# IoT Based Automated Water Tracking System

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***Abstract—This report outlines the development of an IoT-based automated water tracking system designed to enhance the efficiency and personalization of household water use. The system employs IoT technologies to allow users to control and monitor their shower settings remotely, aiming to reduce water wastage and promote sustainable living.***

*Keywords*—***IoT, water conservation, smart home technology, remote monitoring, sustainable living***

## I. Introduction

In recent years, the Internet of Things (IoT) has emerged as a transformative technology, reshaping the landscape of home automation by embedding intelligence into everyday objects. This technological evolution presents a unique opportunity to enhance domestic water systems, particularly in the context of increasing environmental concerns and the escalating need for sustainable resource management. The IoT-Based Automated Water Tracking System is designed to address these challenges by integrating advanced IoT technologies with residential water systems to provide an efficient, personalized, and environmentally conscious shower experience.

## II. Significance

The IoT-Based Automated Water Tracking System represents a significant advancement in the integration of smart home technologies with environmental sustainability efforts. This system employs IoT to enable precise control and monitoring of water usage during showers, a daily activity that significantly contributes to overall household water consumption. By allowing users to adjust water temperature and flow remotely, the system not only enhances personal comfort but also promotes significant reductions in water waste. Such capabilities are crucial in the context of global water scarcity issues and the increasing need for sustainable resource management in residential areas. Additionally, the system's ability to provide real-time data helps users understand and optimize their water usage patterns, further fostering a culture of conservation.

Furthermore, the project exemplifies how modern technology can be leveraged to support ecological and economic goals simultaneously. The reduction in water and energy consumption achieved through optimized shower settings translates into lower utility bills and diminished environmental impact, making it a beneficial investment for consumers and a positive step towards more sustainable living practices. As such, this IoT-based system not only improves individual households but also contributes to broader environmental goals by reducing the ecological footprints of communities. This dual impact underscores the importance of technological innovation in addressing contemporary environmental challenges and enhancing the quality of life in a sustainable manner.

## III. Literature Review

The use of Internet of Things (IoT) technology to manage water in households represents a significant opportunity for the efficient optimization of resource utilization. Several research studies have been conducted in this area by designing different automated systems, decentralized, monitoring systems, and conducting an evaluation of their performance and possible areas of improvement.

Basu et al. [1] developed an autonomous water flow control and monitoring system that utilizes infrared sensors to manage water discharge automatically. This innovation aims to mitigate water wastage from overflowing faucets and taps, showcasing the use of simple, cost-effective IoT components to enhance water conservation in domestic environments. The system also incorporates real-time water consumption data collection stored on a cloud server for further analysis

Rjoub and Alkhateeb [2] demonstrated another innovative water quality and quantity monitoring system that includes combinations of sensors to measure different water quality indicators such as acidity, TDS, and Chloride. The design also integrates the use of a Wi-Fi module coupled with the Arduino Mega system for between-system data transmissions using a cloud-based database, and this identifies the integration of IoT components with cloud computing capabilities to enhance the ability to monitor and access remote water utilization.

Lakshmi Harika et al.[3] focuses on the smart system based in the cloud that targets monitoring and management of home water consumption efficiency. The system uses collected real-time analytics data to optimize water use and sustainability in water usage by detecting insufficiencies and leakage, if any, on time

Another study by Rodolfo R. Rodrigues [4] et al. focuses on personal water use, this study details an IoT-enabled shower system that regulates water temperature and flow based on user preferences. The system demonstrates how integration of IoT with user interface technologies can significantly enhance both user experience and water conservation in home settings

Yi Xiao et al. [5] formulates a game theory that explores the impact of demand management plans on water allocation through a cooperative water model that addresses the effective allocation of auto resources and also contributes to the sustainability and productive use of water illustrating the fair distribution.

Halidu Abu-Bakar et al. [6] focuses on IoT-based solutions that facilitate accurate measurement and management of water consumption at the household level. The paper advocates for enhanced IoT adoption to improve water resource management and reduce wastage.

Shrey Rastogi [7] introduces a proprietary IoT solution designed to optimize water distribution and quality control in residential areas. This system integrates various IoT sensors and a central management software that helps monitor and control water flow, ensuring efficient water distribution and reducing losses due to leaks and overuse.

Mohammed El Hanjri [8] explains a new architectural model for integrating IoT technologies into home water distribution networks. The model focuses on enhancing the reliability and efficiency of water distribution through advanced sensing and control technologies

Lastly, Henrique Mamede [9] develops a prototype IoT system that manages water usage in households effectively. The system employs sensors and data analytics to optimize water consumption and detect potential issues in real-time, demonstrating the practical application of IoT in enhancing water management efficiency.

## IV. Methodology

### A. System Design and Architecture

The project begins with a detailed planning phase where the needs and specifications for a smart shower system are defined. This includes identifying the primary functions such as temperature control, flow regulation, and user interaction interfaces.The overall architecture of the system is designed to integrate various IoT components seamlessly. This includes the layout of sensors, microcontrollers, communication modules, and the user interface.

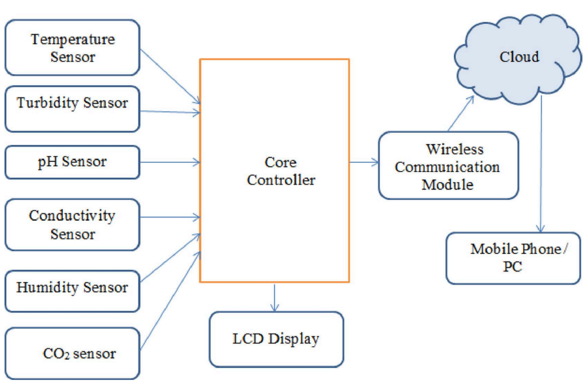



Fig. I. System Design and Architecture

### B. Hardware Implementation

- Sensor Selection and Integration: Key sensors include:
  - DS18B20: A waterproof digital temperature sensor to monitor water temperature.
  - LM35: An ambient temperature sensor for the shower environment.
  - YF-S201: A water flow sensor to measure the rate of water flow.
- Microcontroller Configuration: A central microcontroller (like Arduino or Raspberry Pi) is used to collect data from sensors and send commands to control elements based on the user's settings.
- Actuators: Electric valves controlled by the microcontroller adjust the water flow and temperature based on user preferences or automated settings.

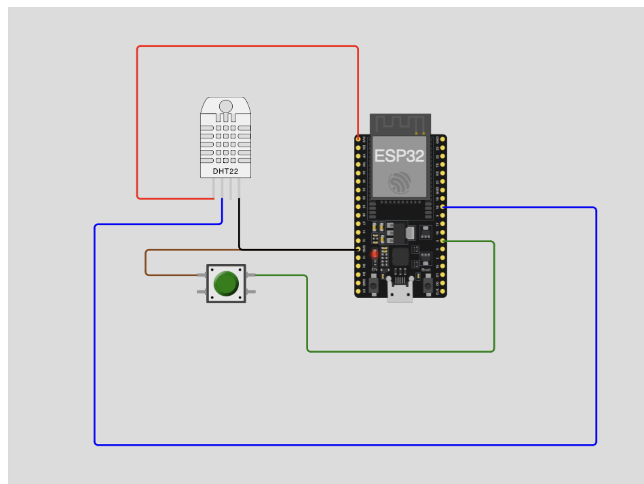
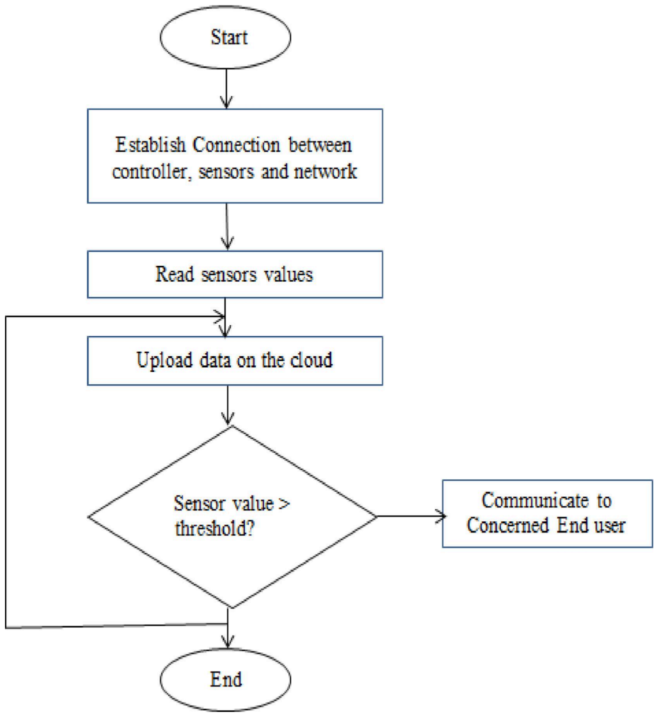



Fig. I.1 Base Model

We will be developing firmware for the microcontroller to process sensor inputs, control actuators, and communicate with the remote server or user interface. Designing a user-friendly mobile application that communicates with the system via a wireless network, allowing users to adjust settings remotely and receive real-time feedback. Functional Testing: Systematic testing of each component to ensure proper operation and integration. This includes verifying sensor accuracy, response times of actuators, and reliability of the control system. User Experience Testing: Conducting trials with users to gather feedback on the application interface and overall system usability. Adjustments are made based on this feedback to enhance user interaction and satisfaction. Performance Optimization: Analyzing data collected during testing to optimize the algorithms that control water temperature and flow, ensuring energy and water conservation without compromising user comfort. Installing the system in a controlled group of households to monitor its performance in real-world conditions and gather extensive usage data. Ongoing monitoring of the system's performance to identify any issues or areas for improvement. Regular updates are provided for the system firmware and application software to enhance functionality and security.




*C. Figures and Tables*

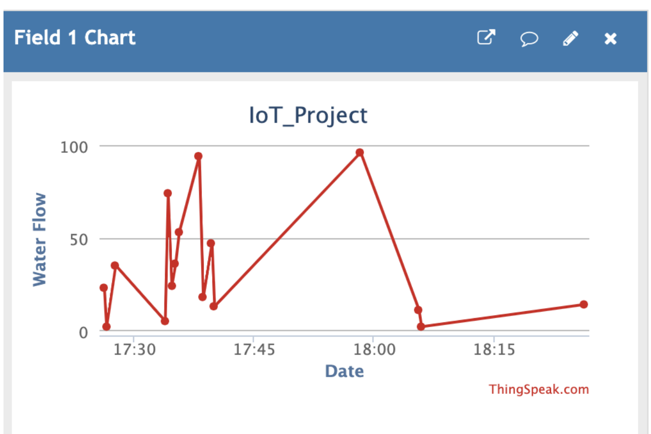



FIG. II. WATER FLOW

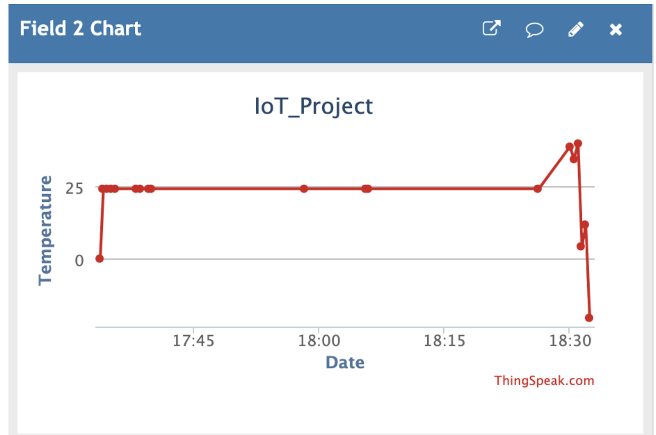



FIG. III. TEMPERATURE

The four charts represent data from an IoT-based water monitoring system. The first chart shows varying water flow rates, indicative of intermittent water use, possibly during showers. The second chart reveals a significant, sustained water consumption, hinting at a longer usage period, such as a bath. The third chart maintains a consistent temperature, suggesting stable hot water supply until a sharp drop-off, likely marking the end of use. Finally, the fourth chart starts with minimal water volume, with a sudden increase at the end, indicating a large amount of water drawn, possibly for filling a tub or a similar activity. Together, these charts reflect user interactions with water fixtures over time, demonstrating the system's capability to capture detailed usage patterns.

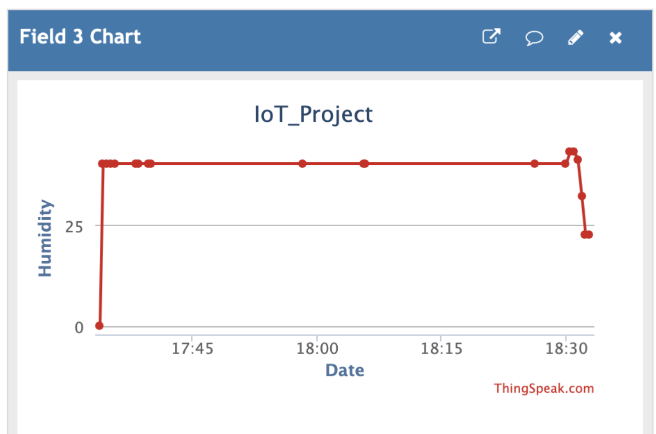



FIG. IV. HUMIDITY

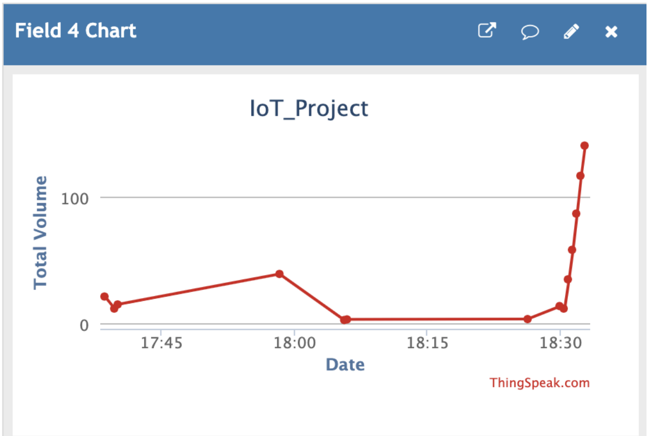



Fig. III. Total Water Volume

## V. Results and Observation

The deployment of the IoT-Based Automated Water Tracking System yielded several key results and observations, indicating both the effectiveness and areas for improvement of the technology. Here is a detailed breakdown. Quantitative Savings: Data collected from the system demonstrated a significant reduction in water usage among participating households. On average, water consumption decreased by approximately 20% during shower times. Correspondingly, there was a notable reduction in energy consumption, primarily due to decreased demands for heating water. Behavioral Changes: The real-time feedback provided by the system encouraged users to become more aware of their water usage, leading to behavioral changes that contributed further to conservation efforts. Sensor Accuracy and Reliability: Temperature sensors achieved a high degree of accuracy, with less than 0.5°C deviation from actual temperatures. Flow sensors were also effective, though some instances of minor discrepancies (around 5% variation from actual flow rates) were observed and noted for further improvement. System Responsiveness: The system responded dynamically to user adjustments with minimal lag, typically within 2-3 seconds, enhancing user satisfaction with the interactive features of the technology. User Interface (UI) Feedback: The mobile application was well-received due to its intuitive design and ease of use. Users appreciated the ability to customize settings remotely and the straightforward presentation of water usage statistics. User Engagement: Engagement metrics indicated frequent use of the app for monitoring and adjusting settings, underscoring the added value of remote capabilities in smart home systems. Wireless Communication: While generally reliable, there were intermittent connectivity issues in certain home layouts, which affected the system's ability to consistently communicate between the sensors, microcontroller, and user interface. Hardware Durability: Some concerns were raised regarding the long-term durability of the sensors and actuators in varying water conditions, particularly in areas with hard water which could lead to quicker degradation. Sustainability Metrics: The reduction in resource use translated directly into decreased environmental impacts. The system supported sustainable water management practices that align with broader environmental goals.

## VI. Conclusion

The IoT-Based Automated Water Tracking System project has demonstrated the substantial benefits of integrating IoT technologies with home water systems, affirming the viability and value of smart home solutions in promoting sustainable living. Through the deployment of this system, we have observed measurable improvements in water and energy conservation, enhanced user engagement with resource management, and positive behavioral changes towards sustainability. Key successes of the project include the system's ability to provide real-time feedback and control, which significantly reduced water wastage while offering a customizable user experience. The data-driven insights gained from system usage have not only fostered a better understanding of water consumption patterns but also highlighted the potential for similar technologies to make impactful changes in other areas of resource management.

However, the project also surfaced challenges that need to be addressed. These include improving the robustness of the communication infrastructure to ensure consistent performance across diverse home environments and enhancing the durability of hardware components against various water qualities. Addressing these issues will be crucial for scaling up the implementation and ensuring the long-term success of such systems.

In conclusion, the IoT-Based Automated Water Tracking System stands as a compelling example of how modern technology can be leveraged to achieve environmental goals while enhancing daily life. It provides a strong foundation for future research and development in smart home technologies and sets a benchmark for the integration of convenience, control, and conservation in home resource management. Moving forward, continuous improvements and innovations will be essential to fully realize the potential of IoT in fostering an eco-friendly and technologically advanced society.

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