Smart Water Bottle

Project Report Submitted in the Partial fulfillment

For the award of the degree of

BACHELOR OF ENGINEERING
IN
COMPUTER SCIENCE & ENGINEERING

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IN

BRANCH OF STUDY

SCHOOL OF COMPUTING SCIENCE AND ENGINEERING

GALGOTIAS UNIVERSITY, GREATER NOIDA

Under the Supervision of

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June 2021

SCHOOL OF COMPUTING SCIENCE AND ENGINEERIG

BONAFIDE CERTIFICATE

Certified that this project report **"Smart Water Bottle"** is the bonafide work of "Riya Gupta, Ayush Gupta**"** who carried out the project work under my supervision.

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Statement of Project Report Preparation

1. Thesis title: Smart Water Bottle

1. Degree for which the report is submitted: Bachelor of Technology in Computing Science and Engineering.

2 Project Supervisor was referred to for preparing the report.

3. Specifications regarding thesis format have been closely followed.

4. The contents of the thesis have been organized based on the guidelines.

5. The report has been prepared without resorting to plagiarism.

6. All sources used have been cited appropriately.

8 The report has not been submitted elsewhere for a degree.

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ACKNOWLEDGEMENT

I would like to convey my sincere gratitude to all those who provided us the opportunity to work on the project "**Smart Water Bottle**". Foremost, A special appreciation to our supervisor **Mr. Ramesh Kumar C.** for his continuous support, patience, motivation in this research whose guidance helped me in all the time of research and writing of this thesis..

Last but not the least, we would like to express special gratitude to our friends and family who helped us a lot in finalizing this thesis within the limited time frame.

Bharat Chandra Varshney

Ayush Gupta

Abstract

Scientific studies tell us that an average human requires a minimum of 3 litres of water everyday to keep the body fully hydrated but due to the busy schedule we often forget to keep up with that amount. We need to keep our body hydrated all the time. But the water we usually drink is polluted and unfit for consumption. Hence, to overcome some of these problems we present a revolutionary water bottle. A water bottle that not only keeps the water intact but also keeps the water fresh for a long time. It also tells us the pH level of water and the percentage of harmful chemicals dissolved in it. It has an inbuilt sensor and it can be connected to your phone or smart watch and it provides you a notification, just to remind you to drink water. Our product is not so expensive so, the lower class people can easily afford it and reduces the chances of disease and they will also have healthy water daily.

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Chapter 1

Introduction

1.1 Background

Exponential growth of the number of physical objects, connected to the Internet, also known as Internet of things or IOT, is expected to reach 50 billion devices by 2020. New applications include smart homes, transportation, health care and industrial automation. Smart objects equipped with physiological and activity sensors, i.e. Smart Stuff provide new opportunities for unobtrusive physiological monitoring.

Integration of Smart Stuff with wearable body sensor networks is facilitated with smart phones and smart watches for continuous measurement of physiological parameters, such as heart rate, galvanic skin resistance (GSR), and temperature. Big data analytics can support personalized health monitoring and intervention.

One of the most important factors for health and wellbeing is proper hydration. Water makes up to 60% of our body, 75% of our brain and 85% of our blood. An intelligent hydration monitoring and management platform can provide automatic, accurate, and reliable monitoring of fluid consumption and provide configurable advice for optimum personalized hydration management. A smart water bottle can satisfy the needs of a variety of groups, including athletes that want to enhance performance, dieters that want to achieve their weight goals as well as elderly in group homes that can suffer from dehydration.

1.2 Literature Review

For such a revolutionary and helpful technology, there is a limited literature related to it. According to the study of Harvard, it has been found that the people actually

suffer a lot of problems just because they don't take an adequate amount of water. The study also quoted that "BRAINS could go nuts without sufficient water."

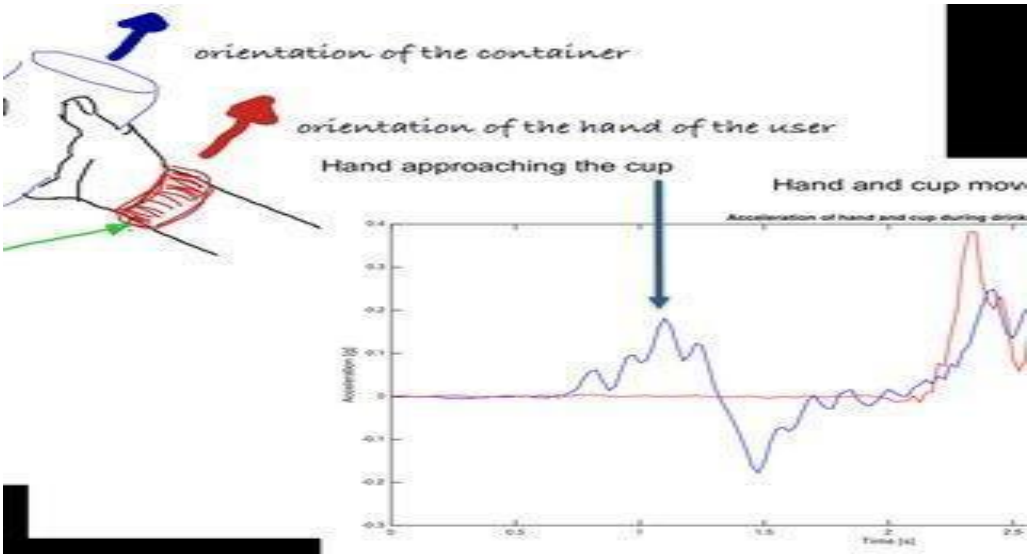
According to Mohammad Abdur Razzaque, in the last few years, there is much a vast development in the field of sensors and actuators. In some cases, IOT can be thought of as a thing-oriented technology having used sensors and actuators. It not only makes use of a single device but it combines various devices under one roof to collect accurate data and perform actions using actuators.

Luca Catarinucci et al, in their thesis 'An IOT aware architecture for smart Healthcare Systems', said that for improving the effectiveness of the health care system, a variety of sensors are attached to the body of patient that help doctors to achieve different parameters like blood pressure, temperature, ECG, motion etc. These are sent via wireless protocol(RFID).

IOT refers to internet of things in which 'Internet' is the actual link that helps to connect with the user sending the information about the parameter changes. To send the data from the sensors to the controller the ZIGBEE protocol can be used which require low power and low bandwidth. This protocol is basically a simpler and cheaper alternative to Bluetooth or WIFI.

1.3 Problem formulation

We are planning to use tech used in arogya setu app, the way they used bluetooth for monitoring covid-19 patients. We implemented several versions of a smart water bottle to evaluate user factors and performance of different configurations. Three main configurations include: a) body area network integration, b) WIFI cloud system integration, and c) ZIGBEE protocol. The controller communicates with the custom smartphone application through a Bluetooth Smart wireless interface. The smartphone application process data from the smart water bottle and sends processed information to the backend server. Limited range of the bluetooth wireless interface may be an issue for some applications. In the case of collective monitoring in hospitals and assisted living facilities, it is not practical that every user keeps a smartphone platform with them most of the time. Therefore, we implemented a cloud based solution with WIFI connectivity as presented.



1.4 Objective

Fitness tracker in terms of hydration.
It tracks the time and amount of water intake.
It monitors the water level then sends reminder to user.
It can be recharged through micro USB socket.

Chapter 2

Technology and Requirements

2.1 Internet of Things(IOT)

The internet of things (IOT) refers to a system of interrelated, internet-connected objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet without the human interventions. IOT has become one of the most important technologies of the 21st century. These devices range from ordinary household objects (kitchen appliances, thermostats, baby monitors) to sophisticated industrial tools (Cars), or between people, processes, and things rather we should say, the physical world meets the digital world – and they cooperate.
Furthermore, smart water bottle that also guides users to consistently drink appropriate amounts of water by applying **Internet of things (IOT)** technology.

2.2 Zigbee protocol

Zigbee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless IOT networks. The Zigbee standard operates on the IFFF 802.15.4 physical radio specification and operates in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz.

In our project, to send the data from the sensors to the controller the ZIGBEE protocol can be used which require low power and low bandwidth.

Features of Zigbee Protocol:

- Support for multiple network topologies such as point-to-point, point-to-multipoint and mesh networks.
- Low duty cycle- provides long battery life.
- Low latency
- Direct Sequence Spread Spectrum(DSSS)
- Up to 65,000 nodes per network
- 128-bit AES encryption for secure data connections.
- Collision avoidance, retires and acknowledgements

2.3 WIFI cloud System integration

This is the age of innovation and sophistication when it comes to wireless internet. With some of the smartest and the most futuristic minds working on elevating enterprise connectivity experience, cloud WIFI technology has come across the global.

Cloud integration is a system of tools and technologies that connects various applications, systems, repositories, and IT environments for the real-time exchange of data and processes. It is created to breakdown data silos, improve connectivity and visibility, and ultimately optimize business processes. It is a response to the need to share data among cloud-based applications and to unify information components. Cloud integration has grown in popularity as the use of Software as a service (SaaS) solutions continues to increase. Studies have indicated the more than 90 percent of enterprises employ a multi-cloud strategy, and SaaS usage will soon outspace traditional product delivery. Deployments that are both fully in the cloud of hybrid are considered cloud integration – the ultimate goal is to function as a cohesive IT infrastructure. Once combined, the data and integrated cloud services can then be accessed by multiple devices over a network or via the internet.

2.4 Required of Sensors

1. ph sensors
2. Touch and pulse sensors(TAPs)
3. Photoplethysmographic sensor(PPG)
4. MAX30100(Pulse oximetry sensor)
5. Dissolved oxygen sensors

2.5 Oxygen Water Detection

- **Input:** Borosilicate glass, H2O tracker at the base using vacuum and magnetic connection, weight sensor.
- **Output:** Warning of water quality
- **Benefits:** Hydrated and Healthy body

CHAPTER 3

WORKING/IMPLEMENTATION AND TESTING

3.1 Description

Although the use of the word ‘Smart’ has become a little vague, recently in this case, it generally means that the water bottle is connected to the phone using Bluetooth or ZIGBEE protocol.

Aside from that, it also offers some different features like Hydrate spark which will simply glow when you need to take a sip – no phone needed around it.

3.2 Oxmo active water bottle

This is a USB chargeable smart bottle that can hold 473 ml of fluid. It is leak-proof and has sensors to detect water levels. It works with the Ozmo app, and the user can set hydration goals. There are three LED lights on the bottle which tell the user of their progress. The bottle vibrates if one has not had water from it for an hour. The app provides a daily, weekly and monthly breakdown of water intake.

Oxmo active water bottle

3.3 Equa smart water bottle

Equa smart water bottle is the stainless steel bottle that has double insulation and works with the Equa app that provides personalised plans for water intake. It can keep its content hot or cold, for 12 hours and more. The tracker is attached to the base and has built-in LED lights to remind the user to drink water**.**

Equa smart water bottle

3.4 Hidrate spark water bottle

Hidrate spark water bottle helps improve your water intake by tracking your water consumption and glowing when it's time for a drink. It calculates and adjusts a personalised hydration goals based on your body and activity level. The sensor inside the bottle records how many ounces and millimetres you drink and can also record via the app on your smartphones. It will train you to sip more and itching us closer to our hydration goals.

Hidrate spark water bottle

3.5 Testing

Threshold values for water parameters testing are shown in the table:

Parameters	Minimum value	Maximum value
Chloride	0	250
Ammonia	0	1.5
Nitrate	0	0
Floride	0	0.4-0.6
pH	6.5	9.0

The values for the parameters that are captured from the sensors will be sent to the controller. The controller then uses these values in its conditions on the real time constantly keeps on monitoring for any change in its values. If any values changes any time the changed value is compared against its mapped value. If it crosses the threshold value notification is triggered immediately. The warning will be displayed in the bottles digital touch screen, the color of LED on the bottle neck change and also the user can be additionally notified on the smart phone.

Chapter 4

Design

4.1 Designing Sensors

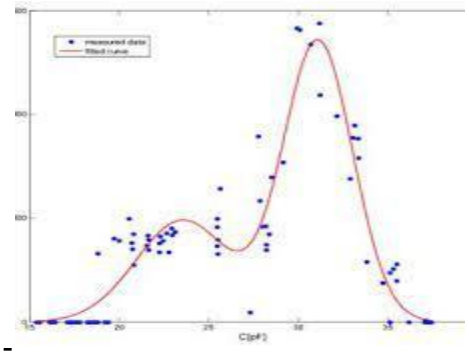
A new sensor design for detecting water hardness using complexometric and colorimetric concepts has been presented in this report. Calmagite, a metal ion indicator, changes color of a solution to wine red in presence of calcium (Ca2002B;) and magnesium (Mg2002B;) ions at pH 10. When Ethylenediaminetetraacetic acid (EDTA) is added to the solution, it displaces the indicator from the metal-indicator complex and turns the solution blue. A red solution is transparent to a red light whereas nontransparent to a blue light and vice versa. If a photodiode is placed across the solution, the voltage (V) across the diode will vary based on how much of red or blue light passes through the solution and strikes the photodiode. Finally, based on visual inspection of color change of a water sample and voltage change, around 30% and 13% in

average for blue light and 6% and 74% in average for red light, hardness of the sample is detected.

Dissolved oxygen sensor consists of a self polarising galvanic cell with automatic temperature. It has linear mV output, the probe could measure oxygen in aquaculture, water quantity. The TAPs sensor uses capacitive sensing to detect when user touches the bottle and physiological monitoring using a PPG(photoplethylsmographic) sensor. The PPG sensor is a 2-layered board(0.625 by 0.92 inches) that features the Maxim MAX30100 heart rate and pulse oximeter sensor.

Fig. 3. PPG sensor on the smart water bottle

PPG Sensor



PPG amplitude

4.2 Work plan Layout(Construction Price)

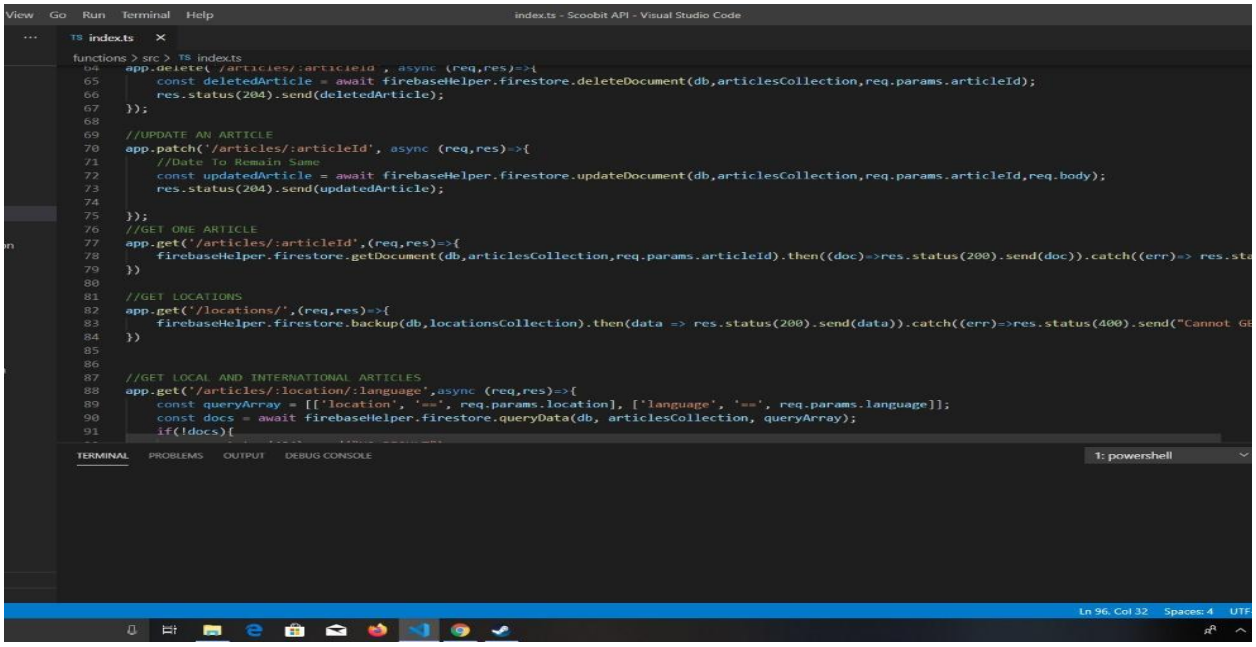
1: Waterproof LED Lights **-- Rs. 189**

2: Electromagnetic Buzzer with indicator **-- Rs. 60**

3: Different Sensors **-- Ranging between Rs. 150- 200**

4: Overall price of bottle ranging between **-- Rs. 400- 500**

4.3 API for fetching data



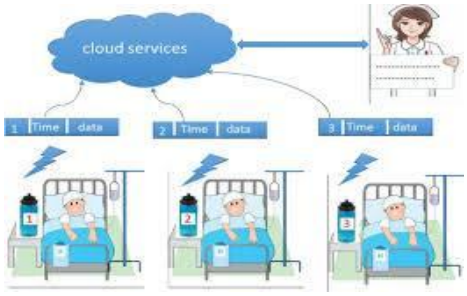
4.4 Methods

We have implemented several versions of the smart water bottle, and is evaluated on a number of factors, and the performance of the different configurations. The two configurations, comprising: (a) lan-body integration, and (b) the inclusion of a cloud system, a Wi-Fi connection.

The features of the smart water bottle, integration, via a smartphone app . The controller interacts with the user via a smartphone app using Bluetooth Smart wireless interfaces. A smart-phone, data processing programs, a smart water bottle, send the information, which is processed to an internal server. There is a limited range of a Bluetooth interface, for certain applications, it may be a problem.

In this case, the collective supervision, supervision in a hospital and a nursing home, it's possible that each user has spent a lot of time when you are holding a smart phone platform. So, we have implemented a cloud-based solution with a Wi-Fi connection.

As a registered nurse, or doctor to obtain information from someone with a bottle, directly, via the cloud, and the current hydrating position and history of each of our users. The system can also send messages and notifications to users and / or staff, the health care provider.



Cloud based implementation

The controller is implemented with the help of the photo of the Wi-fi management platform for IoT applications in the field of Physics . The Photon uses a Broadcom Wi-Fi controller, which supports the 802.11 b/g / n and support for the cloud service. This approach makes it possible for you to integrate a large number of smart devices over existing Wi-Fi infrastructure. In our application, which will make it possible for individuals to use their own water bottles, which are all connected in the cloud using a Wi-Fi interface. In this configuration, it is particularly important to the nursing home, and hospital.

We are made up of the several smart water bottle to the sensors for evaluation, you are able to use the sensors in order to monitor the activities and physiological monitoring of the user. We are using a 3-d accelerometer, which is used in order to detect faces.

Chapter 5

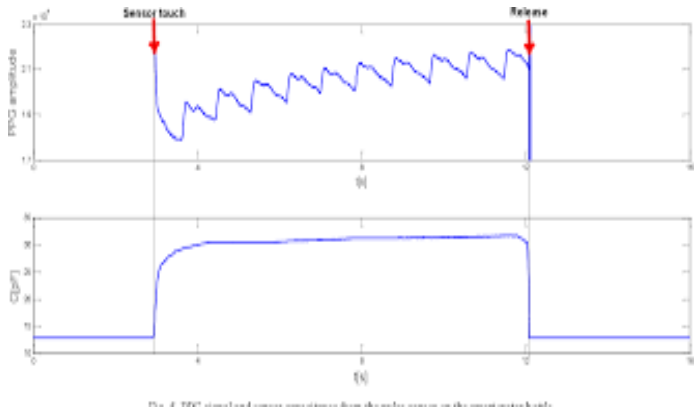
Conclusion

5.1 Application

The user can use smart water bottles at home or take it with us and our office or gym. If we are more in the outdoor games or activities then we can easily slide it into your backpack when leaving for camping, hiking, or climbing. We will most likely need a replacement battery when on road.

5.2 Future Works

Our future work generally concerns the user . We want our product to be user friendly and so we want it to modify it in artificial intelligence . This may increase the cost of the whole setup but it can be revolutionary and beneficial for our future users.



Sensor Variations as per market value

5.3 Results

Pre-tested, physiological sensors, a smart water bottle that show a very high level of quality of the signal, may be used for non-invasive physiological monitoring. An example of a PPG signal, to change the touch screen, which will be displayed in the picture, the change in capacitance due to a touch sensor.

SmartStuff by the sensors, the built-in item that you can use on a daily basis, which means that you are synergistically, in order to deal with the signals of multiple sensors, which greatly simplifies the understanding of the context of the measurement, and the unique insights. We evaluated the performance with the use of sensors to identify the user.

Inertial sensors on the bottle and the smartwatch of the user can be used to detect the same pattern of activity as a means of identification of the user. A typical pattern of activity recorded during the bottle use is presented. Dynamic component of the 3D magnitude of acceleration on wrist (collected by the smartwatch) and the bottle (accelerometer on the bottle) is very similar when the bottle is held on the same hand.

In addition, heart rate from the PPG sensor on the bottle and from the smartwatch can also be used to identify the user, which is useful if the opposite hand is used to hold the bottle. Touch sensor can be used to assess the contact between the finger and the PPG sensor. We investigated quality of the PPG measured as peak-to-peak amplitude of the PPG for each heart beat as a function of the capacitance of the touch sensor. It can be seen that the light touch, indicated as measured capacitance between 10 and 27 pF provides good signal with amplitude around 450 units for the 13-bit precision of the PPG. The amplitude is significantly better with more pressure (28-33pF), but drops significantly with high pressure due to the loss of pulsation in the finger.

5.4 Discussions/Conclusions

High level of intelligence to everyday things, such as the implementation of Smart Things, opening up the possibilities for new applications and services. The synergistic processing of data from Smart Phones and smart watches and other wearable sensors, can significantly improve the m-health field, and longitudinal monitoring. Multi-modal integration, and is a very promising method for the accurate monitoring and an understanding that, in connection with the survey.

Each approach has advantages for specific applications. Integration of a personal body of the network is more energy efficient, but they require a personal gateway (e-mail), in close proximity to the device, at least on a regular basis throughout the day. The Cloud solution provides you with the ability to easily integrate with a large number of profiles, with the help of the standard of infrastructure, but it requires higher energy consumption, and reduce the life of the battery. Challenges, challenges, but also for the future of our cases are discovered, the services of a heterogeneous system integration, energy-efficient, out-of-the-system, and robust processing and identification algorithms.

References

[1] A., M, M. Məhəmmədi, M M., "the Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications," IEEE Inr. Cypв. Tutor., no. 17, nos. 4, pp. 2347-2376, Fourthquarter 2015.

[2] www.Researchgate.com ”Research paper smart water bottle”

[3] C. Perera, A. Zaslavsky, P. Christen və D. Georgakopoulos, "Context Aware Computing for the Internet of things: A Survey", IEEE Inr. Cypв. Tutor., no. 16, nos. 1, pp. 414-454, the First in 2014.