Sustainovation 2025

Team Onyx

Team Name: Team Onyx

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2	Member 2	N.NISHANTH RAJ	4th year
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Clean Water Track

Problem Statement 3:

How can we design a water management system that helps schools (for children) or senior centers to efficiently monitor and conserve water usage, promoting sustainability in their everyday activities?

The Problem We Are Solving -->

- Schools and senior centers use a **large amount of water** daily — for washing hands, flushing toilets, cleaning, and gardening.
- Most of the **used water (greywater)** from sinks, showers, and laundry is **wasted** even though it can be **safely reused**.
- There's **no awareness** and **easy way to monitor** how much water is being consumed and wasted.
- Institutions **lack affordable**, **smart systems** to **conserve**, **reuse**, and **educate** people about **sustainable water practices**.
- Often, janitorial staff or children unintentionally **leave taps** running or **tanks overflowing** due to a **lack of** real-time feedback, resulting in silent, daily water loss that goes unnoticed

Proposed Solution:

We're building **AquaSage**, **a smart**, **affordable**, and **educational** water-saving **system** designed for schools and senior centers.

1. Monitors Water Usage Automatically

- Uses **smart IoT water sensors** to track how much water is used in different parts of the building.
- Alerts if there is **excessive usage** or a **leak**
- Example: Room 4 used 500L today 100L more than usual!

Note: do check out the workflow for recycling watch here

2. Recycles Greywater Safely

- **Filters and reuses dirty water** from sinks and laundry (greywater).
- Makes it usable again for: **Garden irrigation, Toilet flushing, Cleaning floors**
- Uses **UV, sand, and mesh filters — a cost-effective and easy-to-maintain solution**
- Show what water is reused for: garden, toilets, cleaning

Check out code Github

Proposed Solution:

We're building **AquaSage**, **a smart**, **affordable**, and **educational** water-saving **system** designed for schools and senior centers.

3. Educates & Engages Using AI

- Interactive **AI chatbot assistant (HydroBot)** helps students and seniors:
- Receive alerts: "Tap is leaking!" or "Water garden using recycled water
- Learn about water-saving tips in simple language
- Alerts if there is **excessive usage** or a **leak**

4.HydroVision – Computer Vision Leak Detection

- Use **AI + camera** to visually detect:
- Open or dripping taps
- Overflowing water tanks
- Leaking pipes under sinks
- **Camera (Raspberry Pi or USB) + ML model (YOLO/MobileNet)**
- Real-time leak alerts sent to the dashboard and AI chatbot.

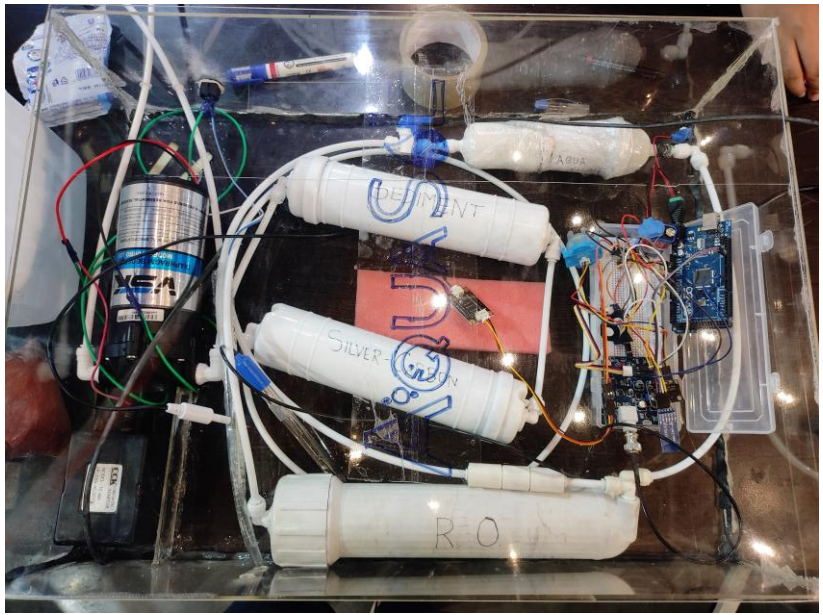
5. Digital Reward System for Engagement of Students

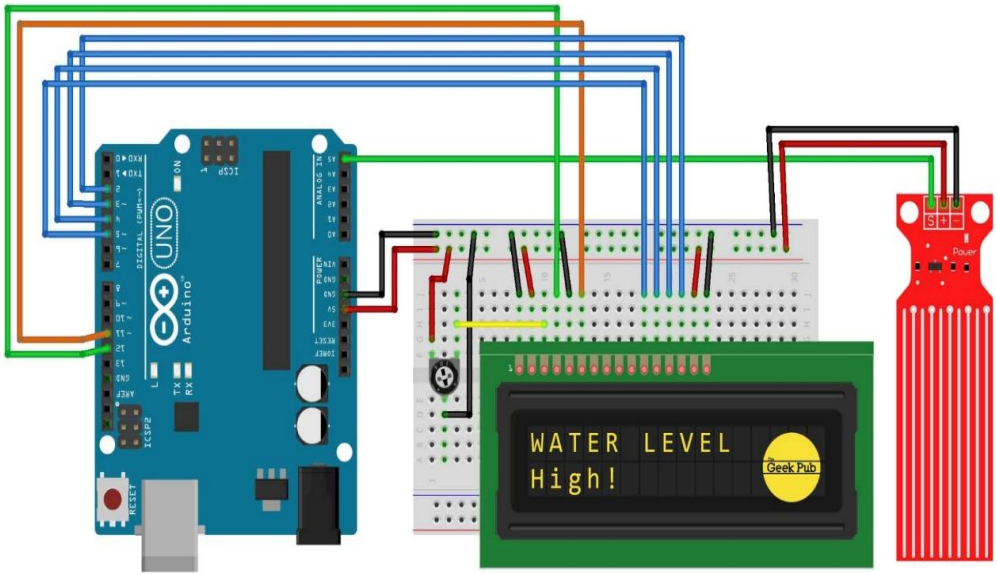
- A gamified **digital reward system** where users earn AquaCoins by:

Completing quiz	+15 AquaCoins
Reporting a leak	+10 AquaCoins
Digital badges 🏅	

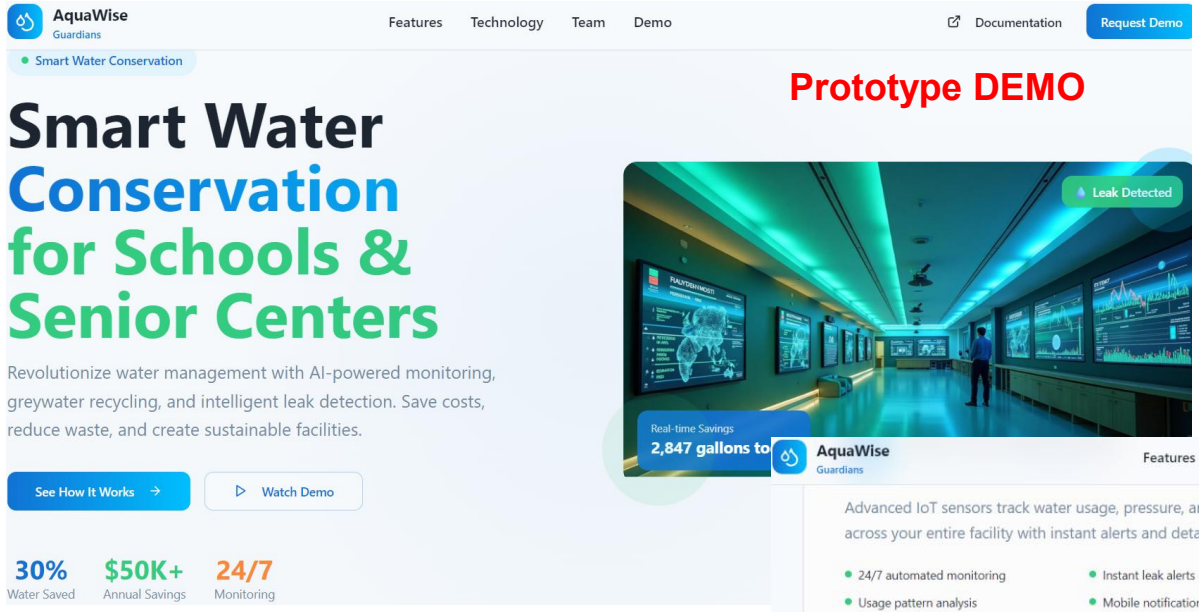
Working Prototype-MVP

PROCESS FLOW ARCHITECTURE for Recycled Greywater





We integrated a **low-cost Arduino water level sensor** to monitor greywater levels in the reuse tank in real-time.
Enables **auto-cutoff to prevent overflow** and triggers reuse mechanisms when the tank is full.
Uses LCD + water sensor to show water status like: **"Water Level: High"** → ideal for smart control and maintenance.
Simple, scalable, and educational – perfect for schools, hostels, and senior centers.



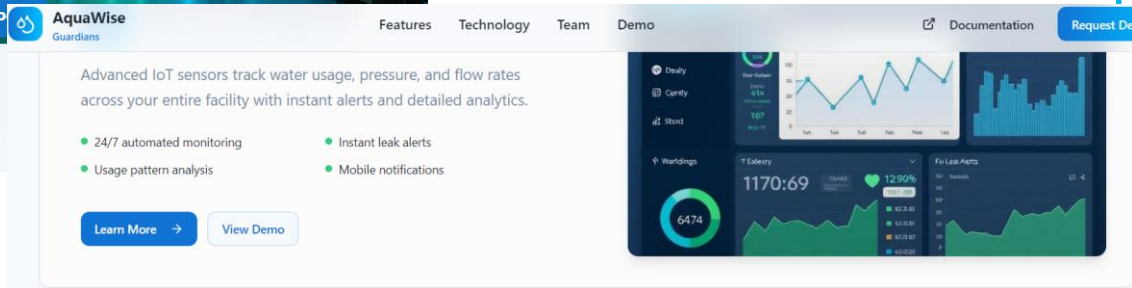
Prototype DEMO

Live Demo | Smart Water Management System

Click to Watch Demo

Source Code Repository

View on GitHub

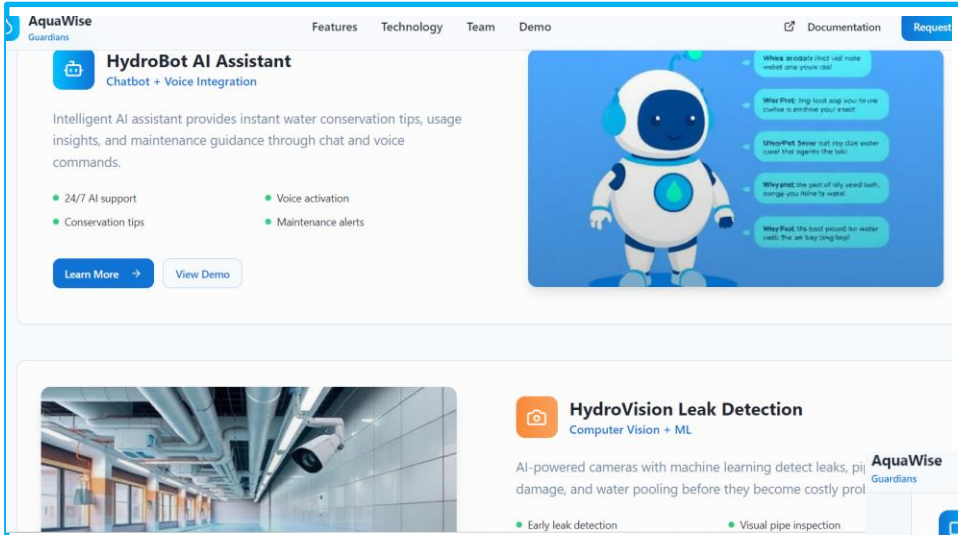


Greywater Recycling
UV/Sand Filtration System

Recycle sink and shower water through our advanced filtration system for irrigation and toilet flushing, reducing consumption by up to 40%.

- 40% water reduction
- UV sterilization
- Automated irrigation
- Cost-effective setup

Product Status: Currently, 85% of the development is complete.
Core functionalities like real-time monitoring and greywater reuse logic are fully implemented — final testing and UI polish are in progress, and final backend integration.



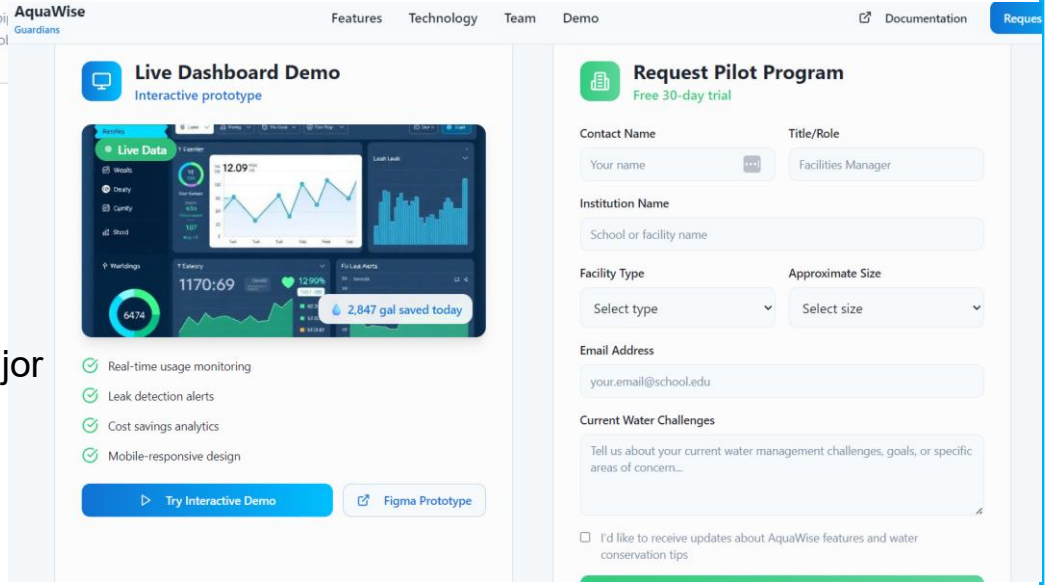
Prototype DEMO

Additional Module

Click to Watch Demo

Modular Implementation:

Project Repository



Live Website:

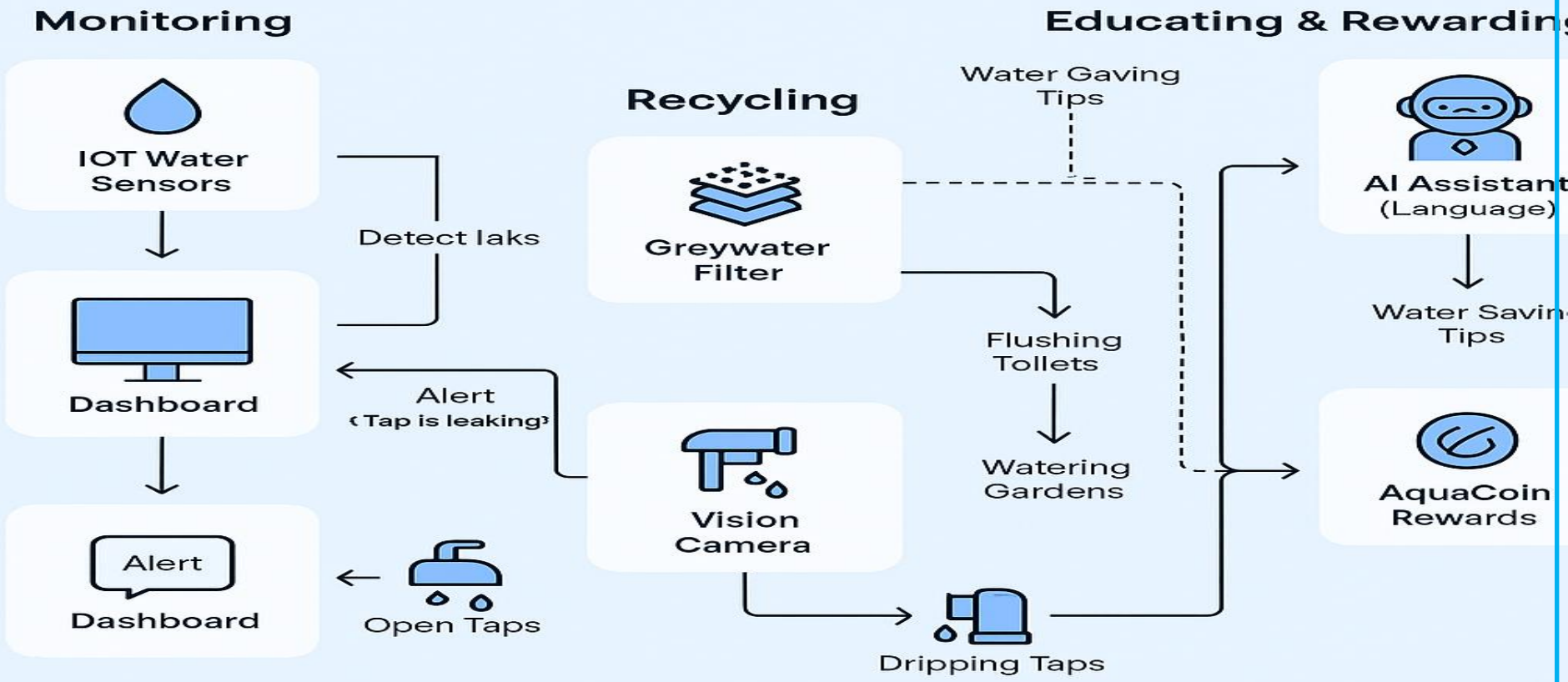
Click here to view the project

Please Note:

We have successfully developed and tested all major components — AI agents, IoT systems, backend APIs, and frontend UI. We are now in the final integration phase to deliver a unified, intelligent application.

PROCESS FLOW ARCHITECTURE

AquaSage



System Components & Technologies Used

System Component	Technologies Used
IoT Water Sensors	ESP32, Flow Meters, IR Sensors, Ultrasonic Sensors
Greywater Filter Unit	Arduino, UV Filter, Sand Filter, Mesh Layers, Solenoid Valves
AI Assistant (HydroBot)	OpenAI API, LangChain, Dialogflow (optional for voice)
Reward System (AquaCoin)	Firebase DB, Google Sheets (basic), Polygon + Web3.js (advanced)
Vision Camera Module	Raspberry Pi Cam, YOLOv8, TensorFlow Lite, OpenCV
Dashboard (Admin/Student)	React.js, Tailwind CSS, Firebase, Chart.js, ShadCN UI
Frontend Interface	React.js, Vite, Tailwind CSS, Heroicons
Backend Server	Node.js, Express.js, Firebase Functions, Firestore
Hosting & Deployment	Vercel, Firebase Hosting, Google Cloud Functions

Budget / Cost Sheet (Per School/Senior Center Unit)

Item	Approx. Cost (INR)	Notes
IoT Sensors (5–6 nodes)	₹3,000 – ₹5,000	Flow + IR + water level sensors with ESP32 microcontrollers
Greywater Filter Unit	₹4,000 – ₹6,000	UV light + 3-stage sand/mesh setup (local materials available)
Camera (CV detection)	₹2,500 – ₹4,000	Raspberry Pi Cam + Mount
AI Assistant Setup	₹0 – ₹1,500	OpenAI API free tier or LangChain with local inference
Dashboard (Web App)	₹0 – ₹1,000	Firebase (Free tier), optional hosting with Vercel
Reward System (Gamified)	₹0 – ₹1,000	Firebase or basic spreadsheet; optional Polygon-based tokens
Installation & Assembly	₹2,000 – ₹3,000	Labor and plumbing/electrical setup
Maintenance (Annual)	₹1,000 – ₹2,000	Filter cleaning, occasional repairs

Total Estimated Cost: ₹12,500 – ₹22,500 (~$150 – $270 USD)

Savings: Pays for itself in **less than 6–8 months** of reduced water bills and maintenance.

ASSURED

Affordable

Scalable

Sustainable

Universal

Rapid

Excellent

Distinctive

Innovation & Uniqueness

•First-of-its-kind combo of AI agent + IoT + greywater reuse + computer vision + gamification in schools & senior centers.

•Uses **real-time behavior reinforcement** (HydroBot + AquaCoin) not just monitoring, but *changing habits*.

•Camera-based leak detection (HydroVision) — **goes beyond traditional sensors.**

•Most water-saving systems are technical. Ours is **playful**, **educational**, **and inclusive**

•Works for **kids AND the elderly**, designed with **accessibility and simplicity**.

•AI speaks in age-appropriate, **local language** (can integrate TTS, speech input).
•Works in **offline/low-internet settings** (NFC + local ESP32 storage → syncs later)

Business Development Plan – AquaSage

Target Users

1. Educational Institutions (Schools, Colleges, Hostels
2. Care & Commercial Facilities (Senior Homes, Hotels, Businesses)
3. Institutions Driving Impact (NGOs, CSR, Government Bodies)

Revenue Streams

Hardware + SaaS: Kit sales and dashboard subscriptions.
CSR + Govt Grants: Funding via partnerships and tenders.
Training + Add-ons: Paid modules, AquaCoin, OSS support.

Scaling Plan

Phase 1: Onboard 50+ schools via govt schemes or CSR pilots.
Phase 2: Scale to 500+ schools with flexible pricing by region.
Phase 3: Expand globally via UN/NGO partnerships in developing regions.

Plan for Further Development

1.AI & Data Intelligence: Enhance HydroBot with **predictive analytics** and **real-time leak detection**.
2. **Global-Ready Platform:** Localize language, compliance, and distribution for international NGO/government rollouts

3. **Student Engagement Gamification:** Expand AquaCoin into a full reward ecosystem with leaderboards and eco-challenges.

4. **Offline Functionality:** Add low-connectivity features using SMS/USSD for rural and remote deployments.

5. **Policy Impact Dashboard:** Aggregate anonymized data into visual reports for government and ESG stakeholders.

Note:
We wasted. We know the value of every drop; that's why we chose this problem statement to create a game-changing **smart water management** solution.
Our application **empowers communities** to monitor, reuse, and save water like never before.

RESEARCH AND REFERENCES

REFERENCE LINKS:

- Sustainable Development Goal 6 (Clean Water & Sanitation)
- India Water Portal – Greywater Reuse in Schools & Homes
- https://jalshakti.gov.in/
- World Health Organization (WHO) – Safe Water Facts

Patent References

- ✓ IoT-Based Water Monitoring System
- ✓ Greywater Recycling System and Method
- ✓ Greywater Filtration and Reuse System
- ✓ Automated Water Conservation System

THANK YOU

WEBSITE REFERENCES:

- Guidelines for Greywater Use
- United Nations – Water Scarcity and Sustainable Development Goals
- Ministry of Jal Shakti – Government of India
- **IEEE Citation**