Streamlining Waste Management: The Innovation of Smart Drainage System

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ABSTRACT - Water is the basic requirement for the survival of life on earth. The water is mainly used for cooking, cleaning and drinking purpose. In which more solid ingredients along with water also reaches. The disposals of sewages are still a challenging task in this modern world. The main purpose of smart drainage system is collecting the solid waste which includes bottles, polythene and transport to the disposal area. Otherwise, the solid waste will block the drainage system. To avoid such situation, the solid waste is need to be collected and disposed it into collecting bin. The proposed system will be using Bluetooth voice controlled cleans the water in the drainage system with the help of drive system controlled by Arduino and the mechanical setup which are driven by DC motor collect the solid waste and dispose it in waste bucket to avoid drainage block. It reduces the cost of manual labor as well as reduces the threat to human life.

KEYWORDS Smart drainage cleaning , Replacement of Human , Maintain Healthy Drainage system .

I.INTRODUCTION

In the realm of drainage maintenance, the current methodologies and practices are confronted with a myriad of challenges that necessitate innovative solutions. As urban environments continue to evolve, traditional approaches to cleaning and managing drainage systems reveal inherent problems that hinder efficiency, safety, and environmental sustainability. These challenges form the backdrop against which the need for a transformative solution arises. Firstly, the reliance on manual labor for drainage cleaning poses significant risks to the health and safety of workers. Exposure to sewage and waste materials in often hazardous conditions underscores the urgency of developing methods that can reduce or eliminate such risks. Additionally, the inefficiency in the collection of various types of solid waste, including bottles and polythene, leads to recurrent blockages in drainage systems, causing disruptions and necessitating frequent maintenance. Moreover, the limited accessibility of drainage systems, nestled in confined or hard-to-reach spaces, compounds the difficulties faced by manual laborers. The frequency of blockages not only disrupts normal water flow but also results in infrastructure damage, escalating operational costs an compromising the longevity of the drainage network. The environmental impact of improper waste disposal further underscores the need for a systematic and ecologically conscious approach to drainage maintenance. Traditional methods also exhibit limitations in terms of real-time monitoring and control, impeding the ability to promptly respond to emerging drainage issues or adapt to changing conditions. Furthermore, the lack of data collection and analysis capabilities hampers the generation of insights necessary for informed urban planning and effective infrastructure .

II. LITERATURE REVIEW

1) Bruno Rente, Matthias Fabian et al "In-sewer field-evaluation of an optical fibre-based condition monitoring system" - IEEE SENSORS JOURNAL, 2019 A Fiber Bragg Grating (FBG) based monitoring system for continuous humidity and temperature measurement has been designed and evaluated experimentally in a sewer environment with high corrosion rates, humidity and the presence of gaseous hydrogen sulfide. The monitoring system has been designed specifically for field use, including packaging prepared for the harsh environment and the challenges of the operation. The system is battery powered and has hardware for controlling the interrogation equipment, power management, data logging and 4G connectivity. Results obtained show the long-term performance, over a 6-month period of non-stop monitoring of real- time data using the same probe. The data acquired was compared to the environmental data of temperature and precipitation for this period from the same location, which showed a good correlation between the expected and the measured data values. The data obtained point to the success of the optical fibre-based sensor system for monitoring in these harsh environments over long periods

2) PhattaleeyaMabpa et al "Clogged Pipe Detection and Monitoring by Using Acoustic Analysis Methodology- IEEE, 2017 Clogged sewer pipelines are one of the main problems that cause Sanitary Sewer Overflow (SSO) which leads to serious environmental issues and property damage. This existing work presented clogged pipe detection and monitoring methods based on acoustic analysis to identify pipe clogged occurrence and degree of blockage that can be mitigating the risks from SSO's problems. The existing technique is to attached with the vibration speaker on the pipe as an acoustic source. The clogged by blockage will be detected by reading the change in the pipe resonance frequency via the microphone installed on the other side of the pipeline. The resonance frequency of the measured signals was characterized by Fast Fourier Transforms (FFT). Compensation based line was used to normalize the frequency responses for easier acoustic analysis. The experiments have indicated the resonance frequency shifting down and Sound Pressure Level (SPL) decreasing when pipe clogged.

3) Robust Sensor Suite Combined with Predictive Analytics Enabled Anomaly Detection Model for Smart Monitoring of Concrete Sewer Pipe Surface Moisture Conditions - IEEE SENSORS JOURNAL, 2020 Due to the unavailability of sensors to monitor concrete sewer surface moisture conditions, water utilities use surrogate measures such as relative humidity of the air as an observation for the model. Hence, the corrosion predictions are often hampered and associated with prediction uncertainties. In existing paper presented the development and successful evaluation of an electrical resistivity based sensor suite for estimating the surface moisture conditions of concrete sewer pipes. The sensor was deployed inside a municipal sewer pipe of Sydney city, Australia to carry out field measurements. The post-deployment studied revealed the survival of the sensing system under hostile sewer conditions and demonstrated their suitability for long-term monitoring inside sewer pipes.

4) A. Monitoring Smart City Applications using Raspberry PI Based on IOT Authors: Prof. S A.Shaikh 1, Suvarna A. Sonawane. Description: the Smart city is 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.The system consist of sensors, collect different types of data from sensors and transfer to the Raspberry Pi3 controller. The acquired output from the controller is sent to the control room through the E- mail and also display .

5) Automated Internet of Things for Underground Drainage and Manhole Monitoring System for Metropolitan Cities. Author: Muragesh S. K1 and Santhosha Rao Description: The Internet of Things (IoT) consists of re 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. 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 proposed model 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. In real time, UDMS can remotely monitor current states of the manholes.

III.EXISTING SYSTEM

- Sewer condition is commonly assessed using closed-circuit television (CCTV) inspections.
- In existing system, they combine inspection results, pipe attributes, network data, and data on pipe environment to predict pipe condition and to discover which factors affect it.
- They applied the random forest algorithm to model pipes assess the variable importance using the Boruta algorithm.

• They analyzed the impact of predictor variables on poor condition using partial dependence plots, which are a valuable technique for this purpose.

IV.PROPOSED SYSTEM

The proposed smart drainage system represents a technological advancement aimed at addressing the persistent challenges associated with sewage disposal and drainage blockages in modern urban environments.

The system integrates Bluetooth technology, Arduino control, and a mechanical setup driven by DC motors to create an efficient and automated solution for cleaning drainage channels. At the core of the system lies the concept of automation. By developing a smart drainage system capable of autonomously cleaning and maintaining drainage channels, the goal is to enhance overall efficiency while mitigating the risks of manual labor in challenging and potentially hazardous environments.

The system is designed to be responsive and precise, ensuring the effective removal of solid waste to prevent blockages. The integration of Bluetooth voice control adds an extra layer of user-friendly interaction. Users can remotely control the drainage cleaning robot using voice commands, allowing for seamless navigation through the the drainage system.

The utilization of Arduino microcontroller technology provides the intelligence needed to interpret these commands and execute the corresponding actions, making the system agile and adaptable to different scenarios.

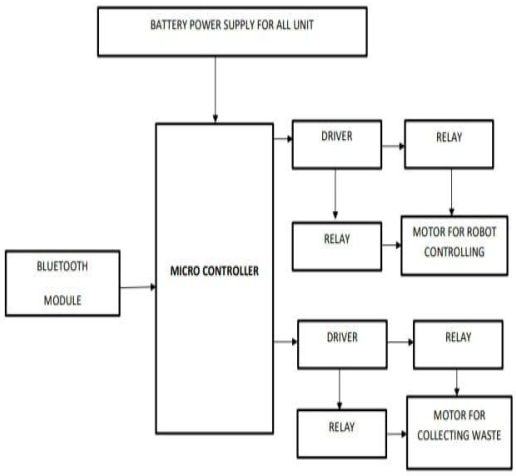
The mechanical setup of the proposed system is a critical component, featuring DC motors that power the movement of the robot and drive mechanisms for collecting and disposing of solid waste. The design emphasizes efficiency in waste collection, targeting items such as bottles and polythene that often contribute to drainage blockages.

The system's ability to collect and dispose of such waste in a controlled manner contributes to the overall health and functionality of drainage systems. Beyond its technical aspects, the proposed system aims to reduce operational costs by minimizing reliance on manual labor. The incorporation of automation not only enhances cost-effectiveness but also increases the safety of the drainage maintenance process. Human exposure to the risks associated with manual sewage disposal is significantly reduced, fostering a safer working environment.

Moreover, the system acknowledges its environmental impact. By preventing pollution and blockages in water bodies through the proper disposal of solid waste, it aligns with the broader goal of environmental conservation. The efficient removal of waste contributes to the overall health of ecosystems connected to drainage system.

The real-world applicability of the system is a key consideration. Rigorous testing in diverse drainage scenarios ensures that the proposed solution is robust and adaptable to various configurations and environmental conditions. This comprehensive testing approach aims to validate the functionality and reliability of the smart drainage system in practical settings.

V.BLOCK DIAGRAM



VI.MODULES DESCRIPTION

BLUETOOTH MODULE

←Bluetooth module is connected with the robot module in order to communicate with the customers.

← The robot module will be connected with the customer's mobile phone Bluetooth and receive the food orders along with the current location or compartments.

← Bluetooth module will be connected with the serial port of the arduino (0,1).

← Customer will be provided with Bluetooth app to place their orders .

INTRODUCTION

 It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard and many more consumer applications.

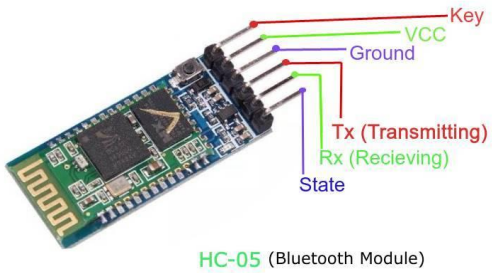
 It has range up to 100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions.

 It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air.

 It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).

HC-05 BLUETOOTH MODULE

 HC-05 is a Bluetooth module which is designed for wireless comunication. This module can be used in a master or slave configuration.



PIN DESCRIPTION

It has six pins,

1. Key/EN: It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode. HC-05 module has two modes,

1. Data mode: Exchange of data between devices.

2. Command mode: It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.

2. VCC: Connect 5 V or 3.3 V to this Pin.

3. GND: Ground Pin of module.

4. TXD: Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)

5. RXD: Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

6. State: It tells whether module.

HC-05 MODULE INFORMATION

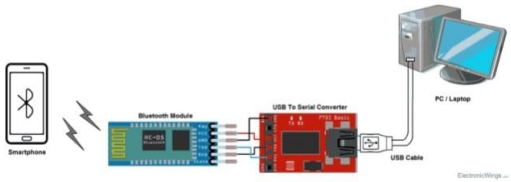
 HC-05 has red LED which indicates connection status, whether the Bluetooth is connected or not. Before connecting to HC-05 module this red LED blinks continuously in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to two seconds.

 This module works on 3.3 V. We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator.

 As HC-05 Bluetooth module has 3.3 V level for RX/TX and microcontroller can detect 3.3 V level, so, no need to shift transmit level of HC-05 module. But we need to shift the transmit voltage level from microcontroller to RX of HC-05 module.

BLUETOOTH COMMUNICATION BETWEEN DEVICES

E.g. Send data from Smartphone terminal to HC-05 Bluetooth module and see this data on PC serial terminal and vice versa. To communicate smartphone with HC-05 Bluetooth module, smartphone requires Bluetooth terminal application for transmitting.



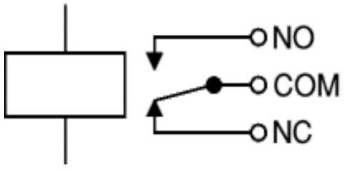
RELAYS

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts as shown in the diagram.

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil.

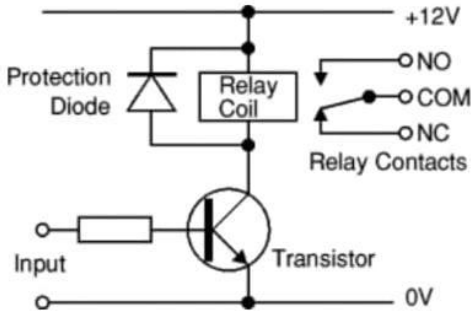
The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification. Relays are usuallly SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available.



The coil will be obvious and it may be connected either way round. Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a protection diode across the relay coil.

PRODUCTION DIODES FOR RELAYS

Transistors and ICs must be protected from the brief high voltage produced when a relay coil is switched off. The diagram shows how a signal diode (eg 1N4148) is connected 'backwards' across the relay coil to provide this protection.



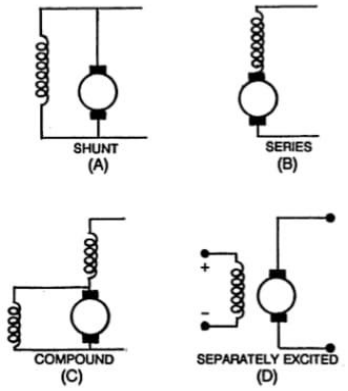
Current flowing through a relay coil creates a magnetic field which collapses suddenly when the current is switched off. The sudden collapse of the magnetic field induces a brief high voltage across the relay coil which is very likely to damage transistors and ICs. The protection diode allows the induced voltage to drive a brief current through the coil (and diode) so the magnetic field dies away quickly rather than instantly. This prevents the induced voltage becoming high enough to cause damage to transistor and IC's.

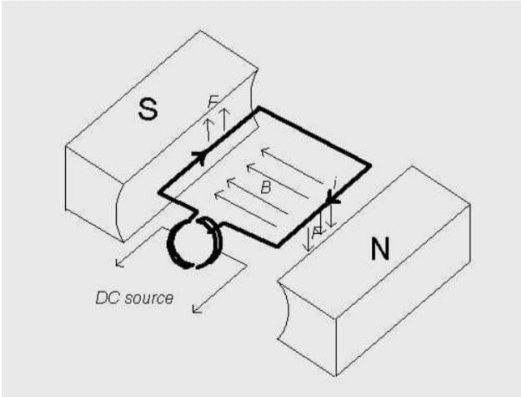
DC MOTOR

DC motors are part of the electric motors using DC power as energy source. These devices transform electrical energy into mechanical energy. The basic principle of DC motors is same as electric motors in general, the magnetic interaction between the rotor and the stator that will generate spin.

Simple motor has six parts:

1. Armature or rotor
2. Commutator
3. Brushes
4. Axle
5. Field magnet 6. DC power supply of some





working principles of DC motors

from north to south pole, the coil will be driven by the force F in the direction as shown in Figure 1. This condition occurs continuously so will result in rotation on the axis of the coil. The direction of the electric current in the coil is fixed, because of the split ring on the end .

The major classes of DC motors are

- Shunt wound.
- Series wound.
- Compound wound.
- Separately excited. These types of motors differ only in the connection of the field circuits The armatures, commutators, and so forth are nearly identical with each other and with those of the generators. All four major classes of motors are widely used. This is in contrast to the generators, in which the compound wound type is used for nearly all general power application.

VII.RESULT

The implementation of the smart drainage system yielded noteworthy results and insights, marking a significant step forward in addressing the challenges associated with sewage disposal and drainage blockages. The system's performance was evaluated based on various criteria, including automation efficiency, user interaction, cost-effectiveness, safety enhancement, environmental impact, and real-world adaptability. The primary focus of the evaluation was the system's automation capabilities. The integration of Bluetooth voice control and Arduino microcontroller technology proved to be effective in providing seamless and responsive control over the drainage cleaning robot.

Users were able to effortlessly command the robot's movements and waste collection, highlighting the user-friendly nature of the system. The automation, driven by DC motors in the mechanical setup, demonstrated agility and precision in navigating through the drainage system.

The efficiency of the waste collection mechanism was a crucial aspect of the system's performance. The mechanical setup, powered by DC motors, successfully collected and disposed of solid waste, including bottles and polythene. This not only prevented drainage blockages but also contributed to the overall health and functionality of the drainage system. The system's ability to target specific types of waste showcased its adaptability to the challenges presented in real-world drainage.

VIII.CONCLUSION

In conclusion, the proposed smart drainage system stands as a technological innovation poised to address longstanding challenges associated with sewage disposal and drainage blockages in contemporary urban landscapes. Through the integration of Bluetooth technology, Arduino control, and a mechanical setup driven by DC motors, the system represents a holistic approach to automate the cleaning and maintenance of drainage channels. The advantages of this system are multifaceted. Efficient solid waste collection ensures that common culprits such as bottles and polythene are promptly removed, minimizing the risk of blockages and maintaining optimal water flow. The inclusion of wireless remote operation through Bluetooth voice control adds a layer of user-friendly interaction, allowing users to control the robot with ease and in real-time. Automation not only contributes to cost reduction by diminishing the reliance on manual labor but also enhances safety measures, reducing human exposure to potential hazards associated with sewage disposal. The precision afforded by the Arduino microcontroller technology ensures that the robot navigates drainage systems with accuracy, optimizing its functionality. Environmental impact mitigation is a key facet, with the system actively contributing to the preservation of ecosystems connected to drainage systems through proper waste disposal. In terms of applications, the system finds relevance in a myriad of scenarios.

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