Aqua-Trail: IOT Based Smart Water Bottle

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Abstract—The Smart Water Bottle is a cutting-edge technical solution created to address the ever-expanding issue of staying properly hydrated in our daily lives. Dehydration is a serious health problem that can have a range of negative repercussions, including poor physical and cognitive function. A smart water bottle is a type of water bottle that uses sensors and technology to track fluid intake, monitor activity, and provide insights into hydration levels. Smart water bottles can typically connect to smartphones or other devices via Bluetooth or Wi-Fi, allowing users to track their progress towards hydration goals, receive reminders to drink water, and view data on their hydration habits. To measure and optimize users' hydration patterns, this smart water bottle makes use of cutting-edge sensor technology, networking, and data analysis. Numerous sensors, including accelerometers, temperature sensors, and fluid level sensors, are included in this smart water bottle. Together, these sensors keep track of ambient conditions and water intake. The information is then transferred to a special smartphone app through Bluetooth or Wi-Fi so that users can quickly access and understand their current level of hydration. To promote healthier drinking practices, the app offers insights into daily water intake targets, personalized recommendations, and historical data. The Smart Water Bottle may alter messages and reminders based on the user's activity levels, the weather in the area, and individual preferences in addition to monitoring water intake. Additionally, it provides the choice of user-customizable hydration goals, allowing users to adjust the suggested water consumption to meet their own requirements. By encouraging proper hydration, assisting in the prevention of health problems associated with dehydration, and minimizing single-use plastic bottle waste, this innovation has the potential to significantly improve public health. The Smart Water Bottle is a promising option for a healthier and more sustainable future since it combines technology with a necessary component of daily living.

Keywords—Hydration, Wi-Fi, Sensor, Smart Water Bottle.

I. Introduction

It is aware of everything in today's world is connected to the Internet, making life more simpler. IOT, or the Internet of Things, is one of the technologies that has grown quickly. It enables us to create web and mobile connected application, such as those for smart homes, healthcare, transportation, and other areas. Dehydration is a common yet frequently ignored health issue. Dehydration, which affects people of all ages and socioeconomic levels, is a serious global health issue, according to the World Health Organisation (WHO). While extreme forms of dehydration, such as heatstroke or extended physical exertion, are frequently associated with dehydration, mild to moderate dehydration is more prevalent and can have subtle but detrimental impacts on our health and daily life.

Water helps break down food particles for absorption and is a crucial ingredient of digestive juices. Maintaining adequate water facilitates the easy passage of food through the digestive system, avoiding constipation and enhancing general digestive well-being. Moreover, water is necessary for the body's metabolic functions, which include turning food into energy. It aids in the body's ability to metabolize fat that has been stored and makes it easier for waste to be expelled through perspiration and urine. Essential for the healthy operation of organs like the kidneys, which remove waste from the blood and excrete it as urine, water is needed. Kidney stones and impaired kidney function can result from inadequate water intake, which may pose major health risks.

Water is an essential component of blood in the circulatory system because it helps carry nutrients and oxygen to cells while eliminating waste. Sustaining appropriate levels of water is essential for promoting heart health and blood circulation.

Beyond just feeling thirsty, dehydration has significantly more negative effects. Dehydration, even minor dehydration, can affect physical and mental performance and increase the chance of developing a number of illnesses. Dehydration is frequently characterized by headaches, weariness, dry skin, and black urine. Chronic dehydration can eventually lead to more serious medical issues like kidney stones and urinary tract infections. For vulnerable populations, such as the elderly, athletes and small children, inadequate hydration is particularly important. People become less able to recognize thirst as they become older, which increases their risk of dehydration. Children, on the other hand, cannot completely comprehend the significance of adequate hydration and frequently require reminders to do so. Severe dehydration can, in some circumstances, be fatal.

Maintaining sufficient hydration might be difficult in today's fast-paced, technologically-driven society. Modern life's distractions, crammed work schedules, and excessive screen time can cause us to become unaware of how much water we need. Additionally, cities frequently have easy access to sugary drinks and caffeinated beverages, which can dehydrate people and encourage bad hydration practices. In addition to these issues, the way we engage with the outside world has altered as a result of our always-connected digital existence, making it simpler to put our health second to our virtual interests.

It is aid those who need a way to keep track of their water use by developing smart water bottles that are IOT-enabled. The usage of sensors, Arduino, a WiFi module, mobile applications, etc. is part of this technology. The first step of the approach is to use an ultrasonic sensor to determine how much water the user has consumed. The sensor collects data,

which is then transmitted via the WiFi Module to the cloud. To track water consumption at any time, data is regularly transferred to the cloud. The mobile application then retrieves this data from the cloud so that the user may check their state of hydration.

The Smart Water Bottle is a potentially game-changing answer to the problems associated with staying hydrated in today's society. Its effects are felt on a number of levels:

The Smart Water Bottle can help prevent a variety of dehydration-related health problems, lessening the strain on healthcare systems, and enhancing general wellbeing by encouraging proper hydration.

The Smart Water Bottle can help athletes and energetic people maintain optimum performance by making real-time hydration recommendations depending on their levels of physical activity. The consumption of single-use plastic bottles can be considerably decreased by promoting the use of reusable water bottles, resulting in a more sustainable and environmentally friendly future.

The Smart Water Bottle raises people's consciousness of the value of healthy hydration. Users may choose their fluid intake wisely thanks to the app's reminders and data tracking, which eventually leads to better lives.

The Smart Water Bottle can be a lifeline for people in need, including the elderly and little ones, making sure they get the hydration they require even when they aren't conscious of their own thirst. Researchers and healthcare professionals can benefit from the quantity of data gathered by the Smart Water Bottle app in order to better understand hydration patterns and create strategies to address concerns connected to dehydration.

Aquatrail measures the amount of water consumed, but it also uses a mobile application to notify the user if their intake is less than average. Thus, as it enables user interaction with the Smart Water Bottle, the role of mobile applications is just as crucial as the roles of other equipment.

Water is essential to human life and plays a crucial role in preserving health, energy, and general well-being. The fact that it is involved in almost every biological function demonstrates its diverse significance. Recognizing the importance of water and staying well hydrated is essential to a happy and healthy life for humans.

II. RELATED STUDIES

A few of the problems we ran into when developing the smart water bottle were with its design and system architecture, components, technology used, functioning, and impact on hydration habits. The publications that we consulted when creating the smart water bottle are really helpful to us. Each article plays a crucial function because it has greatly aided us in keeping track of water level, reminding us about the technology used for alerting by giving reminders, etc.

Managing the data and alerting the user with reminders is essential aspect which we considered which working on the project. This study gives the user statistics about how much water they drink on a daily average, but also reminds them to drink water every two hours. So, this product gives the user a careful method of controlling how much water they consume—something that people often forget to do [2].

This paper suggests a fuzzy algorithm-based model development system. The user can predict how much water they will consume each day with Aquatrail. The outcomes given also comply with the established guidelines, which are classified as low, medium, and high. Because it can display more accurate measurements [3].

An overview of IoT solutions in the developing market was provided in this article. In the near future, the importance of IOT will simplify our lives in a variety of ways, including the environmental requirements and health department. The market solutions were categorized into five major groups in this paper: smart wearables, smart homes, smart cities, smart environments, and smart enterprises. Wearable technology, such as smart watches, informs us about Internet of Things items that we can utilize on a regular basis. Numerous IoT-related solutions, such as smart meters, gas detection, and smart security, are also included in "smart homes." Smart cities have characteristics like intelligent traffic management, where cars use Internet of Things software to track traffic as they go forward. There are also IoT solutions that have been proposed, designed, developed, and brought to market by industrial organizations [4].

An approach to tracking water intake without ongoing user input was presented in this paper. It calculates how much fluid is ingested with each sip and how an individual is drinking using data from an accelerometer on a wristwatch. [5].

This study presents a design and implementation of a fluid intake tracking device that satisfies a number of requirements for the system, including being able to provide data regarding fluid level and container type, being based on an easily accessible, straightforward sensor setup, and working with various drinking containers. [6].

This paper presents an extremely promising design. Instead of just offering recommendations and verifying ingestion, the goal is to create a highly effective and useful hydration management planner that offers both identifying and medication based on individual water intake. Therefore, people in the upcoming higher era who care about in health will pay attention to this solution if it is introduced and helps people create and handle proper water intake habits. It will also usher in a new phase of water intake research. [7].

This study created a system that can be adjusted for both urban and rural settings, minimizing the need for human involvement in water management while taking sustainability into account. It develops a workable system that increases the source's long-term sustainability while automating the tasks. [8]. This study presented a smart bottle architecture model for hydration reminders, which successfully remind people to drink enough water at the right times to maintain a stable body temperature. People in today's world frequently forget to drink enough water, so sending out timely reminders will help to keep them properly hydrated. The system not only monitors the user's water intake but also lets them know if there has been a prolonged period of time without drinking. It notifies the individual through transmitting a message to their smartphone [1].

III. METHODOLOGY

Smart water bottles track and promote hydration through a variety of hardware components and techniques. A

architecture diagram (Fig.1) must be used to design a Smart Water Bottle that is trustworthy and efficient. To monitor and optimize hydration, the development process integrates a variety of technologies, sensors, and software elements. The following is a suggested process for creating a smart water bottle:
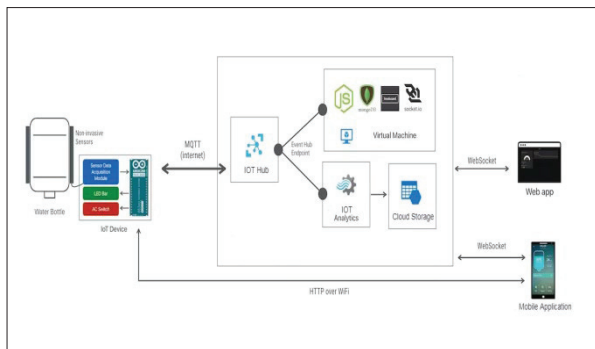

Fig. 1. Architecture Diagram

A. Planning a project and gathering requirements

Establish the project's goals, target audience, and scope. Describe the precise attributes and capabilities that the Smart Water Bottle will have, establish precise performance and usability standards, Set a budget and timeframe for the project. Design the project with the help of block diagram (Fig. 2) to ensure the right workflow.
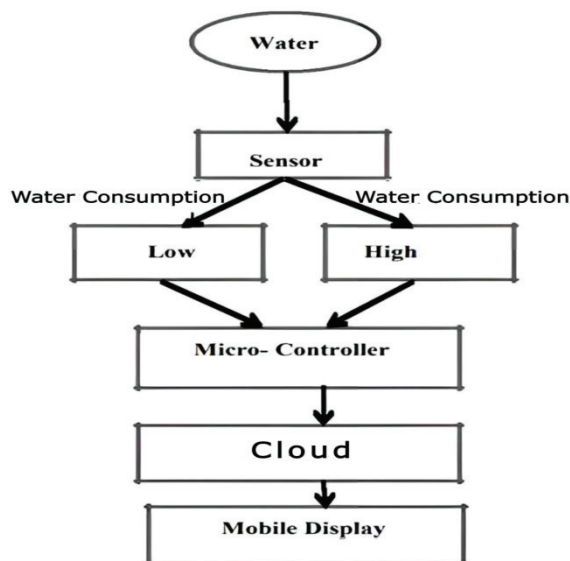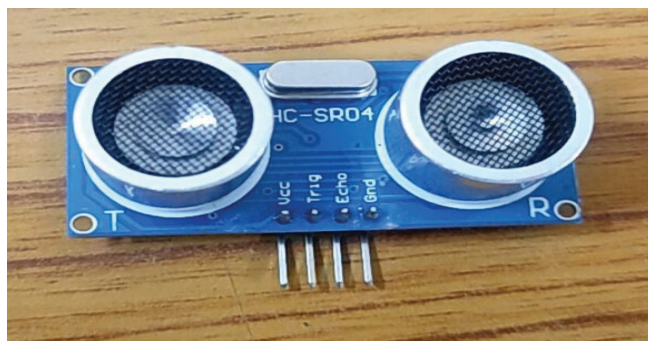

Fig. 2. Block Diagram

Fig. 3.Ultrasonic Sensor

Choose the right sensors (Fig.3) to keep an eye on the environment and water intake. These could consist of ultrasonic sensor, wifi-module, jumper wires, water bottle. To extend the battery life of the gadget, make certain that the selected sensors are precise, dependable, and energy-efficient.

B. Connection Methods

Select the connectivity type for data transmission to a mobile application. Popular options include Bluetooth as well as Wi-Fi Low Energy (BLE). We utilized the wireless network module for connectivity in this project. In this project, the ESP8266 Wi-Fi module is being used (Fig. 4). Make the hardware components needed to establish a stable connection.
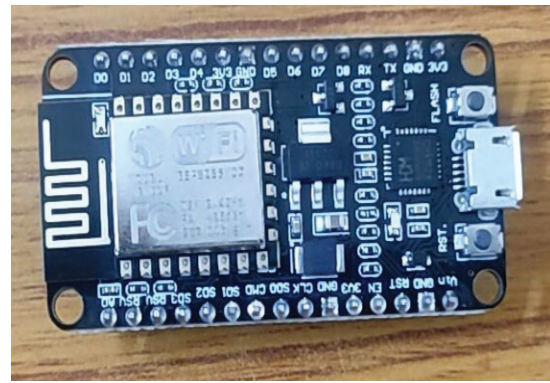

Fig. 4. ESP8266 Module

C. Designing and prototyping hardware

Create the Smart Water Bottle's physical structure while taking into account elements like size, shape, and material (such as BPA-free plastics, stainless steel, or glass). To verify the integration of sensors and connectivity components, make a working prototype. In the prototype (Fig. 5. Protype) we have kept the ultrasonic sensor in the cap of the water bottle to track the level of water. Make sure the bottle can be easily refilled, maintained, and cleaned.

Fig. 5 Prototype

D. Create an application

Create an Android compatible user-friendly smartphone app (Fig.6). To receive and interpret real-time data, integrate the app with the sensors and networking capabilities of the Smart Water Bottle. Include tools for establishing hydration goals, making tailored suggestions, and tracking historical data. Adaptive reminders should be implemented based on user activity levels, the weather, and personal preferences. Give privacy controls and data sharing options while securely storing user data.
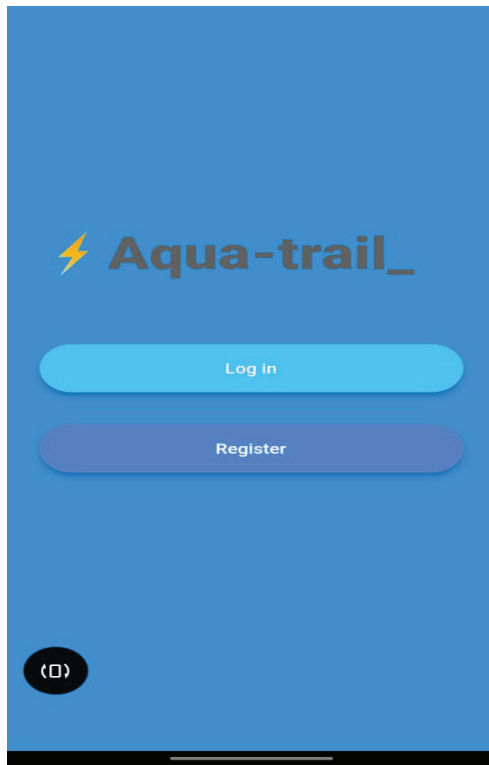
Fig. 6. Mobile Application

E. Stages in the Proposed Method

Input: In the input stage, sensors (HC-SR04) and Arduino are used to gather data. The four pins on the ultrasonic sensor are trigpin, echopin, Vcc, and GND. Trigpin is linked to the the D5 pin of the WiFi module; echopin is linked to the D6 pin; Vcc is linked to the 3V3 pin; and GND is linked to the ground terminal of the respective WiFi module.

Processing: Following data collection, the data must be transmitted to the cloud (using the WiFi-Module ESP8266) via the MQTT protocol utilizing publish and subscribe messaging transport. Once the data has been received by the cloud Firebase. The Firebase is used as it will also help in the authentication process when it needs to save the credentials of the individual in the cloud.

Output: A mobile application is used to establish communication between smart water bottle and the user. The user needs to register and sign-in in the application, then the amount of water which will be consumed by the user will be stored in the firebase. The application will fetch that data and display the amount of water consumed, amount of water remaining etc.

IV. RESULT

The smart water bottle which has been developed has shown a number of ways in improving our life as the results are improved hydration, tracking and monitoring, regular notifications, encouragement for healthy habits etc. A number of studies have shown that smart water bottles can help people drink more water. For example, a 2022 study published in the journal Scientific Reports found that people who used a smart water bottle drank 16% more water per day than those who used a regular water bottle.

Fig. 7. Smart Water Bottle

Another study, published in the journal Computers in Human Behavior in 2021, found that smart water bottles (Fig. 7) can help people develop sustainable water drinking habits. The study found that people who used a smart water bottle for 12 weeks continued to drink more water even after they stopped using the bottle.

Smart water bottles are still a relatively new product, but they have the potential to be a valuable tool for people who are trying to stay hydrated and improve their overall health. However, there are a few things to keep in mind when choosing a smart water bottle.

The research make sure to choose a bottle that is accurate in tracking your water intake. Some smart water bottles have been shown to be more accurate than others. One way to check the accuracy of a smart water bottle is to compare it against a known volume of water. For example, fill a cup with exactly 8 ounces of water and then pour the water into the smart water bottle. We offer additional features such as temperature tracking, hydration reminders, and goal setting.

Finally, budget is also considered. Smart water bottles that use IoT and Arduino are often more affordable than traditional smart water bottles. This is because Arduino is a low-cost platform that can be used to create a variety of electronic devices. Additionally, there are many open-source Arduino projects available online, which can be used to create a smart water bottle without having to purchase expensive components or software.

V. FUTURE WORKS

Exciting prospects for sustainability, user convenience, and health await smart water bottles in the future. Modern connectivity and sensors can track hydration levels and send users' devices real-time data. These bottles may evaluate the surrounding conditions, including humidity and temperature, and suggest the ideal amount of water to drink. Personalization of hydration regimens through integration with wearables and health apps can enhance overall wellbeing.

Sustainable objectives can be furthered by incorporating eco-friendly materials into smart bottles. Given the potential advantages, particularly for the healthcare industry, more

research and development is in fact needed for smart water bottles.

You can also keep a quality check sensor, which gives you information about the quality of the water. For patients with medical conditions that necessitate them to monitor their water intake, developing a mobile application is another option. In the event that they exceed the threshold, the relevant notifications can be sent. Cooperation with smart home ecosystems may make voice commands for temperature control or refilling possible.

In conclusion, the future of smart water bottles will combine sustainability, health, and technology to improve how we engage with our surroundings and stay hydrated.

VI. Conclusion

In conclusion, the AquaTrail project represents a significant step forward in the intersection of technology and health. Through this project, we have successfully designed, developed, and tested a smart water bottle that not only helps individuals stay hydrated but also promotes healthier lifestyles. AquaTrail incorporates a range of features, including hydration tracking, personalized reminders, and compatibility with mobile applications, which provide users with the tools they need to make better choices when it comes to their daily water intake. This project has highlighted the potential for technology to enhance our well-being and encourage healthier habits in a world where staying hydrated can be challenging. Smart water bottles that use IoT and Arduino are often more affordable than traditional smart water bottles. This is because Arduino is a low-cost platform that can be used to create a variety of electronic devices. Additionally, there are many open-source Arduino projects available online, which can be used to create a smart water bottle without having to purchase expensive components or software. Overall, smart water bottles that use IoT and Arduino are a promising technology with the potential to improve people's health and well-being. Here are some specific examples of how these bottles can be used: Athletes can use smart water bottles to track their hydration levels during workouts and competitions. This can help them to avoid dehydration and improve their performance. People with diabetes can use smart water bottles to track their fluid intake and ensure that they are drinking enough water. This can help to prevent complications from diabetes, such as kidney disease. Older adults can use smart water bottles to remind them to drink water throughout the day. This can help to prevent dehydration, which is a common problem among older adults. People who live in hot climates can use smart water bottles to track their hydration levels and ensure that they are drinking enough water to stay hydrated. This can help to prevent heatstroke and other heat-related illnesses.

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