Smart Public Water Dispenser – An EPS@ISEP 2025 Project

Abstract. BiboLink is an innovative smart public water dispenser developed during the European Project Semester (EPS) at ISEP in 2025. Designed for outdoor use in parks and sports facilities, BiboLink provides clean, filtered water enriched with optional supplements such as electrolytes and vitamins, tailored to user activity levels and health needs via a connected mobile app. Addressing the challenges of urban hydration, BiboLink combines sustainability with smart technology, featuring solar power, recyclable materials, and reduced plastic waste. The project highlights the limitations of existing hydration systems, positioning BiboLink as a valid alternative. Ethical considerations, environmental responsibility and compliance with EU standards, were integral to its development. A working prototype demonstrates the main features, such as water distribution and the integration of supplements, although the application's connectivity needs to be improved. BiboLink promotes public health by encouraging proper hydration habits while supporting environmental sustainability. Future enhancements may include advanced personalization through wearable integration and touchless controls. This interdisciplinary project led to the design of a viable solution and provided the students with valuable technical, project management, and teamwork skills, underlining the role of the EPS programme in promoting innovation and collaboration.

Keywords: Engineering Education · European Project Semester · Athletes · Health · Smart public water dispenser · Well-being.

1 Introduction

The European Project Semester (EPS) is a capstone design programme offered by a network of 20 European universities, designed primarily for third-year engineering students [2]. This programme fosters international teamwork and interdisciplinary problem-solving experiences, helping to develop essential skills for future engineers. This document showcases the project work of six students from different countries, engineering disciplines and universities who participated in the EPS at the Instituto Superior de Engenharia do Porto (ISEP) in spring 2025. They chose to focus on health and well-being by creating a public, personalised hydration solution for active individuals.

BiboLink is a public water dispenser that promotes health and hydration in parks, sports facilities, and other public areas. Users can benefit from clean filtered water supplemented with optional electrolytes, vitamins, or other compounds, tailored to their activity and personal needs. Equipped with smart tech-

nology, the dispenser also offers nutrition tips through a connected mobile application. By promoting sustainable hydration and reducing plastic waste, it improves both athletic performance and environmental responsibility.

Amateur athletes often struggle to maintain adequate hydration levels while exercising in urban public spaces, mainly due to restricted access to clean drinking water and appropriate hydration options, which are essential for optimal physical performance and good health. A dehydration level as low as 2 % of body weight can affect endurance performance, while losses exceeding 5 % may reduce work capacity by approximately 30 % [5].

In addition, athletes at university and club levels show a high prevalence of dehydration and inadequate nutritional awareness [7], suggesting that people have limited knowledge of their hydration needs. As a result, many athletes begin exercise sessions in a state of dehydration due to sweat loss. This problem is more serious in urban environments, where public sports facilities often lack adequate hydration facilities. The lack of convenient and clean hydration points discourages regular fluid intake. This knowledge gap, combined with restricted access, presents a huge barrier to maintaining hydration during physical exercise.

BiboLink is an intelligent hydration station for public spaces. Besides providing clean, filtered drinking water, it also offers the option of enriching the water with nutritional supplements such as electrolytes and vitamins. Users interact with the device using a mobile app, which adjusts hydration to their sport and health needs, and also offers personalized doses. Primarily powered by a solar panel, it can also adopt a hybrid model with grid backup. Very useful for recreational athletes, BiboLink promotes sustainable hydration habits while supporting public health. Thanks to intuitive usability, modular maintenance access, and modern design, it offers intelligent and environmentally friendly hydration where it is needed.

2 Preliminary Studies

2.1 Related Work

Most existing hydration technologies and products still have drawbacks. Two examples are Bevi and Refill+. Bevi is designed for places like offices or gyms [1]. The user can personalise drinks with add-ons such as flavours or supplements via a touch screen. However, as it is not designed for outdoors, it is not resistant to weather or vandalism and depends on access to the electricity grid. Refill+ provides tap water and allows users to enrich it with vitamins and minerals [6]. It offers still, cold, or sparkling water, and is also operated via a compact touchscreen interface. Like Bevi, Refill+ is designed primarily for indoor settings.

People can easily and affordably get drinking water in public spaces using public water fountains. These water stations are connected to the city's public water supply and help to reduce plastic waste, since the user has to bring a bottle or cup to use. However, they are often not clean and do not allow the distribution of personalised supplements.

A study conducted by the Sintra Municipality examined the water quality of 42 public drinking fountains between February 2006 and April 2007 [9]. The results showed that nearly all of the tested fountains had poor water quality, mainly due to bacteriological contamination. Therefore, relying on these sources for hydration is not always healthy.

Besides physical water sources, digital apps also play a role in hydration. Apps like Water Minder [4], Hydro Coach [3], and Plant Nanny [10] help the user to stay hydrated. They track water intake and remind the user when to drink based on the collected information. However, they do not supply water. BiboLink fills this gap by combining free hydration with drink customisation.

In order to lead a healthier lifestyle, it is possible to use supplements in addition to controlling hydration. Tablet supplements are easy to take, making them perfect for people who are very busy or spend a lot of time outdoors. Possible supplements include electrolytes and BCAAs for hydration and muscle recovery, caffeine for more energy, or magnesium, zinc and vitamin C for recovery and immune defence. A smart outdoor water station dispensing these supplements would allow the user to stay hydrated and achieve personal health goals.

Table 1 has been created showing the strengths and weaknesses of existing hydration solutions and help BiboLink's market positioning.

Table 1. Comparison of Hydration Systems

Feature	**Bevi**	**Refill+**	**Public Fountains**	**BiboLink**
Water Filtration	Yes	Yes	Yes[1]	Yes
Supplement Integration	Yes[2]	Yes[3]	No	Yes[4]
User Customization	Yes	Yes	No	Yes
IoT	Yes	No	No	Yes
Outdoor Use	No	No	Yes	Yes
Public Access	No	No	Yes	Yes
Hygiene & Maintenance	Good	Good	Poor	Good[5]
Plastic Use Mitigation	Yes	Yes	Yes	Yes

[1] Tap water only; [2] Flavours only; [3] Electrolytes and vitamins;
[4] Electrolytes, vitamins and minerals; [5] Automated alerts and servicing.

2.2 Ethics

Technical innovation must always be consistent with social, environmental, and legal responsibility. In engineering ethics, values such as honesty, transparency, safety, and the common good guide the development of the product. The team

works within its professional competences and avoids conflicts of interest in order to develop a hygienic product that benefits public health.

Ethical responsibility is also an important area for the team. In both sales and marketing, honesty and accurate communication without greenwashing are essential guidelines. All information is presented in a transparent and understandable way to avoid confusion from consumers. Environmental ethics also plays a central role. To achieve this, the team is guided by the circular economy approach. Plastic is avoided and both durable and recyclable materials are used. Energy-efficient components are also used. This ensures compliance with, for example, the EU Green Deal. Further info can be found in Table 2.

In terms of product liability, the product complies with the most important EU directives, such as the requirements for drinking water quality, the safety of products, and the machinery directives. Filtration, supplement dosage, and digital control are implemented with particular attention to user safety and health.

In summary, ethical responsibility is an integral part of the BiboLink team. The system is being developed with the highest possible technical standards, legal requirements, and ecological goals. To ensure that BiboLink remains socially and ecologically responsible in the future, compliance with the ethical framework will continue to shape its development, alongside technical development.

Table 2. Core Design Principles of the BiboLink System According to EU Standards

Aspect	**Description**
Materials	Stainless steel, food-grade, recyclable
Plastic Avoidance	No single-use plastics, long-lasting components
Filtration	Integrated system meeting EU water standards
Supplement Dosing	Transparent, regulated, and safe dispensing
Energy Use	Efficient electronics, optional solar integration
User Interface	Clear info via UI and app, no greenwashing
Technical Integrity	Expert-developed components, reliable design
Maintenance	Safe access for service and refilling
Legal Compliance	Meets CE, RoHS, EMC, and related directives
Accessibility	Inclusive, modular, and community-friendly

2.3 Marketing

Market Needs The fitness market is expanding rapidly; however, the appropriate hydration solutions in outdoor public spaces are still very limited. Although indoor environments often provide hydration machines, as mentioned in Subsection 2.1, the same kind of technology is not available outdoors, creating a new market opportunity to be explored by BiboLink. In this respect, BiboLink will create a network of public hydration stations adapted to the needs and desires of each user.

Target Market Segments BiboLink is creating real value for those who want to stay hydrated when they are actively exercising. The team's main focus is on persistent, dedicated and motivated semi-professional athletes who may not know how to hydrate and supplement properly when playing sport.

Design Decisions and Product Features BiboLink is designed to be an easily accessible public outdoor facility. It offers a smart support application that allows the user to access and personalise hydration. The BiboLink device is made with sustainable materials and powered by solar energy.

2.4 Sustainability

BiboLink can contribute to sustainability by reducing single-use plastic while also employing sustainable materials like steel (highly resilient and recyclable) and using plastic in smaller amounts in its construction. The use of solar panels not only makes it environmentally friendly, but also allows it to be used in off-grid scenarios. BiboLink works with simple, less energy-intensive mechanisms.

3 Proposed Solution

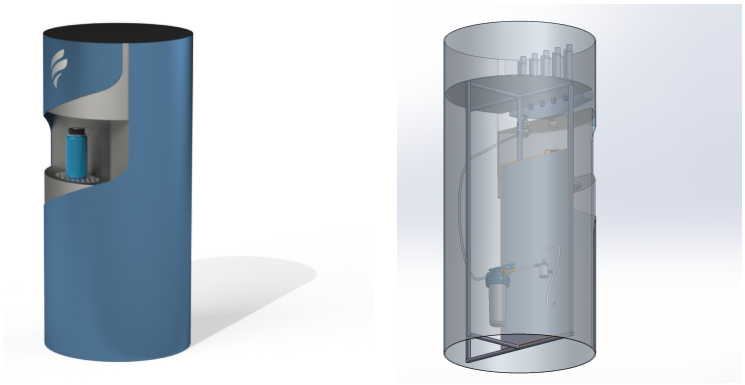
3.1 Concept

BiboLink is a smart, modular hydration station designed for outdoor use in parks, sports fields, and public recreation areas. Its main purpose is to provide clean, filtered water enriched with optional supplements such as electrolytes, caffeine or BCAAs, so that users stay hydrated and improve their physical performance. Users interact with BiboLink via a mobile application. After setting a hydration profile based on their activity level and health needs, the system dispenses a personalized drink when they scan their reusable bottle at the station. BiboLink offers a sustainable, accessible and health-oriented alternative to traditional public fountains or single-use drinking bottles. The solution combines physical wellness with digital intelligence and encourages better drinking habits through convenience, personalization and real-time guidance.

3.2 Design

BiboLink's design is very simple, with a cylindrical shape and ease-of-use in mind. The clean design is combined with renewable, recyclable materials to ensure the machine is as sustainable as possible.

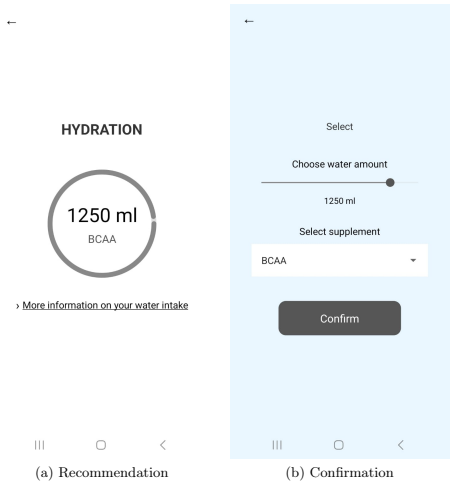
Structure The device has a casing with an inner and outer layer, both made of stainless steel, which gives it its characteristic cylindrical shape, and a tubular structure inside holding all components. The structure is detailed in Figure 1.



(a) Outer (b) Inner

Fig. 1. BiboLink's Structure

Web/Mobile Application The mobile app features an initial screen for user registration, authentication, and connection to the dispenser by scanning a quick response (QR) code. A second screen allows the user to set the volume of water and select the supplements. The user can either input their own preferences or follow the system's recommendations (see Figure 2a) which consider the type of exercise, the current activity level, and the desired water intake. Finally, the confirmation screen displays the contents to be added to the bottle (see Figure 2b). The user can manage the entire filling process through the mobile app, ensuring ease and convenience.



(a) Recommendation (b) Confirmation

Fig. 2. Mobile-app

Packaging The packaging (see Figure 3) has two parts. The inner cork sheet case, which provides the rigidity needed for transport, protection and easy unpacking. It has an 18-sided base and roof, and a half mantle. The outer cardboard cylinder provides further security. After transport, the inner cork case can be used as a flower pot. In this way, it is possible that the cutout patterns for packaging are as waste-free and environmentally friendly as possible while providing the necessary safety.

Fig. 3. Packaging solution

4 Prototype Development

The prototype envisages recreating all of the device's main functions in order to simulate how it works. This includes the water dispensing function, which, in conjunction with the flow sensor and soilenoid valve, can dispense a precise amount of water. It also includes the supplement dispensing function, which uses servo motors to dispense the correct supplement in response to a customer request. An infrared sensor, a push button, and a liquid crystal display (LCD) provide interaction and feedback options that will also be implemented in the actual product. To save costs and keep complexity manageable, the water filter and the pump are not required, as the pressure and water quality from the tap are sufficient for the prototype. Additionally, only two servo motors for the supplements were used instead of five, as these are sufficient to test the app's selection function. In addition to the functional components, the device's design has been significantly simplified.

4.1 Assembly

The structure of the prototype is designed for functionality and modularity, allowing for easy testing and adaptation of individual components. A suitable device design supports both hardware integration and software development.

(a) Drawing (b) Frontview (c) Backview

Fig. 4. BiboLink prototype: design and implementation views.

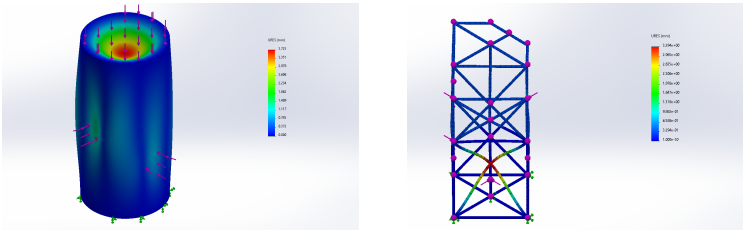
Structure The prototype is based on a wooden frame construction to replicate the functionality of the final product layout (see Figure 4). A wooden mounting plate also allows for easy modification, which is crucial for the assembly of actuators and sensors. The vertical wooden plate provides a clear separation between the water dispensing components and the electronic and control components. The solenoid valve, flow sensor, and connecting water lines were sealed with Teflon tape and attached to the mounting plate using cable ties. To implement supplement delivery, the principle used in the BiboLink product was replicated. For this purpose, the two servo motors were precisely embedded in the wooden plate, secured, and each equipped with a 3D-printed rotator to push the tablets out of the vertical tube. The supplements then fall onto the curved metal plates, which guide them into the drinking bottle. In summary, the prototype closely replicates the internal structure and logic of the final product.

Smart Control The control system was implemented using an ESP32 C3 microcontroller. This offers enough general-purpose input/output (GPIO) interfaces to control the sensors, actuators, and LCD display. A push button allows the user to start the process manually on the device after receiving the desired data from the application. The Wi-Fi interface of the microcontroller connects the application and the device.

Web/Mobile Application The front-end of the mobile application communicates with the back-end through an application programming interface (API). The back-end then connects to the database to store user data. Data communication between BiboLink and the back-end API uses the Message Queuing Telemetry Transport (MQTT) protocol, supported by a Mosquitto MQTT server.

4.2 Tests & Results

Structure All parts of the station were designed using SolidWorks and then simulated by creating an outer cylinder with thickness close to the combined thickness of both outer shells with the dimension of the full cylindrical structure. The structural elements were subjected to lateral stresses, from a single



(a) Outer (b) Inner

Fig. 5. Simulated deformation of the structure when subjected to abuse

kick to four people kicking, and to top stresses, with one person jumping (see Figure 5). The simulations stayed within the material stress limits and showed minimal strain along with the dislocations suffered, proving that the outer shell can withstand these impacts, being even more reinforced by the inner part.

Smart Control Table 3 displays all the functional results of the smart control system.

Table 3: Device: functional results

Use Case	Result
Switch on/off	Pass
Water dispensing (controlled volume)	Pass
Solenoid valve opens/closes correctly	Pass
Flow sensor counts pulses accurately	Pass
Supplement dispensing (servo motors)	Pass
LCD displays system status	Pass
Start button triggers process	Pass
Infrared sensor detects bottle	Pass
Wi-Fi connection established	Fail
MQTT messages received	Fail

Since the prototype was still in the development at the time of writing, the software/hardware integration was not fully complete.

5 Conclusion

5.1 Project Outcomes

During this project, the team successfully developed a functional concept and prototype of the BiboLink hydration station. The first challenge was to define a solution that was not only technically feasible but also meaningful to the user and sustainable in a public environment. One of the key results is a working prototype that simulates key features of the final system, including supplement delivery, filtered water, app integration and user interaction. Despite limited resources and time, the prototype demonstrates the core value of the concept. Beyond the technical product, the team gained valuable insights into interdisciplinary collaboration, design thinking and the importance of user-centered development. The combination of technical skills, communication, planning and creativity was essential to bring this project to life.

5.2 Personal Outcomes

According to the team members, the BiboLink project provided a hands-on learning environment that fostered both technical and interpersonal development. They highlighted the value of working in multidisciplinary international teams, which encouraged adaptation to diverse communication styles and collaboration methods. Task division and structured planning were frequently mentioned as key to achieving goals efficiently and maintaining motivation.

Several testimonies emphasized the importance of trust, flexibility, and mutual support within the team. Communication skills improved significantly due to the need to adapt to different working styles and expectations. The experience also prompted reflection on work-life balance and personal organization.

Participants reported growth in both soft skills—such as teamwork, communication, and project management—and technical abilities. Exposure to different engineering disciplines broadened knowledge and inspired creative problem-solving. The project was considered a valuable and enriching opportunity that offered practical insight into real-world teamwork and technical project development.

5.3 Future Development

Looking ahead, BiboLink can grow and become even more useful for end-users. One of the first steps is to turn the prototype into a product. This means improving the design, particularly the tablet delivery system and the connection between device and app, and ensuring that all parts work well over time.

New functionalities can be added in the future. These could include the dispensing of water capsules that can be consumed without the need for a bottle [8], touch-free controls for better hygiene, and links with city health systems to support public health. The use and integration of weather, movement, and wearable data would allow greater personalization of hydration tips.

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