Article

Robotics Project Smart Water Bottle

Authors

1 Sarah Kanwar	6738062121
2 Yanichadapa Pohnvisethkul	6738069621
3 Peakthipol Panhoon	6738185721
4 Puttima Phrirojchaikul	6738190821
5 Warichaya Decharin	6738235421
6 Sukrist Eksangsri	6738258921

E-mail: warichaya@gmail.com, sarah.sqk@gmail.com

Abstract. This project presents the development of a Smart Water Bottle designed to address insufficient daily water intake, a common issue that can lead to dehydration and related health complications. The objective of this study was to create an automated system capable of accurately tracking water consumption and providing real-time feedback to promote healthier hydration habits. The system utilizes a load cell sensor integrated with an HX711 amplifier to measure weight changes and estimate consumed water volume (1 g ≈ 1 mL). An ESP32 microcontroller processes the sensor data and transmits it via Wi-Fi to the Blynk IoT platform, where users can monitor their daily intake and receive reminders. Additional sensors, including a TDS sensor and temperature sensor, were incorporated to provide water quality and temperature information. Testing results demonstrated stable weight measurement, successful drinking event detection, and reliable wireless data transmission. The results indicate that the system effectively increases awareness of hydration behaviour and offers a practical, low-cost solution for smart health monitoring applications.

1. Introduction

The increasing demands of academic and professional life have led many individuals to overlook basic health habits, including adequate daily water consumption. Insufficient hydration is a common issue among students and office workers, often resulting in fatigue, reduced concentration, and potential long-term health complications. Despite the availability of reusable water bottles, most people do not actively monitor how much water they drink throughout the day. This lack of awareness highlights the need for a practical and automated solution to encourage better hydration behaviour.

In the initial design phase, our team proposed a system that would measure water intake using a weight-based sensing approach combined with manual tracking features. The system aimed to detect drinking events and provide local feedback to the user. However, after further evaluation, we identified the need for improved accuracy, automation, and remote monitoring capabilities.

Considering usability, cost efficiency, and system reliability, the final design integrates a load cell sensor with an HX711 amplifier and an ESP32 microcontroller to automatically calculate consumed water volume. The system also incorporates IoT connectivity through the Blynk platform, enabling real-time monitoring and reminder notifications.

This final report outlines the development process, design modifications, and testing results of the Smart Water Bottle system. The effectiveness of the system will be evaluated in terms of measurement accuracy, usability, reliability, and its potential to promote healthier hydration habits.

2. Literature Reviews

Research from Cambridge University shows that dehydration negatively affects cognitive performance, mood and physical endurance. Being properly hydrated is widely acknowledged as crucial for clear thinking, efficient metabolism, and overall well-being. Natalie A. Masento et al (2014). Study from Journal of Medical Internet Research also indicates that behaviour monitoring and self-awareness assist in healthy habit formation, including drinking water. [1]

According to WHO guidelines for Drinking-Water Quality (4th edition), total dissolved solids (TDS) and temperature has a significant effect on water quality. total dissolved solids (TDS), which is an amount of mineral that is dissolved in water, TDS concentration below 600 mg/l is considered in the range of good drinking water, while water exceeding 1000 mg/l may result in unpalatable taste. The temperature of water also affects the quality and the palatable of water. Water with high temperatures is associated with the growth of microorganisms and effect on taste odour and colour of water, while low temperatures are more palatable. WHO (2022). [2]

In recent years, many commercially smart water bottles have been developed to track user's drinking behaviour by using load or pressure sensors at the base, capacitive sensors positioned in the bottle and measuring sip volume. The data that is collected is transmitted via Bluetooth to a mobile application and is stored in the app. However, after testing it was found that most bottles require recalibration, need to be placed on a flat surface before weighting the water, cannot determine if the water was consumed, discarded or spilled, does not provide raw data for users and cannot save the data for long term usage. R. Cohen et al (2022). [3]

3. Methodology

The function of the Smart Water Bottle is to monitor three aspects of the user's drinking habits - water consumption, water quality, and water temperature - using a load cell, TDS sensor, and temperature sensor respectively, and to send alerts to a mobile device based on established health standards. After several prototype sketches, the team finalized the design of the Smart Water Bottle, which consists of an outer interlocking case and base that houses the ESP32 microcontroller, the three sensors, and an LCD display that provides an interactive user interface for real-time monitoring. The load cell measures the weight of the water in mL to track water consumption while the TDS and temperature sensor measures the water quality and temperature respectively.

These sensor readings are processed by the ESP32 microcontroller, which continuously analyses the data to determine hydration patterns and water conditions. The processed sensor data is transmitted via Wi-Fi through the ESP32 to the Blynk mobile application, enabling real-time monitoring and mobile notifications as part of the system's Internet of Things (IoT) architecture. To ensure measurement accuracy, the team calibrated the load cell using known weights and established a relationship between water weight and volume.

Additionally, the TDS sensor and temperature sensor was calibrated using different water conditions to verify their validity and accuracy. All three readings were then verified through the mobile Blynk application to confirm that the collected data was being transmitted correctly through the IoT monitoring system.

Line official account is created to remind user if they drink enough 2000 ml of water per day or not. A notification is sent every one hour via the line chat to remind the user of the amount of water they have drank and the amount of remaining water left in the bottle daily. Every time the user drinks water, a notification is

sent to show the amount of water they consumed. After 23:59, the Line account is reset to and starts a new tracking cycle. After the user there will be a message of congratulation notification sent that the user has drunk 2000 ml, and there will be no further notification later in that day.

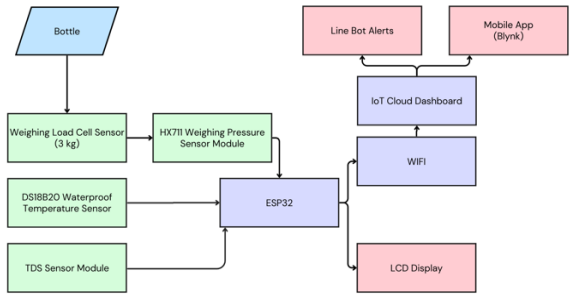


Figure 1.1 illustrates the components of the Smart Water Bottle and how they are connected.

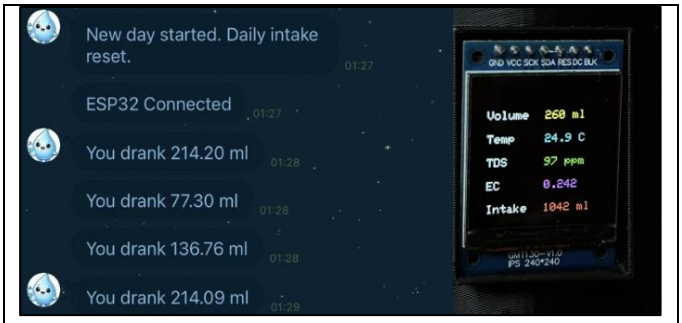


Figure 1.2 illustrates the Line Bot Alerts and LCD screen output of the Smart Water Bottle.



Figure 1.3 shows the final working product of the Smart Water Bottle.

4. Results

After the development of the Smart Water Bottle, several tests were conducted to evaluate the bottle's performance and functionality. During the testing phase, the load cell sensor successfully measured the change in water weight as users drank from the bottle. This allowed the system to record the water consumption and compare it to health standards set by the team of 2,000 ml. Based on the amount of water consumed, the team developed a mobile alert system using Line Official that automatically resets at 23:59 each day.

The TDS sensor was used to detect the quality of water by measuring the total solids dissolved in water. The sensor produced consistent reading that indicated the system could monitor the quality of water effectively.

Additionally, the temperature sensor successfully detected the water temperature and displayed the readings accurately on the LCD screen attached to the smart bottle. The sensor was tested under different temperature conditions and produced consistent measurements. This enabled users to monitor the temperature of the water in real time.

The Smart Water Bottle was tested by students and Pocari Sweat Company Employees. The results showed that the system was able to successfully monitor water consumption and display sensor readings during normal use. The overall feedback given by the students and Pocari Sweat Hydration Company employees is that the smart bottle is accurately able to track hydration habits and record water properties.

Tester	Feature Tested	Result
Student #1 Electrical Dep	Intake of water & Line Bot	Decrease in volume & increase in water consumption noted
Student #2 Chemical Dep	Input of water & Blynk App	Increase in volume & updated features noted
Student #3 Mining Dep	All Features & Output	All features worked normally & updated on Blynk & Line OA
Pocari Sweat Company Employees	Water Temperature & Volume	Cold water temperature & volume updated correctly

The results of this study are consistent with previous research, such as a study by Youngjun Lee and colleagues, on smart hydration habit systems, which also utilizes sensor-based monitoring to track water consumption. Similar studies have shown that integrating water weight sensors and temperature sensors allow the user to be more aware of their

hydration habits. The findings of this project support these theories by demonstrating that sensor-based smart bottles can effectively monitor water intake and provide real-time feedback to users which then promotes better hydration habits. [4]

The following link provides all the codes used in the making of the Smart Water Bottle.

https://github.com/Peak024/Project-Sensor-Group-8--Smart-Water-Bottle/tree/main

5. Discussions

During the development of the smart water bottle prototype, several challenges were encountered that required adjustments to the design and implementation. One issue involved the water sealant used in the bottle. The sealant required multiple layers of adhesive to secure the structure, which occupied more space than originally planned in the 3D-printed design. As a result, the seal was not always completely effective and occasional water leakage was observed during testing.

Another challenge was related to the size of the 3D-printed housing. The casing was designed with limited internal space, making it difficult to accommodate the sensors, wiring, and electronic components. Because of the tight internal layout, assembling the components became complicated and some wires were accidentally pulled from the board during installation. The printing process was also very long which made it difficult to make quick modifications.

Additionally, the printed case did not fully support the bottle structure. The housing sometimes lifted the bottle slightly from the load cell, which affected the stability of the measurements. This caused inconsistencies in the load cell readings and reduced the accuracy of the measured water volume.

For future improvements, the housing design could be refined to better accommodate the internal components and reduce printing time. Additionally, optimizing the battery placement and wiring layout could improve the efficiency of the charging system and make the device more compact and practical for daily use.

At the end, user testing conducted by students and Pocari Sweat company employees confirmed that the smart water bottle system accurately monitored water consumption and reliably updated sensor readings during normal operation.

6. Conclusion

In conclusion, the project successfully developed and tested a smart water bottle system designed to monitor hydration habits and provide useful feedback to users. The final prototype integrated multiple sensors, including a load cell to measure water consumption, a TDS sensor to monitor water quality, and a temperature sensor to detect the temperature of the water. These components worked together to provide real-time data to the user through an LCD display and a mobile notification system using Line Official.

The system demonstrated the ability to accurately track water intake by detecting changes in the bottle's weight. In addition, the temperature and TDS sensors were able to provide useful information about the condition of the water, helping users monitor both their hydration level and water quality. The automatic notification system also allowed users to receive reminders based on their drinking habits, encouraging better hydration awareness.

Although some challenges were encountered during development, such as difficulties with the 3D-printed housing and limited internal space for the battery and wiring, the team was able to successfully assemble and test the prototype.

Overall, the project demonstrates the potential of sensor-based smart bottle systems to support healthier hydration habits. With further improvements in housing design, power management, and system integration, the smart water bottle could become a practical and effective tool for helping users maintain proper daily water intake.

Acknowledgement

This project was assisted by Asst. Prof. Surat Kwanmuang. Additionally, the funding was provided by the International School of Engineering (ISE).

References

[1] K. S. Pavan, K. Shaik, G. K. Sameer, and et al., "IoT Based Drinking Water Quality Monitoring with ESP32," International Journal for Research in Applied Science and Engineering Technology (IJRASET), [Online]. Available: https://www.ijraset.com/best-journal/iot-based-drinking-water-quality-monitoring-with-esp32. [Accessed: 3-Mar-2026].

[2] World Health Organization, *Guidelines for Drinking-water Quality*, 4th ed., incorporating the 1st and 2nd addenda [Online]. Geneva, Switzerland: WHO, 2022. Available: https://iris.who.int/server/api/core/bitstreams/69c17edd-ee26-425b-9d34-33799377e886/content. [Accessed: 3-Mar-2026].

[3] R. Cohen, G. Fernie, and A. Roshan Fekr, "Monitoring fluid intake by commercially available smart water bottles," Scientific Reports, vol. 12, 2022. [Online]. Available: https://pmc.ncbi.nlm.nih.gov/articles/PMC8924188/. [Accessed: 3-Mar-2026].

[4] Y. Lee, "Smart water bottle system for hydration monitoring," IEEE Access, 2020. [Online]. Available: https://ieeexplore.ieee.org [Accessed: 3-Mar-2026].

[2