

Eco Hydra- Sustainable water Recycling and Dispensing system

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Abstract - This project outlines a sustainable water treatment and distribution process that transforms treated wastewater into usable resources through a multi-stage purification and smart delivery system. Beginning at the source Sewage Treatment Plant (STP), treated wastewater is collected and clarified to reduce BOD, COD, PH, TDS making it safe for further refinement. This approach maximizes water reuse potential, addressing the growing demand for clean and sustainable water sources in urban and rural settings.

The project also incorporates a smart distribution framework for efficient water allocation and monitoring, reducing wastage and improving operational efficiency. The proposed approach supports sustainable water management by promoting wastewater recycling, minimizing freshwater dependency, and encouraging resource recovery. The system can be effectively implemented in urban and rural regions to address water scarcity challenges while ensuring environmental protection and sustainable development.

Key Words: Wastewater Treatment, STP, Water Reuse, BOD, COD, TDS, Smart Distribution, Water Recycling, Sustainable Water Management, Water Conservation, Environmental Engineering, Resource Recovery

1.INTRODUCTION

The proposed Water ATM project presents a sustainable and innovative approach for wastewater reuse and smart water distribution by integrating plant-based remediation techniques with automated water dispensing systems. The process begins with the collection of wastewater from a Sewage Treatment Plant (STP) or other wastewater sources, which is then treated using constructed wetlands and phytoremediation methods. Aquatic plants such as water hyacinth naturally absorb contaminants, suspended particles, nutrients, heavy metals, and organic pollutants from the wastewater, thereby improving water quality in an eco-friendly and cost-effective manner. This treatment process significantly reduces important water quality parameters such as Biological Oxygen Demand (BOD), Chemical

Oxygen Demand (COD), Total Dissolved Solids (TDS), turbidity, and harmful microorganisms while minimizing the use of chemicals and energy-intensive treatment methods.

After plant-based treatment, the water undergoes additional filtration and purification processes such as sediment filtration, activated carbon filtration, and disinfection to make it suitable for domestic and non-potable applications including irrigation, toilet flushing, gardening, cleaning, and construction activities. The treated water is then supplied through a smart Water ATM system equipped with monitoring sensors and controlled dispensing mechanisms for efficient water allocation and reduced wastage. The proposed system promotes wastewater recycling, minimizes dependence on freshwater resources, and supports sustainable water management practices. Furthermore, it provides an affordable and scalable solution for urban and rural communities facing water scarcity challenges while contributing toward environmental protection and sustainable development goals.

2. Body of Paper

2.1 Existing Wastewater Treatment Systems and their Limitations

Traditional wastewater treatment systems mainly focus on pollutant removal and safe disposal of wastewater into natural water bodies. Conventional treatment plants involve primary, secondary, and tertiary treatment processes using mechanical, biological, and chemical methods. Although these systems are effective in reducing contaminants, they face several limitations:

- High energy consumption and operational cost
- Requirement of skilled manpower and maintenance
- Excessive chemical usage during treatment
- Limited reuse and recycling applications
- Sludge generation and disposal challenges
- Inadequate water distribution and monitoring mechanisms

These limitations highlight the need for sustainable, low-cost, and environmentally friendly wastewater treatment technologies integrated with efficient water reuse systems.

2.2 Role of Phytoremediation in Wastewater Treatment

Phytoremediation is an eco-friendly wastewater treatment technique that utilizes aquatic plants to remove contaminants from polluted water. Plants such as water hyacinth possess high nutrient absorption capacity and extensive root systems that support microbial activity. These plants absorb dissolved nutrients, suspended solids, organic matter, and heavy metals from wastewater, thereby improving water quality naturally.

Constructed wetlands using water hyacinth help in reducing Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), turbidity, and harmful microorganisms. Compared to conventional treatment systems, phytoremediation requires less energy, lower maintenance cost, and minimal chemical usage. Therefore, it is considered a sustainable and economical solution for wastewater treatment, especially in developing regions and water-scarce areas.

2.3 Smart Water ATM Systems: State of the Art

Water ATM systems are modern automated water dispensing systems designed to provide controlled and efficient water distribution. These systems are widely used for community water supply, purified drinking water distribution, and sustainable water management applications. Advanced Water ATM systems include digital monitoring, prepaid smart cards, sensors, automated flow control valves, and real-time water usage tracking mechanisms.

The integration of Water ATM technology with treated wastewater reuse systems can improve water accessibility while minimizing water wastage. Smart monitoring systems also help in maintaining water quality standards, detecting leakage, and optimizing operational efficiency. Such systems provide a practical solution for sustainable water management in urban and rural communities.

2.4 Working Principle of the Proposed System

The working principle of the proposed system is based on biological remediation and automated smart distribution. Wastewater entering the constructed wetland passes through the root zone of water hyacinth

plants, where contaminants are absorbed and decomposed by microbial activity. The phytoremediation process helps in reducing organic pollutants, nutrients, suspended solids, and dissolved contaminants naturally.

The partially treated water then undergoes physical and chemical purification through filtration and disinfection processes. Finally, the purified water is supplied through the Water ATM system for reuse applications such as irrigation, cleaning, toilet flushing, gardening, and construction activities. The smart monitoring system ensures controlled dispensing, operational efficiency, and reduced water wastage.

2.5 Advantages of the Proposed System

The proposed Water ATM system offers several environmental, economic, and operational advantages:

- Eco-friendly and sustainable wastewater treatment
- Low operational and maintenance cost
- Reduction in freshwater dependency
- Efficient wastewater recycling and reuse
- Smart monitoring and automated distribution
- Reduced environmental pollution
- Suitable for urban and rural implementation
- Supports Sustainable Development Goals (SDGs)
- Promotes water conservation and resource recovery

2.6 Applications of the Proposed System

The treated water produced from the proposed system can be effectively used for:

- Irrigation and agriculture
- Gardening and landscaping
- Toilet flushing
- Vehicle washing
- Construction activities
- Industrial cooling purposes
- Cleaning and maintenance works
- Groundwater recharge applications



Fig 1 - Model

3. CONCLUSION

The proposed Water ATM project provides a sustainable and eco-friendly solution for wastewater treatment and reuse using phytoremediation and smart distribution technology. The system effectively reduces pollutants such as BOD, COD, and TDS through natural plant-based treatment and advanced filtration processes. By integrating a smart Water ATM system, the project promotes efficient water distribution, reduces freshwater dependency, and supports sustainable water management practices. The proposed model offers an affordable and scalable solution for addressing water scarcity and environmental conservation in urban and rural areas.

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