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Prevention of Water Overflows and Leakages at the Maharshi Parshuram College of Engineering Campus

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Abstract

Water is one of the fundamental necessities of human life, essential for a wide range of daily activities. People rely on water for drinking, cleaning, cooking, irrigation, and industrial processes. To meet these needs, water is often pumped from ground storage to overhead tanks. However, the use of non-automated switches to operate pumping machines can lead to significant issues, such as water overflow and unnecessary electricity consumption. The proposed system aims to tackle these challenges by providing users with real-time updates on water levels in storage tanks. This system integrates a microcontroller and leverages mobile networks to notify users about water levels via mobile notifications. Additionally, the quality of water is monitored by measuring parameters such as chlorine concentration and salinity. If the water quality deviates from acceptable levels, the user receives an SMS alert. Leakage detection is another crucial feature of the system. Pressure sensors continuously monitor the water flow. If abnormal low pressure is detected, the system identifies a potential leakage and notifies the user via a mobile call, ensuring prompt action. This comprehensive approach not only prevents water wastage but also optimizes electricity consumption. Water leakage, a common issue in homes, public spaces, and residential colonies, significantly contributes to water wastage. A small but steady leak can result in the loss of approximately 226,800 liters of water annually. Awareness and consciousness regarding water wastage are vital to ensuring the availability of adequate water supplies to meet daily needs. In this project, embedded systems are utilized to minimize water overflow and leakage by controlling the valves automatically. As urbanization progresses, water, an essential resource, remains underprioritized and often wasted. Historical civilizations thrived or collapsed based on their water management practices, a lesson modern society must heed. With this knowledge, it is imperative to adopt innovative solutions and responsibly manage this critical resource.

Keywords: Water overflow, leakages, prevention, embedded systems, water quality monitoring

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INTRODUCTION

The present era has witnessed a technological revolution, transforming how we analyze and control our environment. Machines are increasingly replacing human efforts in both industrial and domestic spheres. Water, which is a necessity for all living organisms, plays a vital role in daily life.

Humans use water for agricultural, industrial, and household purposes. According to the Ministry of Water Resources, India hosts 18% of the global population but only 4% of the world's usable water resources. Approximately 8% of global water usage is attributed to household activities alone.

SITE SURVEY

The selected sites for implementing this project are the Vidya Prasarak Mandal, Maharshi Parshuram College of Engineering, and Velneshwar Campus. This location offers an opportunity to study and address real-world water management challenges. The insights gained from this study will guide the practical implementation and optimization of the system.

By introducing this technology, we aim to create an efficient and sustainable system that minimizes wasted water and enhances resource conservation [1–3]. The selected site name is Vidya Prasarak Mandal, Maharshi Parshuram College of Engineering, Velneshwar Campus (Figures 1–9, and Tables 1–3).

Figure 1. Google Map of Maharshi Parshuram College of Engineering Campus.

Figure 2. Maharshi Parshuram College of Engineering Campus.

Table 1. Description of member in college.

S.N.	Description	People number
1	Students staying at hostels	74
2	Students at college	212
3	Teaching staff	33
4	Non-teaching staff	31
5	Housekeeping	14
	Total	364

Table 2. Location table and water use detail.

Name of Institute	VPM's Maharshi Parshuram College of Engineering, Velneshwar
Address	Velneshwar, Guhagar, Ratnagiri, State Highway 78, Hedvi Road Guhagar, Maharashtra, India
Latitude	17.3901267°
Longitude	73.224695°
Nearest city	Guhagar
Water resources	Wells and borewells
Average water consumption per day by the institute	1,56,000 liters
Wastewater going to STP	1,25,000 liters
Water storage tank	9 lac liters

Table 3. Estimation of water requirement for drinking and domestic use.

S.N.	Particulars	No.	Water consumption limit in liters/day	Total water in liters/day
1	Students staying at hostels	74	135	9990
2	Students at college	212	50	10600
3	Teaching staff	33	50	1650
4	Non-teaching staff	31	50	1,550
5	Housekeeping	14	50	700
6	Visitors	4	50	200
	Total	364		24690

Water Storage Tank

The water storage tank has a high capacity of water and is crucial for campus water supply. Issues such as leakage and overflow have been identified, leading to significant water loss. The goal is to implement preventive measures to ensure efficient and sustainable water usage.

Aim

To prevent water overflow and leakage and find a solution for overflow and leakage.

Objective

1. To prevent water leakages.
2. To prevent the water overflows.

Problem Definition

After conducting a survey, the problem statement identifies that there are leakages on our campus, and it seems that overflow also occurs, which may lead to major water loss [4, 5].

METHODOLOGY

Methodology describe in Figures 3–7.

Figure 3. The capacity of the storage tank is 9 lakh liters.

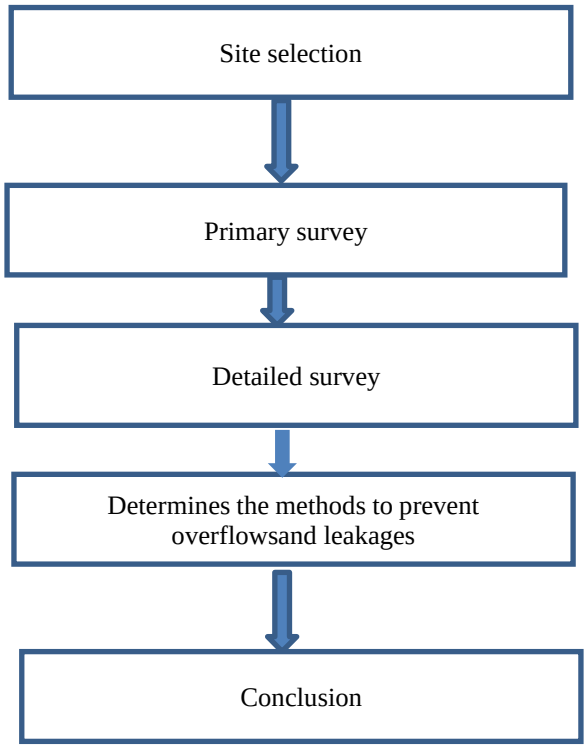

Figure 4. Methodology.

Figure 5. The location is Jnyaneshwari 4.

Figure 6. Pipe section for water leakage prevention.

WATER LEAKAGES

Water Leakages: Causes, Impacts, and Solutions

Water leakage is a critical issue that affects domestic, commercial, and industrial environments. It occurs when water escapes unintentionally from pipes, fittings, or storage systems owing to damage, corrosion, or poor maintenance. This problem is widespread and has far-reaching consequences, including water wastage, structural damage, and increased costs for consumers and utility providers [6].

Causes of Water Leakages

Leakages often result from aging infrastructure, faulty installations, or mechanical stress on the pipes. Corrosion due to chemical reactions between the water and pipe materials is another significant factor (Figure 7). Extreme weather conditions, such as freezing temperatures, can lead to pipe bursts, whereas high water pressure or sudden pressure changes can exacerbate the risk [7].

Figure 7. Joint machine domestic water consumption.

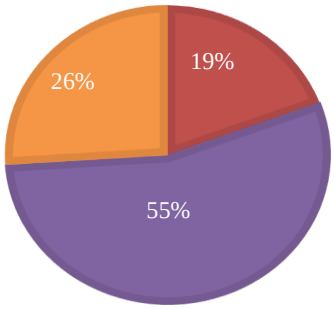

Figure 8. Graph of water consumption.

Impacts of Water Leakages

The repercussions of water leakage are both environmental and economic. From an environmental perspective, leakage contributes to the depletion of water resources, which is a pressing concern in regions that face water scarcity. The energy required to treat and transport water that eventually leaks also contributes to the carbon footprint. Economically, leaks lead to increased water bills for consumers and higher maintenance costs for utility providers. In buildings, persistent leaks can cause dampness, mold growth, and structural damage, endangering the health and safety of the occupants [8].

Solutions to Address Water Leakages

Addressing water leakage requires a combination of technological-, infrastructural-, and policy-driven approaches. Smart technologies, such as Internet of Things (IoT)-based water management systems, play a pivotal role in detecting and monitoring leaks in real time. Sensors can pinpoint leakage locations, whereas data analytics can help predict and prevent future occurrences. Regular maintenance of water infrastructure and replacement of outdated components can mitigate risks. Public awareness campaigns emphasizing the importance of water conservation and reporting leaks can also drive community involvement in addressing this issue [9]. By investing in advanced solutions and sustainable practices, societies can significantly reduce water leakage and ensure the conservation of this vital resource for future generations (Figures 8–10).

Summary Water Consumption

Figure 8 illustrates the distribution of water consumption across different sectors. Domestic usage accounts for 26%, industrial usage for 19%, and agricultural consumption dominates with 55%. This highlights the significant demand in the agricultural sector, emphasizing the need for efficient water management strategies.

Figure 9. Water leakage.

Figure 10. The location is below the main water tank.

Methods to Prevent Leakages

Water leakage can cause significant damage to infrastructure, increase water waste, and lead to costly repairs. To prevent leakage, it is essential to adopt appropriate measures to ensure a secure and efficient water distribution system. Below are some key methods for preventing water leakage.

1. *Tighten the fittings:* Properly tightened fittings help ensure that water does not escape from connections or joints. Regularly inspecting and tightening loose fittings can prevent minor leaks from becoming major issues.
2. *Seal the joints:* Applying high-quality sealing materials to the joints can significantly reduce the likelihood of leaks. Sealing products such as pipe thread sealants or Teflon tapes create a durable barrier against water seepage.

3. *Schedule professional inspections:* Routine inspections by professionals can help identify potentially problematic areas before they lead to significant leaks. Experts have used advanced techniques such as pressure testing and thermal imaging to detect hidden leaks and ensure a well-maintained system (Figure 11) [10, 11].

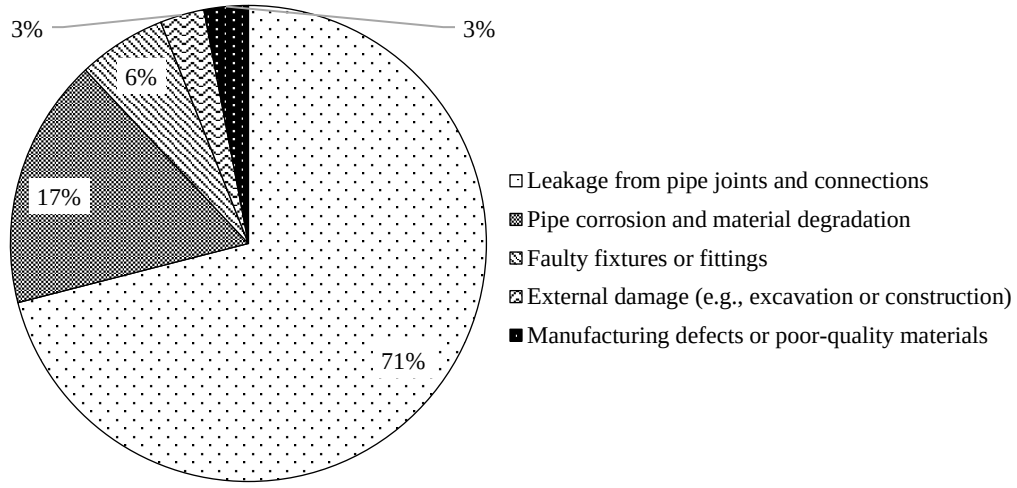

Figure 11. Sources of water leakage.

Water Leakage Prevention Materials

Various materials are available to address and prevent water leakage in different applications. These materials provide effective solutions for enhancing the durability and water resistance of the structures.

1. *Waterproofing membrane:* A waterproofing membrane is a thin layer of material applied to surfaces, such as roofs, walls, or foundations, to prevent water penetration. These membranes can be either liquid- or sheet-based, providing a seamless and durable barrier to water infiltration.
2. *Sealants:* Sealants are versatile materials that are used to fill gaps, joints, and cracks on various surfaces. They are commonly applied in areas such as windows, doors, pipes, and concrete joints to prevent water seepage. Silicone and polyurethane sealants are popular choices because of their flexibility and water resistance.
3. *Waterproofing coatings:* These liquid-applied coatings form a protective barrier on the surface, preventing water penetration. Waterproofing coatings are suitable for use on concrete, masonry, or metal surfaces, and are often used in basements, terraces, and industrial settings.
4. *Grout:* Grout is a mixture of cement, sand, and water used to fill the gaps between tiles or stones. It is commonly used in bathrooms, kitchens, and swimming pools to prevent water from seeping through gaps. Specialized waterproof grouts are available for enhanced performance.
5. *Expansion joints:* Expansion joints are designed to accommodate movements caused by temperature changes or structural settling. These joints provide flexibility and help to prevent cracks that can lead to water leakage. They are frequently used in bridges, buildings, and other large structures.
6. *Waterproofing adhesives:* These adhesives are used to securely bond waterproofing membranes or coatings to surfaces, thereby ensuring a watertight seal. High-quality adhesives enhance the longevity and effectiveness of waterproofing systems.

Methods to Prevent Overflow

Water overflow is another common issue that can lead to water wastage and potential property damage. By employing advanced technologies and effective methods, it is possible to control and prevent water overflow efficiently. Some of these methods are as follows.

1. *Ultrasonic sensors:* Ultrasonic sensors are used to detect the water levels in tanks or reservoirs. These sensors use sound waves to measure the distance between the sensor and the water surface, triggering alarms or automated controls when the water level exceeds a predetermined threshold.

2. *Mobile sensors:* Mobile sensors are portable devices that can be placed in various water storage systems to monitor and control the water levels. They are often integrated with mobile applications, allowing users to receive real-time updates and manage water usage remotely.
3. *Water overflow detectors:* Water overflow detectors are simple devices that sound an alarm when the water reaches a critical level. These detectors are easy to install and are widely used in homes and commercial buildings to prevent overflow.
4. *Wireless sensor networks:* Wireless sensor networks consist of interconnected sensors that monitor the water levels and flow rates. These systems provide real-time data and alerts, enabling users to take immediate action to prevent overflows.
5. *Water level controllers:* Water level controllers automate the process of filling and draining the water tanks. These devices use sensors to maintain optimal water levels, prevent overflow, and ensure efficient water use.

CONCLUSION

In this project, we explored various methods and technologies to prevent water overflow and leakage, both of which are critical for conserving water and protecting the infrastructure. This study highlighted the importance of using advanced equipment, such as water level controllers, ultrasonic sensors, and wireless sensor networks, to manage water levels effectively.

Furthermore, we examined the role of high-quality materials, such as waterproofing membranes, sealants, and adhesives, in minimizing water leakage. These materials provide reliable solutions for preventing water penetration in different structures and enhancing their longevity and functionality.

By reviewing research papers and analyzing practical applications, we gained valuable insights into efficient water management practices. Implementing these strategies can lead to significant reductions in water waste and maintenance costs, thereby contributing to sustainable development and environmental conservation. Adopting a proactive approach to water management ensures that both the household and industrial systems operate smoothly and efficiently.

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