E1.05 31 Degrees Team

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Project Overview

Our product is a smart scale device that monitors the weight, temperature, and color of liquid contained in drink dispensing tanks. This sensed information is sent to a microSD card, and wirelessly transmitted to a cloud-based database, where it is prepared for an operational dashboard. A user interface displays this information at the scale itself, powered by rechargeable batteries.

Business Need

This smart scale device is needed to enable event workers to remotely monitor the volume, temperature, and flavor of drink dispensing tanks, saving them valuable time and energy, while reducing costs for our sponsor.

Requirements

User Interface	Displays weight, temperature, and power level.
Power	Uses replaceable, accessible batteries to power scale. Determines battery charge level.
Weight	Up to 450 lbs. ±0.1 lbs.
Data Transmission	Connects to database via WiFi with variable refresh rate.
Temperature	Between 20 °F and 120 °F ±1 °F.
Color Sensing	Differentiates between liquid colors and matches to flavors.
Platform	Uses Arduino or Raspberry Pi microcontroller.
Operating Conditions	Operates in poor environmental conditions, such as rain, extreme temperatures, spilled product, etc.
Enclosure	Securely accommodates various sized tanks.
Database	Uses cloud-based service GoDaddy for up to 500 devices. Prepares necessary information for dashboard.
Operational Dashboard	Compatible with database and supports desktop and iOS devices. Uses Inductive Automation's Ignition software.

Design Approach

The smart scale has been designed to ensure long battery life, quality data transmission, reliable usability, and accurate weight, color, and temperature sensing over their relevant ranges. Each component was selected for minimal demand on the power subsystem, with the ESP32 capable of entering a deep sleep mode when not transmitting data. The sensed data will be temporarily stored in a microSD card for later transmission to the database to reduce the power demand of frequent data transmission, and to preserve data when WiFi becomes unavailable. The color sensor uses an integrated LED, enabling it to detect colors even in low-light environments. And the user interface's e-ink display minimizes reflection of ambient light, providing for increased user visibility in well-lit environments. Additionally, low-cost components were selected in order that the sponsor may expand deployment of more scales across its fleet of drink dispensing tanks.

Fall Semester Plans

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Unit Testing	Each individual subsystem will be tested using simulated test input data.
Integration and Debugging	All subsystems will be combined to form the smart scale and initial bugs will be resolved to ensure basic functionality.
Integration Testing	The combined product will be rigorously tested according to additional simulated test input data.
Deployment	The smart scale will be deployed for sponsor use at event venues.
Improvement	Based on the results of product deployment, the product will be further refined according to the sponsor's needs and standards.

Drink Dispensing Tank

Tanks of various sizes are used as drink dispensing tanks, with volumes of up to 55 gallons.

Enclosure Diagram

This CAD designs of the scale enclosure and panel were developed by the MFGE sub-team.
The enclosure will securely support the drink tanks according to their maximum weight of 450 lbs.
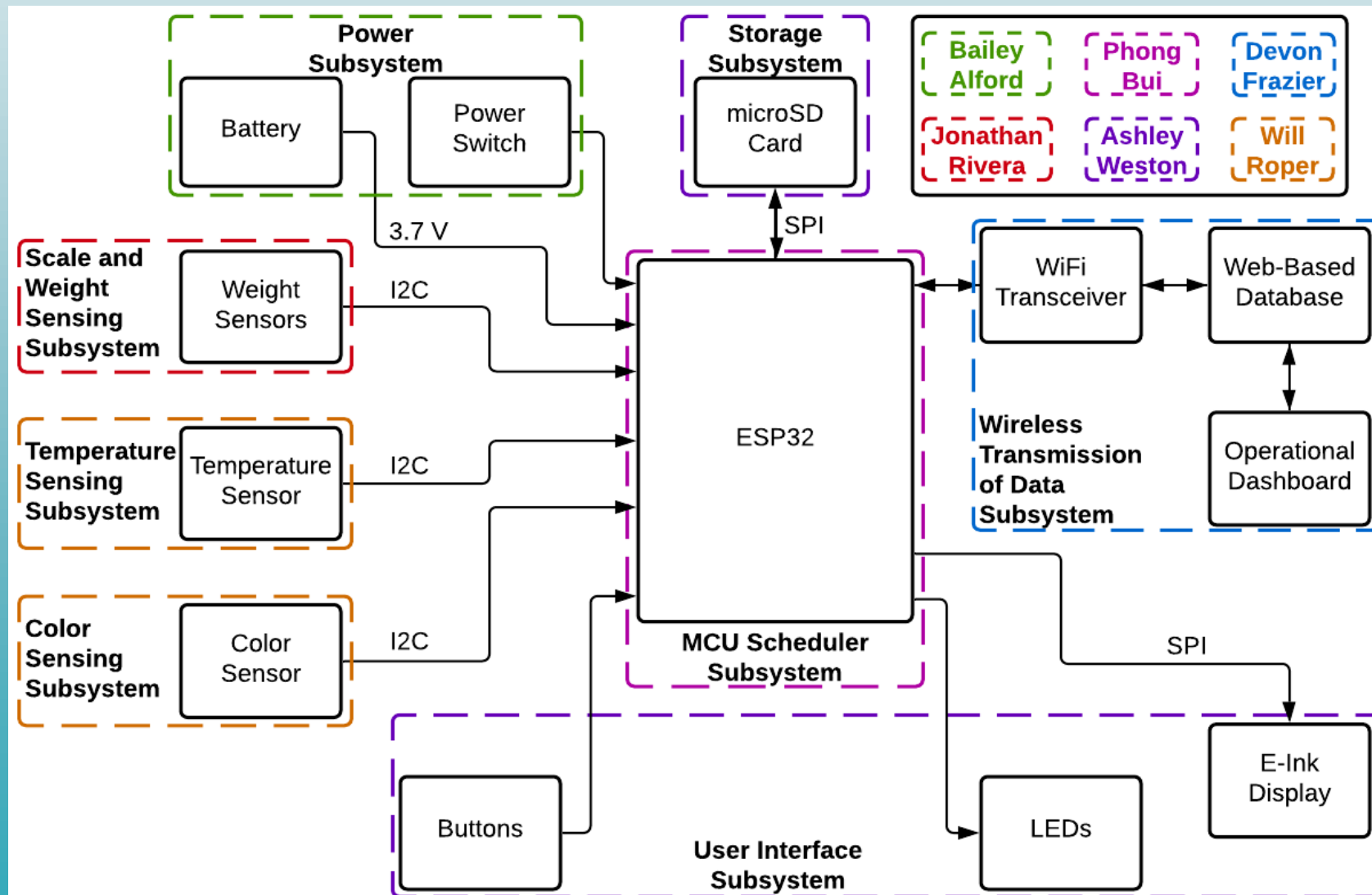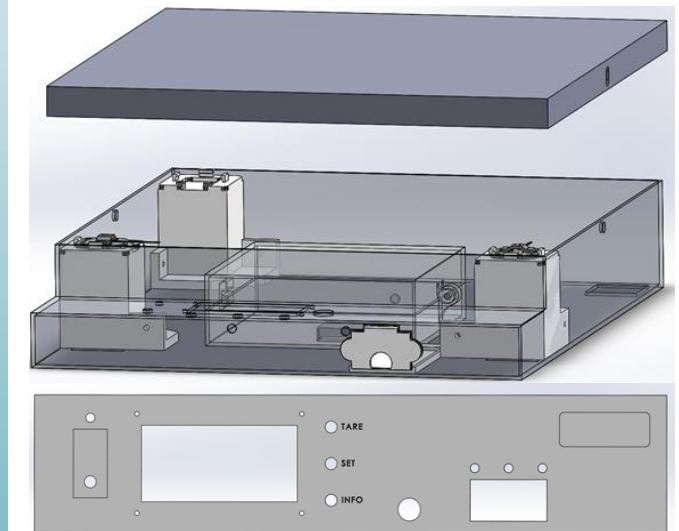
Multi-Disciplinary Sub-Teams

- The Industrial Engineering Sub-Team is responsible for designing the database and operational dashboard.
- The Manufacturing Engineering Sub-Team is responsible for designing the scale's physical enclosure.

Acknowledgements

Block diagram:

- Power Subsystem: Battery, Power Switch
- Storage Subsystem: microSD Card (SPI)
- Team members: Bailey Alford, Phong Bui, Devon Frazier, Jonathan Rivera, Ashley Weston, Will Roper
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- Scale and Weight Sensing Subsystem: Weight Sensors (I2C)
- Temperature Sensing Subsystem: Temperature Sensor (I2C)
- Color Sensing Subsystem: Color Sensor (I2C)
- ESP32 / MCU Scheduler Subsystem
- Wireless Transmission of Data Subsystem: WiFi Transceiver, Web-Based Database, Operational Dashboard
- User Interface Subsystem: Buttons, LEDs, E-Ink Display (SPI)