCD is made up of two glass panels separated by a liquid crystal substance called sand. Transparent electrodes are coated on the inside of the glass plates to define the patterns, symbols, or characters that are to be displayed. Polymeric layers are sandwiched between the electrodes and the liquid crystal to keep the molecules of the liquid crystal at a specific orientation angle.

Outside the two glass panels are pasted one polariser per panel. The light beams traveling through these polarizers would be rotated to a specific angle and in a specific direction. The two polarisers and the liquid crystal twist light beams when the LCD is turned off, giving the impression that the LCD is transparent because the light rays exit the device without any orientation. The liquid crystal molecules would align themselves in a particular way when the electrodes were subjected to a enough voltage.

The polarisers would spin the light beams going through the LCD, activating and emphasizing the desired characters as a result. The LCDs are thin, only a few millimeters thick, and lightweight.

The LCDs are compatible since they use less electricity. Reading in the dark is made feasible by backlighting. The LCDs have a broad working temperature range and a long lifespan. LCDs are more user-friendly because it is relatively easy to change the layout or display. As a result, LCDs are widely utilized in electronics for entertainment and telecommunication. Even in modest TV applications, LCDs have begun to replace cathode ray tubes (CRTs), which were formerly utilized for text and graphic display.



LCD Display

TEMPERATURE SENSOR:

A thermistor is a type of resistor whose resistance varies with temperature. The word is a portmanteau of thermal and

resistor. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting over current protectors, and self-regulating heating elements. Thermistors differ from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a higher precision within a limited temperature range [usually $-90\text{ }^{\circ}\text{C}$ to $130\text{ }^{\circ}\text{C}$]. Assuming, as a first-order approximation, that the relationship between resistance and temperature is linear, then:

ΔR = change in resistance ΔT = change in temperature

k = first-order temperature coefficient of resistance



TEMPERATURE SENSOR

FLOW SENSOR:

Flow sensors are integral devices utilized across various industries to measure and monitor the flow rates of liquids or gases within systems. They operate based on diverse principles, including mechanical, thermal, ultrasonic, and electromagnetic, each tailored to specific application requirements. Mechanical flow sensors employ moving parts or obstructions to gauge flow rates, while thermal sensors calculate flow rates through heat transfer measurements. These versatile sensors find applications in industrial processes, environmental monitoring,



FLOW SENSOR

TURBIDITY SENSOR:

A turbidity sensor is a critical instrument used to measure and assess the cloudiness or haziness of a fluid, typically water. It operates on the principle that as water becomes contaminated with suspended particles, such as sediment, silt, organic matter, or microorganisms, it scatters light, causing the fluid to appear turbid.

Turbidity is an essential parameter in water quality monitoring and environmental assessment because it serves as an indicator of water clarity and the presence of impurities. Turbidity sensors use a light source, often an LED, to emit light into the water sample. Photodetectors or photodiodes then measure the intensity of the light that passes through the fluid. The amount of light scattered or absorbed by the suspended particles in the water is directly proportional to the turbidity of the sample. The sensor translates this information into a turbidity value, typically measured in

- Nephelometric turbidity units (NTU)
- Formazin nephelometric units (FNU)



TURBIDITY SENSOR

ALARM:

A buzzer or beeper is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise). Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm speaker. Nowadays, it is more popular to use a ceramic-based piezoelectric sounder like a Sonalert which makes a high-pitched tone. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.



ALARM

INTERNET OF THINGS (IOT):

The Internet of things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect, collect and exchange data. IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, smart phones and tablets, to any range of traditionally dumb or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled. With the arrival of driverless vehicles, a branch of IoT, i.e. the Internet of Vehicle starts to gain more attention.



INTERNET OF THINGS (IOT)

Power supply:

Batteries or solar panels to power the sensors and microcontrollers.

A relay module: The relay module is the actual device that switches the circuit on and off.

Power supply: The relay module and microcontroller will need a power supply to operate. circuit for audio communication. Comprehending certain technologies and their settings is therefore quite.

ARDUINO UNO:

The Arduino Uno is a popular microcontroller board based on the ATmega328P chip. Designed for hobbyists, students, and professionals alike, it offers a user-friendly platform for creating interactive electronic projects. The board features 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection for programming, and a power jack. It operates at 5 volts and can be powered via USB or an external power supply. The Uno is compatible with a wide range of sensors, actuators, and other electronic components, making it versatile for various applications such as robotics, home automation, and wearable technology. Programming the Arduino Uno is done using the Arduino IDE, which utilizes a simplified version of C/C++ language. With its open-source nature and extensive community support, the Arduino Uno remains a cornerstone in the world of embedded electronics and prototyping .



ARDUINO UNO

Software Requirements

1 MP LAB

MPLAB IDE is an integrated development environment that provides development engineers with the flexibility to develop and debug firmware for various Microchip devices. MPLAB IDE is a Windows-based Integrated Development Environment for the Microchip Technology Incorporated PIC microcontroller (MCU) and dsPIC digital signal controller (DSC) families. In the MPLAB IDE, you can. Create source code using the built-in editor assemble, compile and link source code using various language tools. An assembler, linker and librarian come with MPLAB IDE. C compilers are available from Microchip and other third party vendors.

Debug the executable logic by watching program flow with a simulator, such as MPLAB SIM, or in real time with an

emulator, such as MPLAB ICE. Third party emulators that work with MPLAB IDE are also available make timing measurements view variables in Watch windows. Program firmware into devices with programmers such as PICSTART Plus or PRO MATE II. Find quick answers to questions from the MPLAB IDE on-line Help.

Android Studio

Many testing tools and frameworks are available in Android Studio. It is NDK and C++ compatible. It offers Google Cloud Platform built-in support. It simplifies the process of integrating App Engine and Google CloudMessaging. With its inline debugging and performance analysis capabilities, Android Studio aids in debugging and code performance optimization. Developed exclusively for Android development, Android Studio is the official integrated development environment (IDE) for Google's Android operating system. It is based on JetBrains' IntelliJ IDEA software. Linux, macOS, and Windows-based operating systems can all get it. It serves as the main IDE for developing native Android applications in place of the Eclipse Android Development Tools (E-ADT).

The most recent stable version comes with the following features:

- Support for builds built on gradle.
- Fast fixes and refactoring tailored to Android. Lint tools to detect issues with usability, performance, compatibility between versions, and other issues.
- The ability to integrate ProGuard and sign appstemplates-based wizards to generate standard Android components and designs.
- A feature-rich layout designer that lets users examine layouts on different screen configurations and drag and drop UI components.
- Assistance in developing apps for Android Wear.
- Integrated support for Google Cloud Platform, allowing for Google App Engine and Firebase Cloud Messaging (formerly known as "Google Cloud Messaging") connection.
- Using the Android Studio, you may run and debug apps on an emulator.

With extensions like Go, Android Studio supports all the programming languages supported by IntelliJ (and CLion), including Java, C++, and more. Additionally, software versions

3.0 and higher support Kotlin in addition to "all Java 7 language features and a subset of Java 8 language features that vary by platform version." Certain aspects of Java 9 are backported by external projects. It's unclear to what extent Android Studio supports Java versions up to Java 12 (the documentation says incomplete Java 8 support), despite IntelliJ's claim that Android Studio supports all available Java versions, including Java 12. Android can utilize a minimum of a few new language features up to Java 12. After being compiled using Android Studio, an app can be released on the Google PlayStore. The application must adhere to the developer content guideline set forth by the Google Play Store.

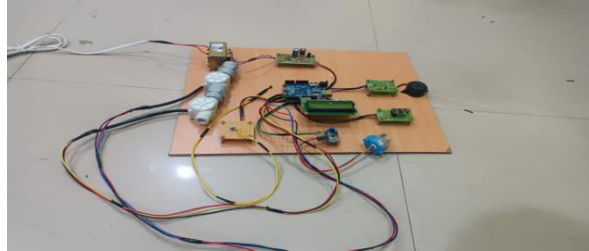
V. RESULT

The implementation of an underground water supply lines monitoring system leveraging IoT technology yields significant benefits. By integrating IOT sensors along the water supply lines, real-time data on water flow, pressure, and quality can be continuously monitored and analyzed.

This data provides insights into potential leaks, bursts, or contamination events, allowing for proactive maintenance and rapid response to issues. Furthermore, IOT-enabled monitoring systems offer remote accessibility, enabling water utility operators to monitor the system from anywhere, at any time. • This enhances operational efficiency, reduces manual inspection costs, and minimizes the risk of undetected water loss or contamination. Moreover, the predictive analytics capabilities of such a system can forecast maintenance needs, optimize resource allocation, and prevent costly infrastructure failures

VI. CONCLUSION

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



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