

## Real Time Drainage Monitoring System

Roshani Bhaskarwar<sup>1</sup>, Aboli Bhor<sup>2</sup>, Mrunali Chavan<sup>3</sup>, Pavan Karkhanis<sup>4</sup>, Yash Govind<sup>5\*</sup>

Datta Meghe College of Engineering

Airoli, Navi Mumbai, India

### Abstract

Monitoring of Sewage System is important to keep the city clean. Blockages in the drainage system are caused by inconsistent sewage system monitoring. The system's inventiveness in addressing crucial water management issues is highlighted, leading the way for sustainable urban and agricultural development. A network-based approach to better water management in urban and rural regions is provided by the Real-Time Drainage Monitoring System. The system monitors the water level of the drainage, if the water level exceeds the high level of the soil moisture sensor the blockage is detected and the alert to the authority is send, meanwhile the project's most notable feature is that the system automatically pumps out water until the authority arrives at the location. The system allows for real-time drainage monitoring and control by utilizing hardware components such as an Arduino Uno, a NodeMCU, a relay module, a soil moisture sensor, and a water pump. It provides affordable and expandable ways to lessen flooding and waterlogging problems through smooth integration.

**Keywords:** Real Time Drainage Monitoring System, Water management, Sustainable development, Monitoring and control, Flooding and watrelogging.

### 1. Introduction

The Drainage System plays a crucial role especially in large cities [1]. Monitoring the underground drainage system plays a very important role in keeping the city clean [2]. The population is growing very fast and many problems are faced in Smart Cities [2]. The drainage system in India is manually monitored and maintained. Manual drainage pipe monitoring and cleaning is required, but too long cleaning can create an unhealthy environment and spread many illnesses [2].

The Real-Time Drainage Monitoring System (RDMS) is a creative initiative that aims to transform water management in both urban and agricultural environments. The growing frequency and intensity of extreme weather events around the world highlight the urgent need for pre-emptive measures to address water-related issues. Conventional drainage systems are inadequate to handle the changing and unpredictable nature of today's environmental circumstances since they frequently depend on human monitoring and intervention.

In this regard, integrating Internet of Things (IoT) technology presents a viable way to improve drainage management's effectiveness and reactivity. Real-time monitoring, analysis, and control of water levels inside drainage infrastructure are made possible by the RDMS

which makes use of networked sensors, controllers, and communication networks as shown in Fig.1. By taking a proactive stance, the risk of floods and waterlogging is reduced, and resource allocation is optimized while environmental sustainability is improved.

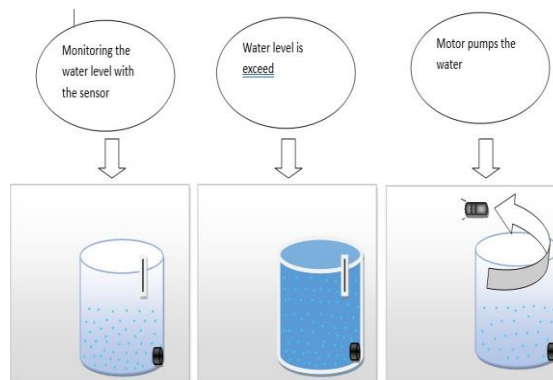


Fig. 1. Architectural Workflow

The way the system operates is that it uses an FC-28 Soil Moisture Sensor to continuously monitor the drainage and check the water level. This sensor is used because the water in the drainage is dirty and contains a lot of dirt and soil particles. The soil moisture sensor has three water levels: low, medium, and high. Low levels are reached when the drainage is filled to 30%, medium levels are reached when it is filled to 60%, and high levels are reached

when it is 90% filled. A blockage is identified when the water level rises above the high level. A notification is sent to the appropriate person to take appropriate action, and in the meantime, a DC water pump is activated to automatically pump water out of the drainage system until help arrives. Essentially, this project is an attempt to address the inherent drawbacks of traditional drainage techniques, which lacked an automated pumping mechanism that would activate simultaneously with an alert. By utilizing powerful control mechanisms to manage water flow and sensors to continuously check water levels, the system can effectively limit potential risks and adjust to changing circumstances. Furthermore, the integration of IoT connectivity facilitates instantaneous, well-informed decision-making by authorized parties through remote monitoring.

## 2. Literature Review

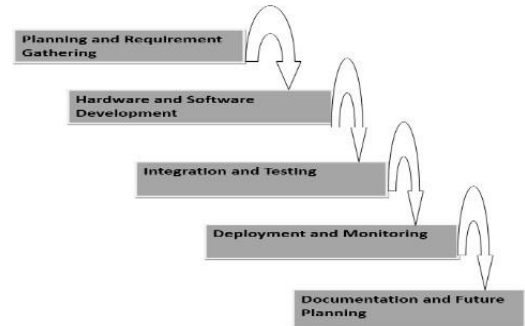
In order to monitor water levels and identify potentially dangerous gases, R. Sarath Kumar et al. presented a system in 2016[3]. It uses a variety of sensors, including gas and water level sensors. These sensors detect blockages in the drainage system automatically and show information about hazardous gasses on a 16x2 LCD display when the system overflows and becomes blocked.

A system to track water levels and quickly detect obstructions in the drainage system was created in 2019 by P.Suseendhar et al. The system notifies the local municipality service via Wi-Fi to take corrective action when certain sensors exceed certain threshold levels[4].

Tushar Pathak et al. set out to develop a smart drainage monitoring and controlling system that might operate in real-time in 2020[5]. This study looks at temperature and levels of hazardous gases in addition to monitoring water levels. A registered cell phone number receives an alarm whenever the water level rises above the set limit, and values are shown on an LCD [5].

Last but not least, in 2021, Ananya Rahaman et al. created an IoT smart drain monitoring system that uses sensors for real-time drainage monitoring, including the MQ135 gas detection sensor, water level sensor, and GSM/GPS [6]. The system alerts the relevant authorities and gives them the coordinates of the place in case the drainage overflows and emits hazardous gases such as CO<sub>2</sub>,

CO, or CH<sub>4</sub>. These initiatives highlight how IoT technology can improve monitoring of subterranean drainage systems and solve important problems with obstructions and dangerous gases.



## 3. Methodology Characterisation

Fig. 2. Proposed Methodology

The RDMS was developed using a process that includes multiple key phases, all of which are essential to the project's usefulness and success. The project lifecycle is covered in detail by these phases, which range from initial planning and requirement collection to continuous monitoring and future planning shown in Fig. 2.

### 1. Project Planning and Requirements Gathering

The goals and scope of the project are established during this first stage. A thorough project plan is created and Municipal Authorities are identified. In order to guarantee the project's effective completion, the plan include establishing precise deadlines, milestones, and resource allocation. This stage provides a blueprint for the following stages of development and implementation, acting as the project's foundation.

### 2. Hardware and Software Integration

In this stage, the hardware parts are integrated with the corresponding software systems. Making sure the system works as a cohesive unit and that the hardware and software can communicate with each other successfully is the aim.

When integration is done correctly, Arduino Uno can process data from the soil moisture sensor and send it to NodeMCU, which can then send it to the cloud. It serves as the central component of the system, enabling data transmission for remote monitoring, water pump control, and level monitoring. The necessary hardware and software are listed below, along with details and use cases.

**a. Arduino Uno Integration:** The system's primary controller is the Arduino Uno. It analyzes

information from the soil moisture sensor, decides what to do based on readings of the water level, and uses the relay module to manage when the water pump is activated. The microcontroller is coupled with the Arduino Uno software [5]. Data processing, control, and acquisition are handled by this software. When the water pump has to be turned on, the relay module is triggered by the water level data that is obtained from the soil moisture sensor. The connections and wiring between the Arduino Uno and the other hardware elements like water pump, relay module, and soil moisture sensor are done with great care. This guarantees that there will be effective communication between the Arduino and these parts.

**b. NodeMCU Integration:** When it comes to facilitating IoT communication and data transfer to a distant platform, NodeMCU is essential. It guarantees that data gathered in real time by Arduino Uno can be transmitted to the cloud for oversight. The NodeMCU software is integrated, allowing it to connect to the internet and send data to the cloud platform. The intermediary between the local system and remote monitoring is this program. By connecting NodeMCU to the internet, usually via Wi-Fi, data can be transferred to a specified cloud server [6]. The efficient and secure transmission of data is guaranteed by the integration procedure.

**c. Data Flow and Communication:** A transparent data flow is established by the integrated system. The Arduino Uno is used to process data that is gathered by the soil moisture sensor. The Arduino triggers the relay module, which in turn operates the water pump, upon detecting high water levels. Data is supplied to NodeMCU simultaneously so that it can be transmitted to the cloud platform. This data flow guarantees that authorities can access pertinent information remotely and enables real-time monitoring and control.

**d. Testing and Validation:** During the integration stage, a lot of testing is done to make sure that all the software and hardware parts function together. This entails verifying the responsiveness of the control mechanisms, the dependability of the data transmission, and the connectivity between the Arduino Uno and NodeMCU. Validation makes ensuring that the integrated system operates as

planned, giving precise control and monitoring of the water level.

**e. Documentation and Troubleshooting:** Wiring diagrams, configuration settings, and any necessary troubleshooting steps are all included in the extensive documentation that is produced to describe the integration process[7]. In order to ensure that the system can be maintained and fixed as needed, troubleshooting procedures are created to handle any problems that might occur during the integration phase. A crucial stage in creating the RDMS is the effective integration of hardware and software components. It lays the groundwork for the system's operation, enabling data transmission for remote monitoring and alerting, water pump management, and level monitoring. When the system is integrated properly, it runs smoothly and effectively and reacts quickly to changing water conditions.

### 3. Deployment and Monitoring

There are several crucial elements in the RDMS deployment process. The soil moisture sensor, Arduino Uno, NodeMCU, relay module, and water pump are then placed securely positioned to ensure optimal functionality. To ensure correct performance, wiring and connections are meticulously set up on-site. For continuous operation, a dependable power supply is offered, and network connectivity is set up for data transmission through cellular or Wi-Fi networks. When the system is deployed, the soil moisture sensor is used to gather data continuously. Data is then sent to a cloud-based platform for remote monitoring. This platform provides real-time data updates and system status monitoring to authorized party. When water levels hit below 370 thresholds, alert notices are issued by email. Regular maintenance inspections are carried out to quickly address any problems, utilizing established troubleshooting techniques where required[8]. This phase of deployment and monitoring guarantees that the system effectively controls water levels, taking proactive measures to protect the environment and providing required paperwork and training for all parties involved.

### 4. Documentation and Future Planning

Assuring the sustainability, scalability, and flexibility of the RDMS project depends heavily on the documentation and future planning stage. The

phase of documentation and planning for the future guarantees that the RDMS will continue to be a viable and innovative solution. Support for continuous operation and maintenance is given via user and technical documentation, and future planning efforts concentrate on scalability, technological improvements, and cooperative efforts to tackle the changing issues of water management.

#### 4. System Flow

Fig.3 below shows the block diagram, which includes initializing the system, configuring the sensor, gathering data, monitoring water levels, identifying obstructions, sounding alarms, initiating water management actions (such turning on the water pump), and concluding the operation.

The initialization step, which involves setting up the system to have it ready for use, is where the RDMS's system flow starts. This covers setting up settings, initializing software systems, and booting up hardware components. The system initializes and configures the sensor that measures the water level in the drainage system. The sensor is positioned and calibrated to monitor water levels in real-time with accuracy. The system then begins to gather information from the sensor and keeps track of the water levels in the drainage system continuously. After that, the data is examined to see if the water level rises above the high level suggesting a possible danger of flooding or waterlogging. The system moves on to other steps to deal with the issue if the threshold is exceeded.

When the system detects that water level is exceeded the high level, it looks for obstacles or blockages in the drainage system. The system notifies Municipal authorities of the approaching problem by sending an alert notice to specified smart devices in the event that a blockage is detected. The system initiates water management strategies simultaneously, such as turning on a water pump to clear the drainage system of extra water and lessen the chance of floods. The system completes its cycle of operation once the water management procedures are implemented and the problem is resolved. By using a methodical approach, drainage systems' water levels may be efficiently monitored, detected, and managed, reducing the risk of floods, etc.

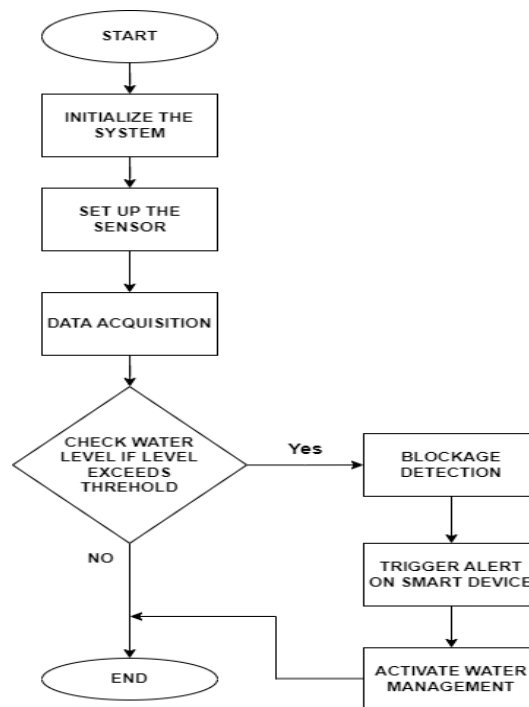


Fig. 3. Block Diagram

#### 5. Results

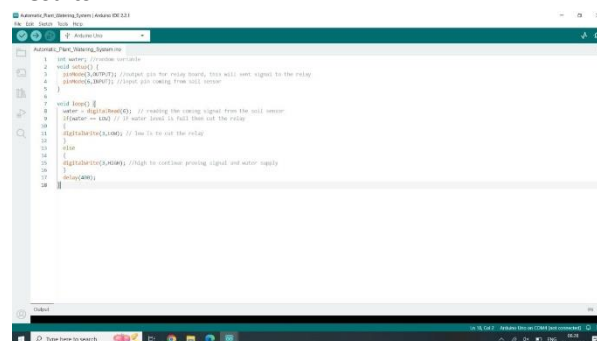


Fig. 4. Water Level Detection

The Arduino programming for monitoring the drainage's water level and detecting it through sensor FC-28 soil moisture sensor after exceeding the high level is shown in the above Fig. 4. The engine then starts and pumps the water out of the drainage.

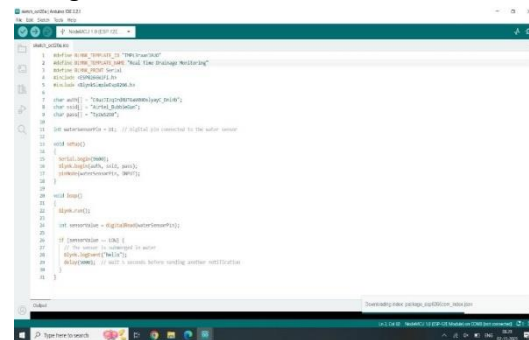


Fig. 5. Alert Mechanism

The Arduino Programming to notify the appropriate authorities to take further action is shown in the

above Fig. 5. The alert is send to the authority via email when the water level of the drainage exceeds the High level of the FC-28 soil moisture sensor.

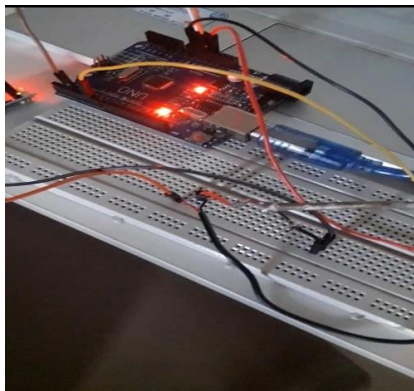


Fig. 6. Connection Setup

The connection between the Arduino and NodeMCU sensors on the PCB board is shown in the above Fig. 6. The NodeMCU is used to start the motor, while the Soil Moisture Sensor monitors the water level.

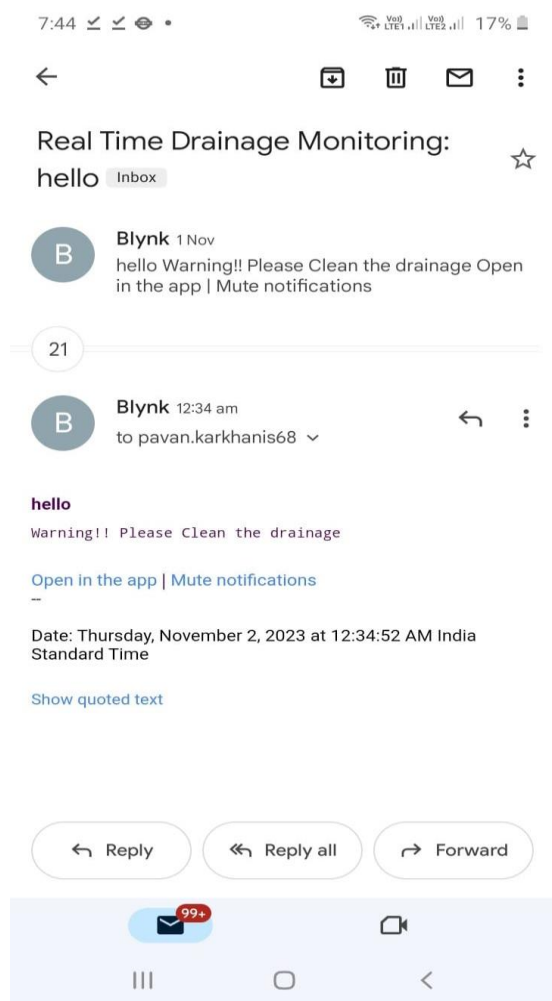


Fig. 7. Received Alert

The system's communication to the authority when the water level rise above the specified threshold value is demonstrated in the Fig. 7.

## 6. Conclusion

The RDMS System project offers a creative and useful way to deal with the urgent problems related to water management in urban and rural areas. To completely transform drainage management, this project makes use of IoT technology, effective hardware parts, and proactive monitoring and control systems.

The path from project planning to deployment, along by continuing observation and planning for the future, emphasizes the importance and promise of this approach. Water level monitoring in drainage systems is possible in real time because to the effective integration of hardware and software components. This feature guarantees prompt control and water pump activation upon detection of elevated water levels. The alarm mechanism notifies Municipal authorities when critical water levels are reached, which further improves the system's response. The system is accessible and maintainable, and its adaptability and long-term usefulness are further highlighted by plans for future scaling, mobile application development, integration with weather data, and cooperation with Municipal authorities.

## References

- [1] P. Tiwari, "IoT Based Smart Sewage Monitoring System using GSM and Wi-Fi Module," International Journal of Innovative Science and Research Technology, vol. 6, no. 5, pp. 995, May 2021. ISSN 2456-2165.
- [2] S. Bhutada, S. More, T. Shrivastav, C. Suryawanshi, and P. Suryawanshi, "IoT Based Smart Sewage Monitoring System for Smart City," International Journal for Research in Applied Science & Engineering Technology (IJRASET), vol. 10, no. XI, Nov. 2022, ISSN: 2321-9653, IC Value: 45.98, SJ Impact Factor: 7.538, pp. 1702.
- [3] R. Sarath Kumar, B. Maruthi Shankar, S. A. Sivakumar, P. Ananth, M. Mukunthan, and N. Parthipan, "Underground Drainage Monitoring System Using IoT," Solid State Technology, vol. 63, no. 2, 2020.

- [4] P. Suseendhar, S. Aravinthasamy, R. Karthick, D. Robin, A. Sathiyamoorthy, and E. Ajith, "Underground Drainage Blockage Detection and Rectification System," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE)*, vol. 10, no. 5, May 2021, DOI: 10.15662/IJAREEIE.2021.1005031.
- [5] T. Pathak, S. Deshmukh, P. Reddy, and H. P. Rewatkar, "Smart Drainage Monitoring and Controlling System Using IoT," *International Journal of Research in Engineering and Science (IJRES)*, vol. 9, no. 7, pp. 23-29, 2021. ISSN (Online): 2320-9364, ISSN (Print): 2320-9356.
- [6] S. Sultana, A. Rahaman, A. M. Jhara, A. C. Paul, and J. Uddin, "An IoT Based Smart Drain Monitoring System with Alert Messages," in *Intelligent Human Computer Interaction*, pp. 84-95, DOI: 10.1007/978-3-030-68452-5\_9, February 2021.
- [7] R. Shende, A. Sangode, V. Kalbande, M. Bhambore, and R. Khule, "Case Study of Smart RDMS System," *International Journal of Research in Engineering, Science and Management*, vol. 3, no. 2, pp. , Feb. 2020. ISSN (Online): 2581-5792.
- [8] Haswani, N. G., & Deore, P. J. (2018). Web-Based Realtime Underground Drainage or Sewage Monitoring System Using WirelessSensor Networks. In *2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA)* (pp. 1-6). IEEE.
- [9] R. T. Wahyuni, Y. P. Wijaya, and D. Nurmalasari, "Design of Wireless Sensor Network for Drainage Monitoring System," *Innovative Systems Design and Engineering*, vol. 5, no. 5, pp. 6, 2014. ISSN 2222-1727, ISSN 2222-2871.
- [10] N. Sonawane, P. Patil, and M. Pangaonkar, "DRAINAGE MONITORING AND CONTROLLING SYSTEM," in *Conference Proceedings of TECHNO-2K17 (Technical Symposium)*, *International Journal of Innovations in Engineering Research and Technology (IJIERT)*, ISSN: 2394-3696, Department of E & TC Engineering, Marathwada Mitra Mandal's College of Engineering, Pune, India.
- [11] R. K. V, S. S, T. Prasanna, T. N. Reddy, and P. N. Sudha, "LITERATURE SURVEY ON SMART REAL-TIME DRAINAGE MONITORING SYSTEM," *Journal of Emerging Technologies and Innovative Research (JETIR)*, vol. 10, no. 12, Dec. 2023, pp. [1-5], ISSN: 2349-5162.
- [12] G. Sonawane, C. Mahajan, A. Nikale, and Y. Dalvi, "Smart Real-Time Drainage Monitoring System Using Internet of Things," *IRE Journals*, vol. 1, no. 11, May 2018, ISSN: 2456-8880, pp. 1-6.
- [13] S. V. S. Bharath, S. T., S. Kaviti, and B. B., "Drainage Monitoring System Using IoT (DMS)," *Indian Journal of Public Health Research and Development*, Oct. 2017.
- [14] C. Booma Devi, J. Jafri Sheran, D. Lakshanaa, and N. Logalakshmi Bala, "IoT based Underground Drainage Monitoring System using Pic Microcontroller," *International Journal of Engineering Research & Technology (IJERT)*, vol. 10, no. 09, ICONNECT– 2022 Conference Proceedings, ISSN: 2278-0181.