Department of Electronic and Telecommunication Engineering

University of Moratuwa

EN1190 Engineering Design Project

Project Report

Team Name: Spartans

Aqua Tracker

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Abstract

We identified that lack of water consumption of people mainly who work most of their time at a desk, is a major problem in our society which leads to many serious health issues. After validating this problem, we developed a water consumption tracking device to keep track and remind the users to track the daily water intake.

To meet our expectations, we designed this device with two user interfaces, one is the display and other one is Telegram bot. We simulated our circuits using Proteus simulation software and prototypes. The design of enclosure and PCB was done using SOLIDWORKS and Altium softwares with the required standards and paying attention to more detailed problems like the size of our end product. We have included the detailed functionality, explanation of the design and the challenges we faced during the development of our final product in this report.

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1. Introduction

At present, most of the people neglect their physical well-being due to their busy lifestyles. They often forget to drink water which is an essential part of physical and mental health. Specially, people who work at a desk, such as office workers and employees in the IT industry, who deal with files and computers during a lot of their work time, face this matter. Undergraduates are also a group who are affected by this. The lack of water consumption forms the basis for a lot of diseases.

In our project, we tried to tackle this issue by introducing a water consumption tracking device which tracks the amount of water a single user consumes daily and reminds him/her to keep up with the recommended amount of water intake. We have used Telegram as the main user interface to communicate with the user – to remind him/her to consume the recommended amount and to allow the user to adjust the recommended amount of water he/she has to consume according to their weight. An OLED display is also attached to the device to display the daily water consumption as a percentage and the current time for attractiveness.

2. Methodology

2.1 Power Circuit

Our device has modules which operate on 5V, namely the OLED display and the HX711 amplifier and 3.3V, namely the WiFi module. So, we have to use separate circuitry to supply these voltages.

- Two 3.7V 3400mAh Li-ion batteries

We use two 3.7V, 3400mAh Li-ion rechargeable batteries connected in parallel to power our device. This is to increase the capacity of the batteries and to maintain the 3.7V output for a long period of time. But since our modules run on 5V and 3.3V we have to both step up and step down this voltage in order to obtain the required voltages.

- 5V 2A Power Bank Charger Module

We have used this power bank charger module to charge the above-mentioned batteries and to obtain a constant 5V supply. The batteries are charged by plugging the micro-USB charging cable directly to a wall outlet and the 5V output is given through a USB-C port. There are two USB ports in this module, but we use a single one because it's enough for our purposes.

- LM2596S 3-40V to 1.5-35V 4A DC to DC Adjustable Step-Down Buck Module

We use this buck converter to step down 5V to 3.3V. The 5V input is fed from the Power Bank Charger Module's USB-C port and the Buck Converter's output is then fed to the Wi-Fi module via the PCB.

2.2 Rest of the Circuit

- ATMEGA328P Microcontroller

We have used an ATMEGA328P microcontroller as the brain of our device. It does all the necessary calculations and controls all the modules according to our requirements.

- 0.96-inch 128x64 OLED Display Module (SPI)

This display is used to display all the information on our device.

- Load Cell 5kg

The main sensor we have used in our product is the 5kg load cell. When the user puts his/her bottle or any cup or something which stores water on our device this load cell measures the weight and that signal is sent to the microcontroller through the HX711 amplifier.

- HX711 Dual-channel 24-bit AD Conversion Amplifier Module for Load Cell

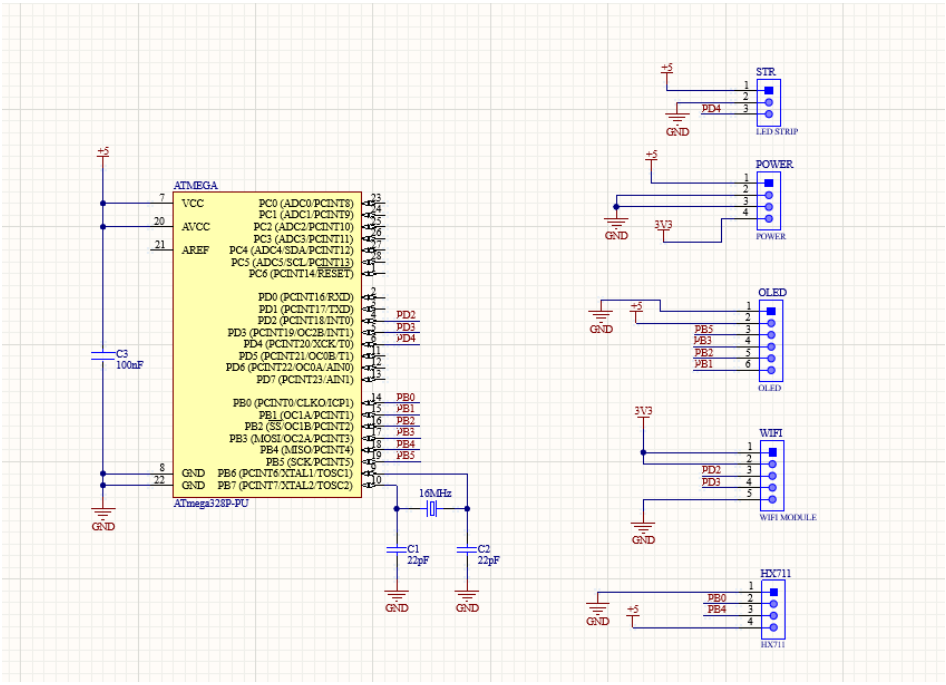
HX711 Amplifier is used to amplify the voltage signal obtained from the load cell and send it to the microcontroller.

- ESP8266 ESP-01S WiFi Module

We have also used a WiFi module to mainly connect with the user through Telegram. For this, we selected ESP8266 because it's readily available in the market and is cost-effective for our product. We also use it to obtain the time from the internet to the display.

3. PCB Design

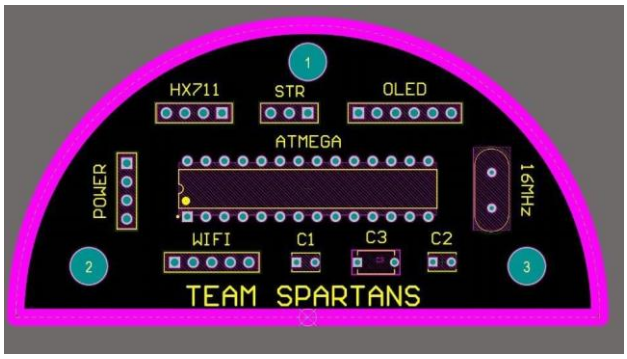
3.1 PCB Schematic Design

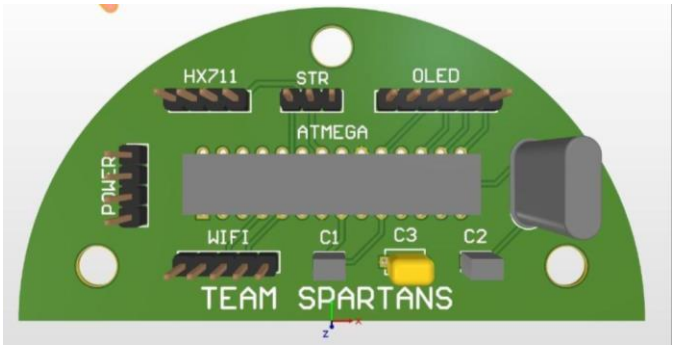


3.2 PCB Design Rules

For normal connections we used the trace width as 0.4 mm as the current flowing through those paths is not more than a few Amperes. For power lines, we used 0.5 mm as specified by the trace width-current charts available by measuring the overall current flowing in our circuit. We used the via diameter size as 1.27mm and the hole diameter as 0.711mm. For drilling holes, we used 5mm diameter.

3.3 Footprint and 3D model of PCB



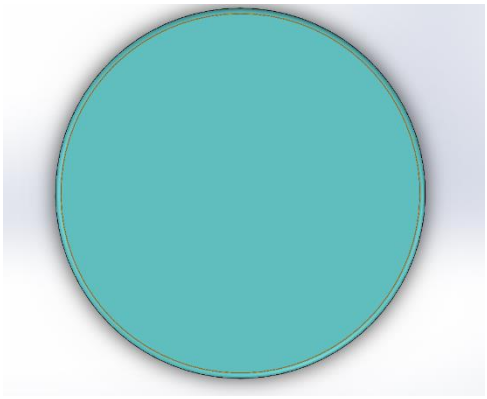


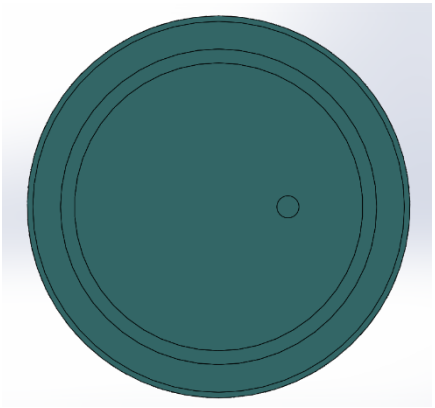
4. Enclosure Design

Since this is a tabletop device, this should take minimum space on the desk as most tables are not spacious. So we had to go for a two-storied structure. We kept the thickness of the enclosure at 3 mm. We noticed that for more efficiency, the plate in which the load cell has to be connected should be of round shape. So we decided to go with a round-shaped enclosure. With the minimum space, we calculated the diameter of the enclosure should be 13cm and the height should be about 6.5cm. The batteries, buck converter, load cell, and HX711 amplifier module were kept on the upper part. On the bottom part, PCB, wifi module, and power bank module were placed. We had to cut three parts on the surface pf the enclosure for the switch, display and power cable. We also had to design the lid as a separate part because it should move up and down in order to get

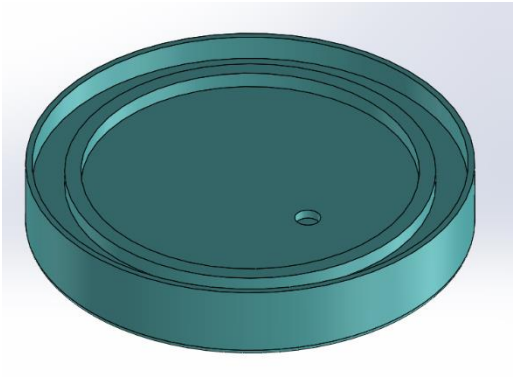
readings from the load cell. After considering all of these, the required strength and simulating using SOLIDWORKS Simulations, we decided to go with PLA material for our design.

- Top and Bottom view of the enclosure lid

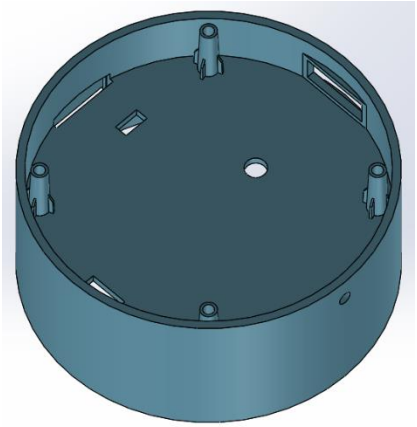


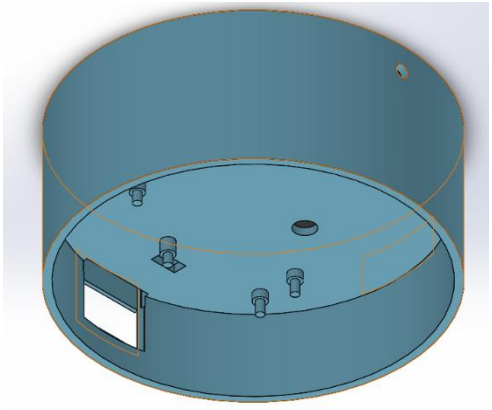


- Side view of the enclosure lid

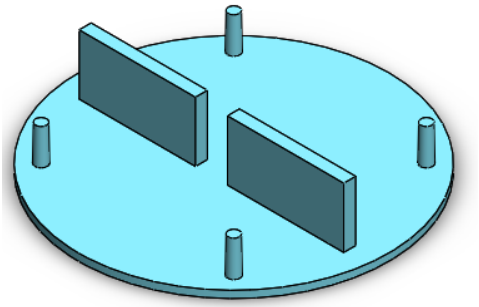


- Side views of the middle part of the enclosure





- Side view of the bottom of the enclosure



5. Bill of Quantities

The technical feasibility of this product depends on a few key factors such as sensors, connectivity, power, display etc.

Component	Price (Rs.)
Load Cell 5kg	700
HX711 Dual channel Module	250
Rocker Switch	30
ESP-01S WIFI module	480
Crystal Oscillator	40
22pF Ceramic Capacitor (2)	10
0.96 inch OLED display	1030
DC-DC Adjustable step-down buck module	270
3.7V 18650 Battery (2)	1100
Battery Casing	100
Acrylic Board for load cell (2)	500
5V 2A Power bank charger module	450
Connectors and other related items	480
PCB	440
Enclosure	4200
Total	**10,080**

6. Discussion

We had to face various challenges during this project. Those are stated below in detail.

- After coding each part separately by our members, we combined those parts together. After that, we had to face many issues of malfunctioning which we overcame timely. One major problem was an issue we identified with the protocols we dealt with. We use SPI communication for the display, and we can't use those pins for other purposes although we use only one-way communication here. But accidentally, we used that other SPI communication specified pin for another purpose, which made us take a few weeks to debug what really had happened. After changing that to another GPIO pin, we could overcome this issue.
- We first decided to go with a rechargeable battery with the requirements we had decided. But unfortunately, that item was out of stock, and we had to find alternative methods to fit that option, leading us to use two batteries with a power bank module.
- We initially decided and designed to keep this as a single-storied enclosure. It was not as efficient as we thought and would take more space. So, we decided that we should go for two storied enclosure.

7. Acknowledgement

Overall, our project was interesting as well as challenging because it is our first project at the department. Integrating all of the modules was a brainstorming task for all of us. Our team was able to learn a lot of concepts on product designing and manufacturing, as well as various other technical skills.

We are truly grateful for the guidance and support of Dr. Ajith Pasqual, our lecturer, throughout this project. All the milestones we were given along with the mid-evaluation, motivated and encouraged us to engage in the project more actively and make it a success.

In addition, we are immensely grateful to all the seniors who were always there to guide us throughout this journey.

Finally, we extend our heartfelt gratitude to all the other people who helped us throughout this journey in making this project a success.

8. References

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