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IoT PURIFLUX - Advanced Sewage Purification and Monitoring

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Abstract: ***This research paper introduces the conceptualization and design of an Internet of Things (IoT) technology-based automated sewage monitoring system. The system is designed to address the growing challenges of sewage management in cities. The system uses a chain of core components, including NodeMCU microcontroller, SIM800L GSM module, XL6009 booster module, MQ gas sensor, JSN SR-04T waterproof ultrasonic sensor, and on/off switch. The NodeMCU is the core controlling module, allowing data collection, processing, and transmission. The SIM800L GSM module supports wireless communication and establishment of a communication link, allowing remote control and operation. The XL6009 booster module supplies a reliable power source to the system components. With this combined system, real-time information on sewage levels, gas levels, and system status can be compiled and sent to a central server or user interface. The information allows proactive management and timely intervention of sewage-related issues, hence improving sanitation and public health. The proposed automated sewage monitoring system, utilizing IoT technology, has the capability to revolutionize sewage management practices, offering an economic and efficient solution for urban cities.***
Keywords: Sewage Monitoring, IOT, Automation, NodeMCU.

I. INTRODUCTION

With the rapid rate of urbanization and population growth that has been witnessed in the recent past, the management of sewage has emerged as a serious issue of concern. Ineffective management of sewage has serious health and environmental consequences and adversely affects the quality of life in urban areas. Traditional sewage management and regulation methods are mostly linked with time-consuming manual processes that are prone to human errors. To overcome such drawbacks, the use of IoT (Internet of Things) technology has emerged as a potential solution to the development of automatic and real-time sewage monitoring systems.The SIM800L GSM module offers wireless communication, which facilitates remote monitoring and management of the sewage system. This feature allows authorities and stakeholders to receive real-time feedback, thus enabling them to take action in time against any emerging issues or emergencies [2].

To ensure a stable and continuous power supply to all the elements of the system, the XL6009 booster module has been successfully integrated into the design. This particular module efficiently regulates and boosts the input power received by it, thereby ensuring smooth and continuous functioning of the entire system at all times. Additionally, the MQ gas sensor executes an absolutely critical role of detecting any hazardous gases present in the sewage system, thereby acting as an early warning system essential in avoiding potential hazards or health risks that may arise.

The JSN SR-04T waterproof ultrasonic sensor has been used specifically to accurately and precisely measure the sewage level. This advanced sensor utilizes ultrasonic waves to determine the precise distance between the sensor and the liquid surface, thereby providing reliable and authentic data for the continuous level monitoring of sewage in tanks or containers. Additionally, the on/off switch offers manual control to the entire system, presenting users with the facility of overriding automatic functions if such a need arises.

By combining these different parts, the suggested automatic sewage monitoring system tries to get up-to-date info on key factors like sewage levels, gas amounts, and how the whole system is doing. This gathered data can then go to a main server or user screen letting the right people and groups see this vital info and make smart choices about how to handle sewage well.In general terms, this research paper is an exhaustive solution to automating sewage monitoring with the help of IoT technology. Employing a network of interconnected devices and sensors, the system offers various benefits, such as real-time monitoring, anticipatory management, and improved response time. Finally, the use of such a system can really change the sewage management processes, thus making city life cleaner and healthier.

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Our project work objectives are as follows:

1) Design an IoT-based automated system for monitoring sewage conditions.
2) Implement gas sensors to identify and notify about potential sewage hazards.
3) Utilize waterproof ultrasonic sensors for precise measurement of sewage levels.
4) Facilitate remote supervision and management of the sewage network through wireless connectivity.
5) Enhance the efficiency and reliability of sewage management operations.

II. LITERATURE REVIEW

Some of the challenges are selecting and installing sensors securing data, and managing privacy concerns. Nevertheless, IoT-based sewage monitoring systems have the capacity to be utilized in different ways from remote locations to factories and cities. Such systems can detect blockages or leaks, optimize the utilization of resources, and ensure environmental compliance is met, among other good things [3].

Literature review ends with the applications, limitations, and advantages of IoT-based sewage monitoring systems. IoT-based sewage monitoring systems can enhance sewage management with remote monitoring and real-time information. Sensor's integration, data security, and privacy are some of the concerns that need to be tackled before implementation.

III. METHODOLOGY

Methodology clarifies the structure and the stages of creation of an IoT-based programmed wastewater observing framework. The up and coming passages are an by and large survey of the inquire about venture methodology:

1) System Plan: The preparatory organize comprised of creating the system's engineering. The prepare moreover included the choice of the suitable components, their association, and their functions.
2) Integration of Components: The vital components were amassed into a single framework. The NodeMCU microcontroller was utilized to perform the information gathering and handling capacities. The components were all interfaces to the microcontroller by means of appropriate wiring and interfacing. The SIM800L GSM module was utilized for remote communication, and the XL6009 booster module for a clean control supply. The MQ gas sensor and the JSN SR-04T waterproof ultrasonic sensor were utilized to degree the gas concentration and the volume of the sewage, individually. An on/off switch was moreover physically operated.
3) Program Advancement: The computer program portion of the extend was related to programming the NodeMCU microcontroller in arrange to execute different capacities. Arduino Coordinates Improvement Environment was the instrument utilized for composing and exchanging firmware code that would control the microcontroller. There were schedules in the program that included filtering the status of sensors, handling the information they given, and making a GSM call to send the information to the server or client interface. The computer program had a information logging work and too mistake dealing with in arrange to guarantee that the framework was working appropriately without interruption.
4) Examination and Alteration: The reason of the examination and alteration stage was to make beyond any doubt the framework would be able to work precisely and dependably. The sensors were at that point calibrated utilizing set up calibration measures and forms. Numerous sewage levels, gas concentrations and natural components were the conditions at which the framework was put to test.
5) Integration with IoT Foundation: Interfacing the sewage observing framework to the bigger IoT foundation was the final stage. This included setting up an web association and setting up the framework to interact with a client interface or central server.

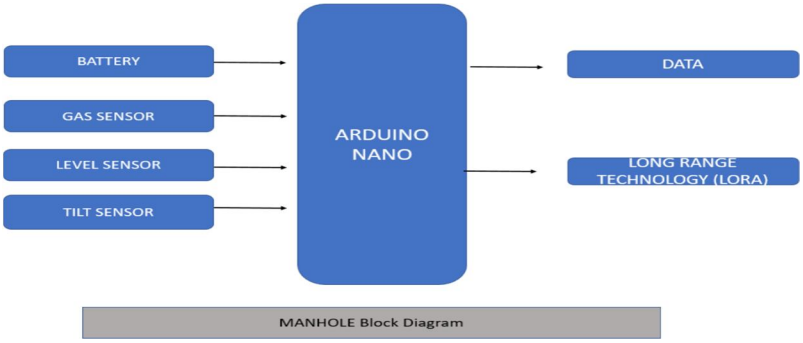


Fig. 1 Block Diagram of Automatic Sewage Monitoring system using IoT

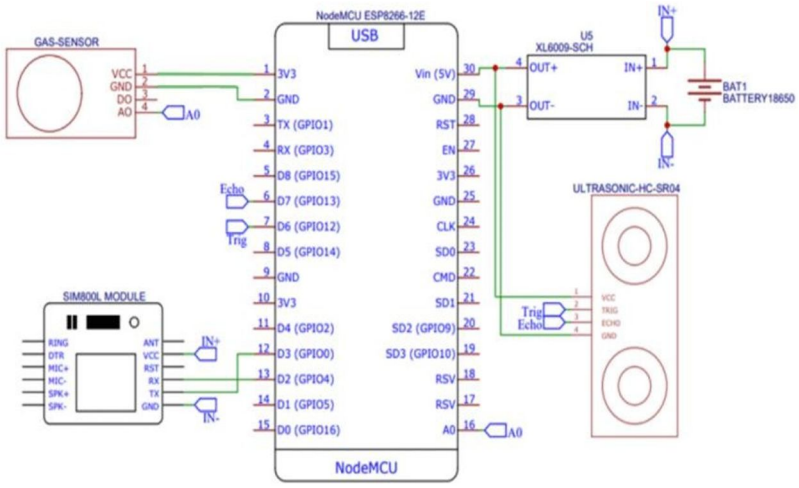


Fig. 2 Circuit Diagram of the Project

IV. WORKING OF THE SYSTEM

The programmed sewage observing framework is ceaselessly obtaining the information from the taking after sensors - the JSN SR-04T waterproof ultrasonic sensor to degree the stature of the sewage and the MQ gas sensor for the gas concentrations. The NodeMCU (ESP8266) microcontroller is exchanging the gotten sensor information into the related amounts. The information handled is at that point passed on by the SIM800L GSM module that gives a remote interface over the cellular organize. Laborers who have the qualifications can observe the framework remotely on a central server utilizing a client interface. The measures like sewage levels, gas concentrations, and the condition of the framework are accessible in real-time there. They are too competent of looking over the information, deformities' distinguishing proof, and finally, they are cautioned around a few vital occasions. As a result, the framework is too prepared with the capacity to be controlled from farther places, meaning that commands can be sent from the central server or the client interface to alter framework parameters or to turn on or off the framework. The highlights of inaccessible observing and control this framework gives enormously improve operational effectiveness not as it were by dispensing with the require for physical reviews but too by permitting convenient activity in the case of an event of a issue or an crisis. It gives the included parties nitty gritty data for legitimate support arranging and the optimization of the sewage administration handle as well as contributes to the maintainability of the earth.

V. RESULTS AND DISCUSSION

The IoT-based sewage observing framework utilizing mechanization has effectively been executed and tried, with noteworthy comes about detailed. The succeeding segment presents the key discoveries as well as illustrates their effects

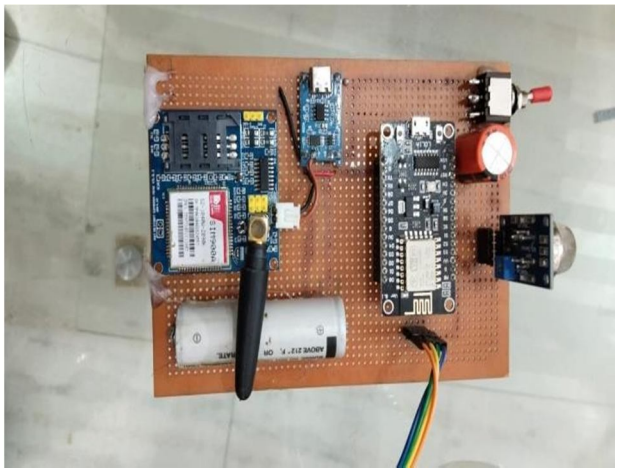


Fig. 3 Hardware used in the project

A. Accurate and Real-time Monitoring

The framework demonstrated to precisely degree sewage volume with the JSN SR-04T waterproof ultrasonic sensor. The information obtained demonstrated to be steady and solid, making it conceivable to precisely screen sewage volume in holders or tanks. The capacity to screen in real-time empowers organizations to make evidence-based choices almost sewage administration, for occurrence, provoke pump operation or upkeep planning

In the Diagram if the water level and gas detection are high then the results are as follows:



Fig.4 When the Level of water is high.

B. The Blinkit App

Acts as a vital component of our extend, the IoT-based programmed sewage observing framework. This customized portable app gives an easy-to-use interface for information gathering and examination of information created by gas and ultrasonic sensors. The clients can helpfully screen sewage levels in real-time, distinguish gas emanations, and get convenient cautions with respect to conceivable issues through the Blinkit App. The easy-to-use interface of the app permits simple information visualization and examination, and clients can make compelling choices approximately sewage administration and natural conservation. The Blinkit App acts as a central information store for information collection and improves the proficiency and adequacy of our programmed sewage checking system.

The underneath fig speaks to the water level and gas location amid tall water levels and moo gas rates

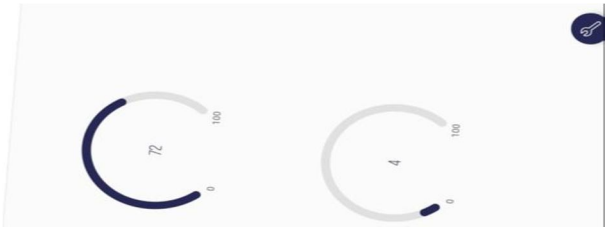


Fig 5 Gas Detection and Water Level Detection on Software (Blinkit)

1) Early Detection of Hazards

The integration of the MQ gas sensor facilitated the early detection of harmful gases in the sewage system. The sensor provided timely alerts and notifications when gas concentrations exceeded safe limits. This functionality is crucial for ensuring the safety of the environment and preventing potential health hazards for workers and nearby communities.

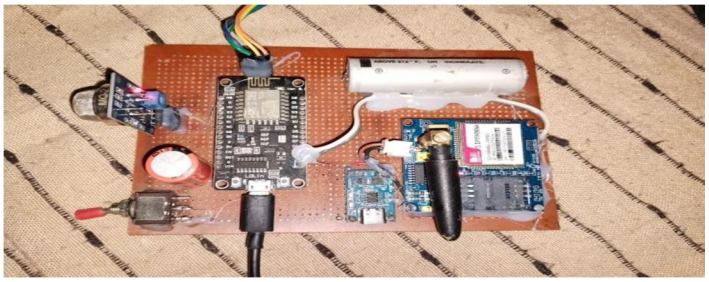


Fig. 6 Hardware in ON state.

2) Remote Monitoring and Control

The system's remote monitoring and control capabilities proved to be highly effective. Authorized personnel were able to access real-time data, monitor system performance, and remotely control various functions. This feature significantly improved operational efficiency by reducing the need for physical site visits and enabling prompt intervention in case of system issues or emergencies.

3) Integration with IoT Infrastructure

The successful integration of the sewage monitoring system with the broader IoT infrastructure allowed for seamless data transmission and centralized data management. The system transmitted sensor data through the SIM800L GSM module to a remote server or user interface. This integration facilitated data analysis, visualization, and reporting, empowering stakeholders with valuable decision-making and resource allocation insights.

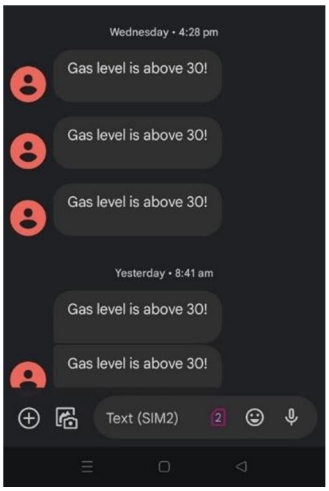


Fig. 7 Message Received on Mobile

4) System Reliability and Robustness:

Throughout the testing phase, the system demonstrated a high level of reliability and robustness. It successfully operated under various environmental conditions, including temperature fluctuations and humidity. The system's components and connections were stable, ensuring continuous data acquisition and transmission.

The discussion of these results highlights the potential benefits and practical implications of the automatic sewage monitoring system. By providing accurate and real-time monitoring, early hazard detection, remote control capabilities, and seamless integration with the IoT infrastructure, the system offers an efficient and effective solution for sewage management. Future enhancements could focus on expanding the system's scalability, incorporating additional sensors for comprehensive monitoring, and integrating advanced analytics for predictive maintenance and optimization.

5) When Water Level is low and gas detection is low



Fig 8 Water Level is Low

So the results of the project detect when the water level in the tank is high and the gas level in the tank is high then the message gets displayed on the registered number and also in the software app so that the Nagar Nigam people will take strict actions on time and save their life by the spread of harmful gases in the tank.

VI. CONCLUSION AND FUTURE SCOPE

In conclusion, an IoT-based sewer monitoring system has so far lived up to expectations as a great solution for sewage management. The system can check the level of sewer infection, gas pollution, and real-time data transmission of great significance to both people's health and environmental sustainability. It is also more comfortable, cheaper and safer. All these advantages come from the fact that the system could be used not only inside the house but also in the situation of emergencies. The system is simple to use as it will help the local citizens to deal with any potential water issues.

Integration of the IoT infrastructure that is successful allows the system to send data flawlessly and to save it at the datacenter. All involved parties thus are giving timely and effective insights to them. In general, the execution of that project unquestionably points out the chance this system holds for the renovation of sewage management procedures. Next to this, it can also generate improved effectiveness, reliability, and robustness than the traditional manual monitoring way of doing things. The outcomes as seen in the testing part of the system and an analysis of the performance outline the advantages of real-time detection, early stage spotting, and the functional nature of remote control.

The IoT technology driven sewer monitoring system that is fully automatic possesses a highly prospective nature for growth and the expansion in the years to come. In an exemplary manner, machine learning algorithms that are capable of ensuring the optimal and the timely maintenance of the system and the sewage may even be used by the way the IoT system gets integrated further. Likewise, the inclusion of more sensors into the present system will result in the system becoming a powerful monitoring tool.

Take for instance, pushing in a pH sensor for the determination of the levels of acidity, the use of which can detect any abnormal condition. Other sensors are still welcome, for instance, choosing to put in a turbidity sensor which could give accurate reading on the quality of water or temperature sensor through which a signal will be given. Creating decision-support systems that can learn from the collected data and at the same time support proactive decision-making is a great help to a company that has the system.

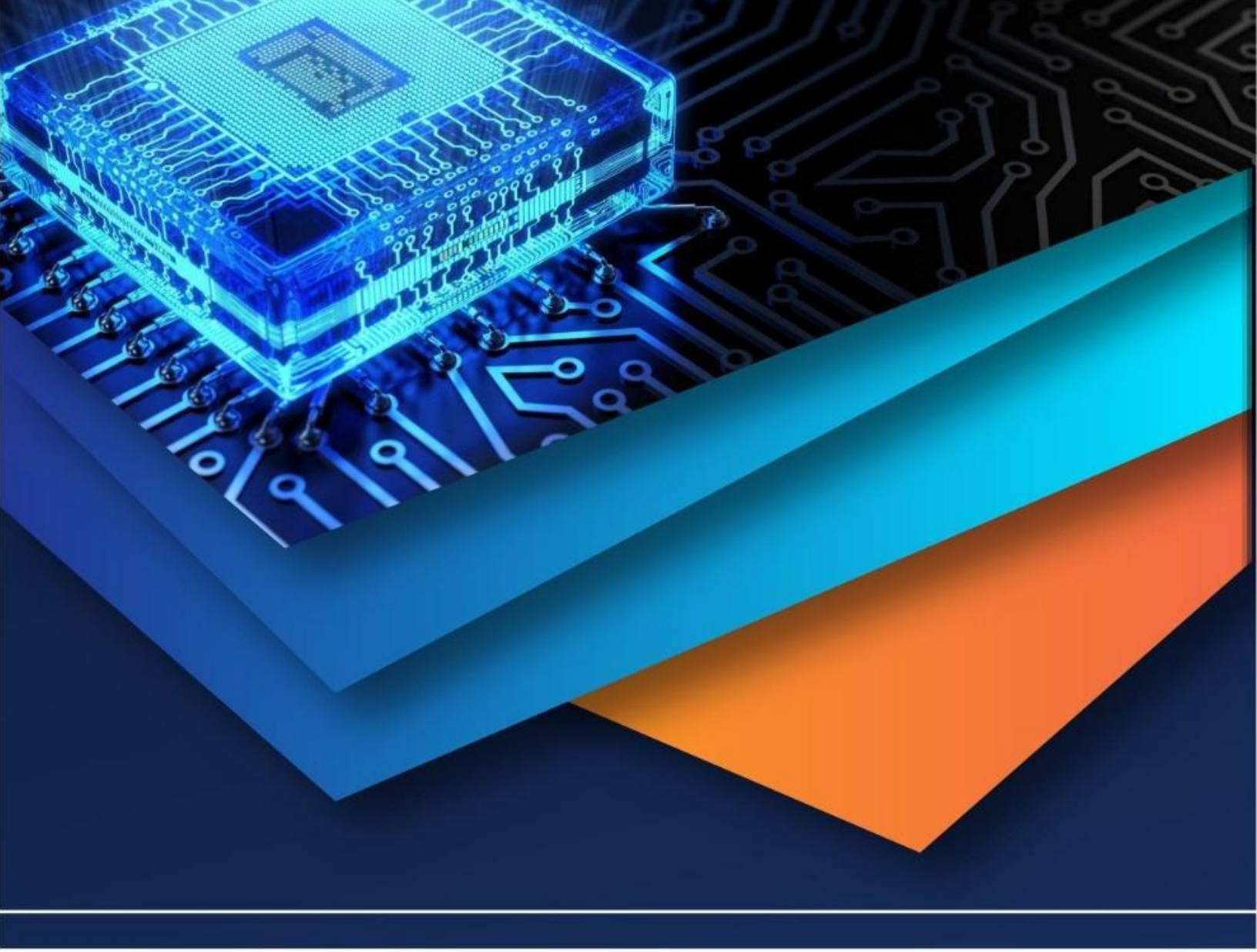
The system takes into account not only the time of the data reception and the reading from the sensors but also the weather events and the legally required specifications, and then the system can give advice and recommendation to the best management strategies for the sewerage with the emergency planning. The combination of the automatic sewage monitoring system with other smart city infrastructure devices can be a definite pathway to urban management that is not only integrated but also holistic.

The automatic sewage monitoring system can diversify if we look into new directions which may be critical in nature for example it can address newer issues which may arise in the sewage management field and help in building smarter and more sustainable cities through the use of this technology.

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