IS 1901 – Microcontroller based ICT Project

PROJECT PROPOSAL REPORT

Level 01

Real-time Household Water Management System

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Table of Contents

1. Introduction 2

1.1. Problem in Brief 2

1.2. Significance of study 2

2. Literature Study 3

3. Proposed Solution 4

3.1 Features of the Proposed Solution 4

3.2 Components Required for the Proposed Solution 6

3.3 Nature of the Solution 7

3.4 Solution Design 8

3.5 Resources 9

3.6 Workload Matrix 10

4. References 10

1. Introduction

Efficient management of water in households is crucial for promoting responsible usage practices and ensuring a sustainable environment. However, the absence of a proper system to track household water usage, check water cleanliness and prevent water overflow poses significant challenges. This highlights the need for innovative solutions to address these concerns and empower consumers to monitor and manage household water usage effectively.

1.1. Problem in Brief

The primary objective of this project is to provide a solution for the prevalent concern in a contemporary household which is the lack of comprehensive understanding and strategies for effective monthly water usage within budgetary constraints which owing to consumers often struggling to track their water consumption and manage the usage effectively. Furthermore, the absence of a real-time solution for monitoring and controlling water usage leads to inefficient usage and water overflowing in household contexts. Additionally, the deficiency of a convenient method for assessing water quality within households further compounds these challenges and highlights the necessity of the development of a user-friendly solution to streamline these critical facts of water management in households.

1.2. Significance of study

This project addresses the need for effective water management solutions in households by providing a comprehensive system that monitors water levels, prevents overflow, and ensures water quality. This addresses a critical gap in current practices, where consumers often struggle to manage their water usage efficiently. The impact of the problem on relevant stakeholders, including homeowners, renters, and property managers, is significant. Inefficient water management practices can lead to unnecessary wastage and increased utility bills. Moreover, compromised water quality poses health risks to household residents. Existing manual monitoring methods or basic sensor-based systems for household water management lack real-time monitoring capabilities, user-friendly interfaces, and comprehensive features for managing water usage effectively. The proposed project seeks to

surpass these limitations by integrating advanced technology, automated functionalities, and a user-friendly mobile/web application increasing transparency.

Aim:

The aim of this project is to optimize efficient water management practices, alongside facilitating the monitoring of water quality and prevention of water overflow, seamlessly integrating into the routines of the individuals, and addressing the challenges posed by contemporary demanding lifestyles.

Objectives:

- To develop hardware sensors capable of accurately measuring water levels in tanks and detecting overflow conditions to prevent wastage.
- To implement sensors to assess water quality by measuring the total amount of dissolved solids in water.
- To develop a user-friendly mobile/web application allowing users to set monthly water usage preferences, receive daily usage summaries, and receive alerts upon reaching 80% and full depletion of allocated water units.
- To develop an affordable, simple, efficient, and real-time system, compared to the existing water management systems.

2. Literature Study

One established method for monitoring water level in tanks is using water level indicator which utilizes nine probes placed inside the tank or water container in increasing order of height, displaying the water level of the tank using a seven-segment display where ‘0’ indicates an empty tank and ‘8’ indicates a full tank. Additionally, a buzzer is incorporated here to notify the user that the container is full. Thus, the indicator provides users with detailed information on the water level in water tanks [1].

However, the use of nine probes is high cost and the temperature changes, humidity, and quality of water might affect the probes as those are placed in water. Furthermore, over time probes

might be susceptible to corrosion due to the same reason which might require regular maintenance or replacement.

Another currently existing solution for water management is using a water level controller that uses an 8051 microcontroller to display the water level of the tank using an LCD and to control the motor automatically according to the water level [2].

The suggested solution incorporates an ultrasonic sensor to detect water levels which makes the system cost-effective, less susceptible to corrosion, and low maintenance addressing the issues with the water level indicator. Additionally, has integrated the automatic motor control feature using a relay module and solenoid valve with advanced features such as an app with previous records of water usage, preference of water usage, the remaining amount preferred and water quality.

3. Proposed Solution

Our solution addresses the absence of a proper system to track household water usage, check water cleanliness, and prevent water overflow by leveraging a combination of hardware and software technologies. Additionally, the solution involves developing a user-friendly mobile or web application for interaction with the system. Through this app, users can input their budgetary amount for the month and receive real-time updates on their water usage. Additionally, by incorporating a database, users can track their water consumption over time. Furthermore, the app provides information on water level and water cleanliness, ensuring users have comprehensive oversight of their water management.

3.1 Features of the Proposed Solution

- **ESP32**: This will serve as the main microcontroller, responsible for interfacing with the various sensors and controlling the relay module and solenoid valve. It will also handle communication with the app via Wi-Fi or Bluetooth.
- **Water Flow Sensor**: This sensor will be used to measure the flow rate of water passing through a pipe. It will help in monitoring water usage in real-time.

- **Ultrasonic Sensor**: The ultrasonic sensor can be used to measure the water level in a tank. This information is essential for preventing water overflow and ensuring efficient usage.
- **TDS Sensor**: The Total Dissolved Solids (TDS) sensor measures the concentration of dissolved solids in water. This can help in assessing water cleanliness and quality.
- **GSM Module**: The GSM module will play a pivotal role in alerting the user regarding their water usage in accordance with the budgetary amount they have entered. For instance, it will notify the user when they have consumed 80% of their input amount, reached 100% of their input amount, or exceeded it. This proactive notification system ensures that users are promptly informed about their water consumption status, empowering them to manage their usage effectively and stay within their set budget.
- **Relay Module**: The relay module will be used to control the solenoid valve. It can be triggered by the microcontroller to open or close the valve based on the water level.
- **Solenoid Valve**: The solenoid valve is a type of valve that is electromechanically controlled. It can be used to regulate the flow of water in a pipe. In this project, it can be employed to shut off the water supply in case of overflow.

Capability to solve the problem.

- **Real-time Monitoring**: Users receive real-time updates on water usage, enabling them to track their consumption and make informed decisions.
- **Budgetary Control**: Alerts notify users when they approach or exceed their budgeted water usage, empowering them to adjust their behaviour accordingly and prevent overspending.
- **Water Quality Assurance**: The system provides insights into water quality, ensuring users are aware of any potential issues and can take corrective actions promptly.
- **Prevention of Water Wastage**: By allowing remote control of water flow, the system helps prevent wastage due to overflow or unnecessary usage, contributing to water conservation efforts.

Feasibility of Implementation

- **Hardware**: The required hardware components, such as ESP32, sensors, GSM module, relay module, and solenoid valve, are readily available and relatively affordable. Integration and assembly may require basic electronics skills but can be achieved with off-the-shelf components.
- **Software:** Is feasible to implement due to the availability of comprehensive documentation, libraries, development frameworks, and tools for the chosen technologies (ESP32 firmware development, mobile/web application development, communication protocols, database integration, and alerting mechanisms). With proper planning and development effort, each software component can be effectively implemented and integrated to create a functional and user-friendly system. Overall, software implementation is feasible due to ample documentation, libraries, and development tools available for each component.

Overall, the proposed solution combines hardware and software technologies effectively to provide users with the tools and information needed to manage their household water usage efficiently, making it feasible and capable of addressing the identified problem.

3.2 Components Required for the Proposed Solution

- ESP32
- Water Flow Sensor
- Ultrasonic Sensor
- TDS Sensor
- GSM Module
- Relay Module
- Solenoid Valve
- Power supply

3.3 Nature of the Solution

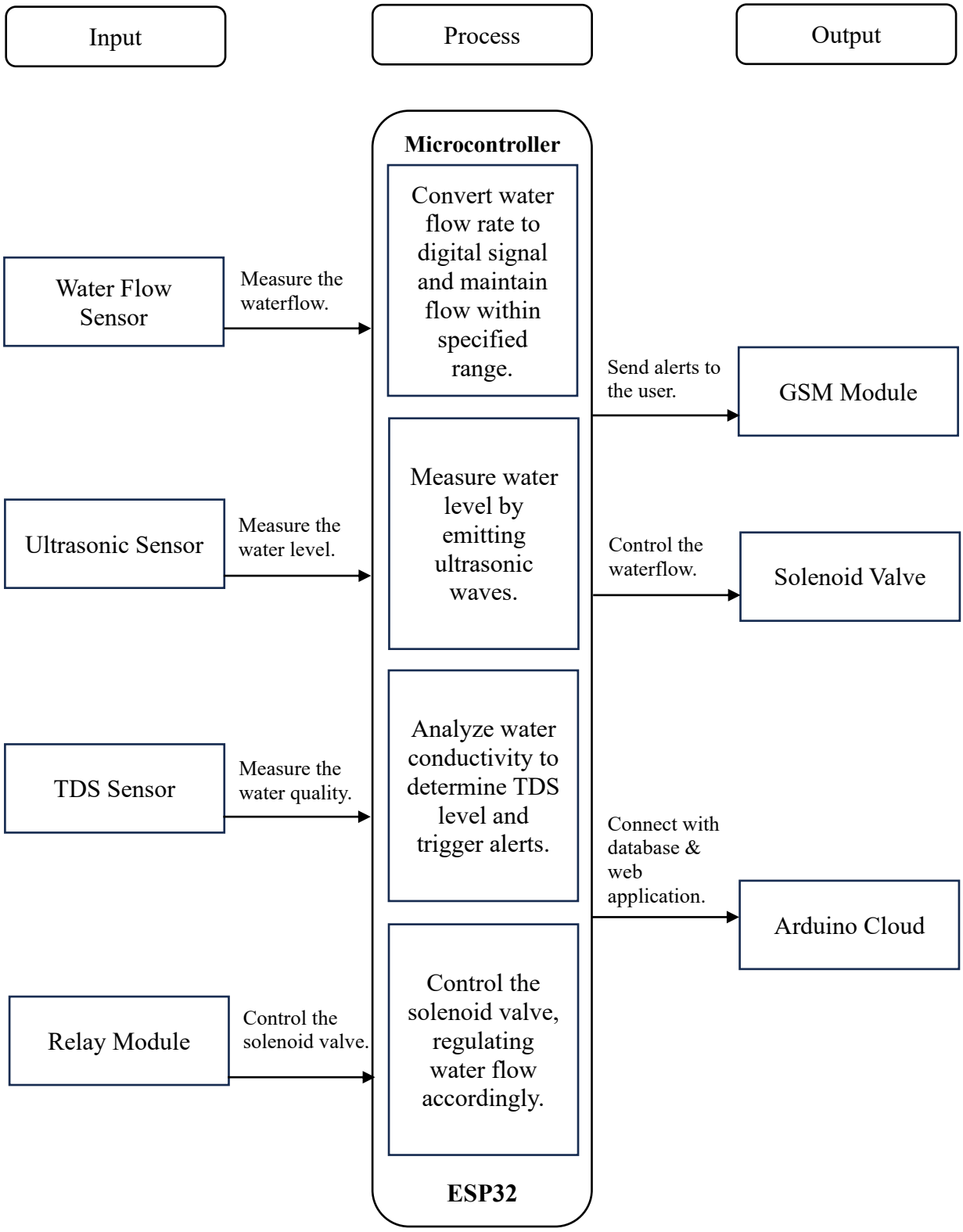
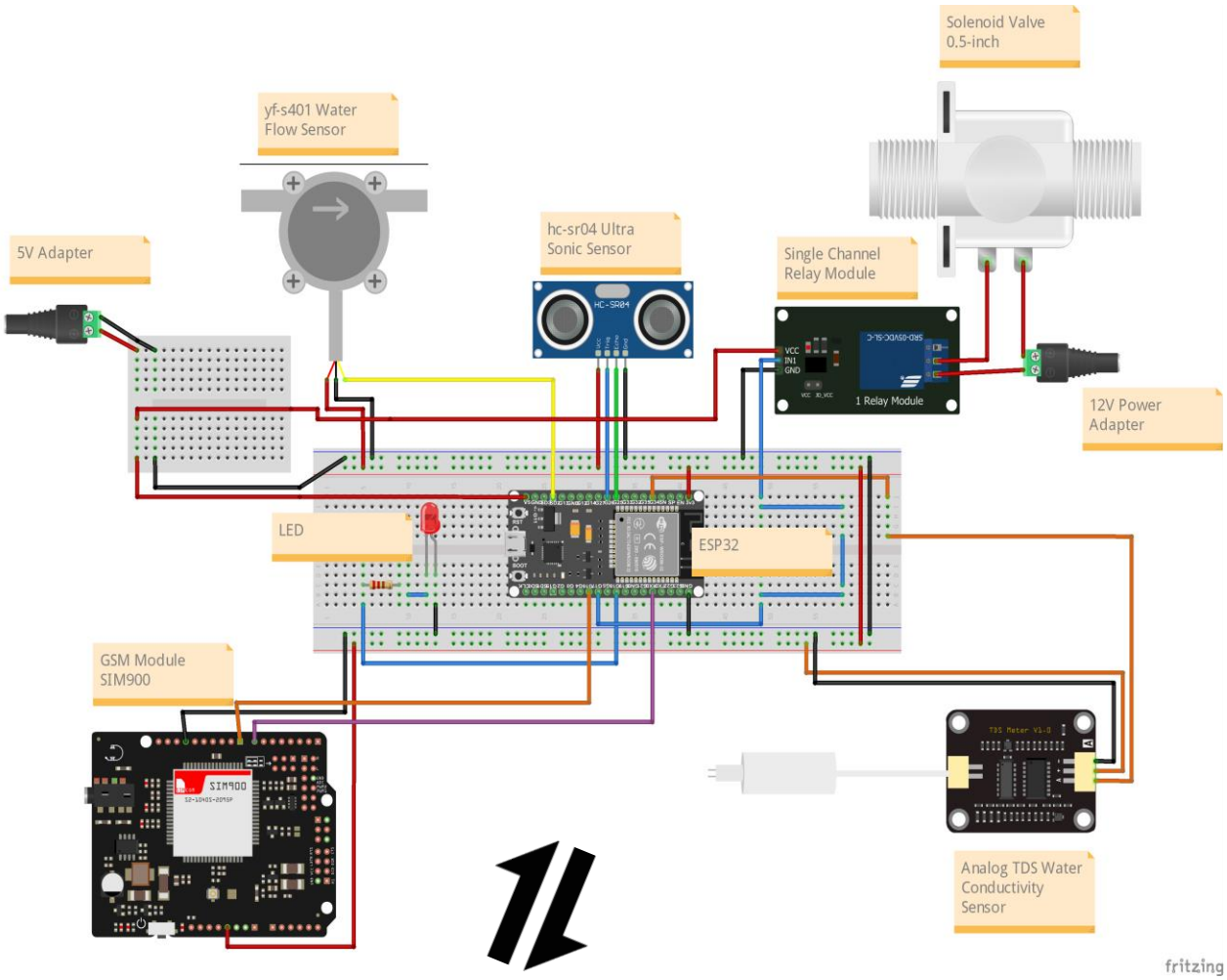


Figure 01: Block diagram of the input, process, and output

3.4 Solution Design



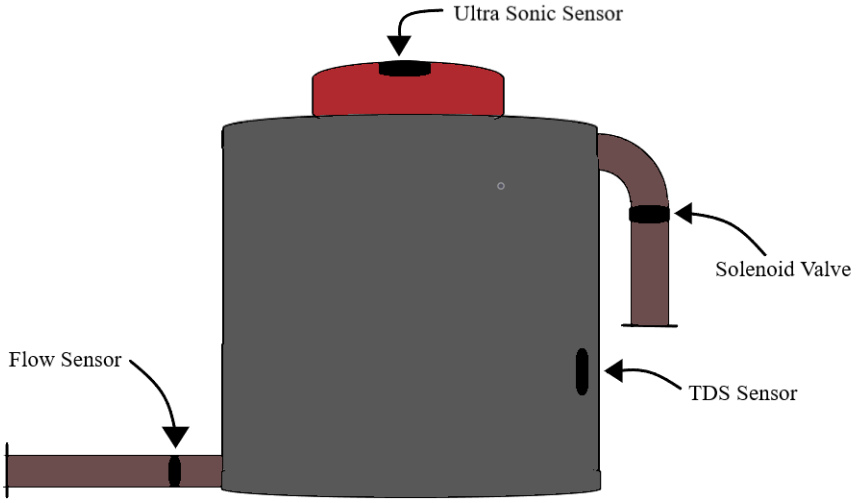


Figure 03: A graphical view of the solution

3.5 Resources

Table 01: Components with budget allocation

Component	Unit Price (LKR)	Unit	Total Price
ESP32	1500	1	1500
Water flow sensor	1000	1	1000
Ultrasonic sensor	300	1	300
TDS sensor	3000	1	3000
GSM module	2000	1	2000
Solenoid valve	900	1	900
Relay module	200	1	200
Power supply	1000	1	1000
Total			**9900**

3.6 Workload Matrix

Table 02: Workload Matrix

Registration Number	Assigned Responsibilities
225018A	GSM Module (Send alerts to the user) Database design and integration Web application design
225031G	Ultrasonic sensor (Measure the water level) Web application design
225073K	TDS sensor (Check the water quality) Web application design
225009X	Water flow sensor (Measure water usage) Web application design
225082L	Relay module (Control the solenoid valve) Solenoid valve Web application design

4. References

[1] Water Level Indicator. Available: https://www.electronicshub.org/water-level-indicator/

[2] Water Level Controller using 8051 Microcontroller. Available: https://www.electronicshub.org/water-level-controller-using-8051-microcontroller/