Boston University
Electrical & Computer Engineering
EC463 Capstone Senior Design Project

First Prototype Testing

Blitz

Team 7
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1. Required Materials

1.1Hardware

1. ESP32 Module
2. HX711 AD Module
3. 4 x 50kg Half Bridge Load Cells
4. 3D Printed Load Cell Mount
5. Breadboard
6. Jumper Wires
7. 3’ x 1.5’ Plywood Board (Shelf surface)
8. Objects of known weight (apple juice, 2 x peanut butter jar, bag of chips)
9. Laptop (for power and to host local server)
10. USB to Micro USB (for power and data transfer)
11. Linksys Router

1.2Software

1. Arduino IDE Calibration Sketch
2. Arduino IDE Weight Testing Sketch
3. Node.js Server (server.js)
    a. This server receives data from ESP32 through a UDP socket and sends inventory data to the frontend using an HTTP get request
4. HTML File (index.html)
    a. This file receives inventory updates using an HTTP get request and displays a visual of the database

2.0 Set Up

2.1Overview

Hardware setup consists of the physical positioning of load cells on their plastic bases and the placement of the composite shelf on the array of four load cells, in addition to the interconnection of the load cells and the HX711 and the interconnection of the HX711 and the ESP. The ESP and SQL database are connected via WIFI following the initialization of the Node server, and localhost:3000 is accessed via a web browser.

2.2Hardware Procedure

1. Attach each load cell to its plastic mount
2. Connect the load cells to each other and to the HX711 and connect the HX711 to the ESP32 according to Figures 1 and 2 in section 3.4

3. Place the 3’ x 1.5’ plywood board atop the 4 load cells
4. Upload the Calibration_Sketch.ino to the ESP32 via a USB to Micro USB cable
5. Place an item of known weight onto the scale while the sketch is running; determine the correct calibration factor
6. Upload the First_Prototype_Testing_Sketch.ino to the ESP32
7. Adjust the calibration factor in First_Prototype_Testing_Sketch.ino to the determined calibration factor
8. Take items of known weight off of the scale

2.3Software Procedure

1. Start Node server (node ./LabTest_1/server.js)
2. Open localhost:3000 in browser
3. Observe weight changes using the update button

3.0 Testing

3.1Overview

Initial system testing primarily focuses on the validation of basic hardware and software functionality, as well each system’s ability to interface with the other. Hardware functionality will be tested through the addition and removal of four items: 1.0 gal of apple juice, two identical 16.3 oz jars of peanut butter and a 6.25 oz bag of chips. Three unique sequences of item addition and removal will be followed to test the system’s adaptability. Following the addition or removal of any item, the shelf’s recorded inventory in mydb.shelf in MySQL Workbench will be compared with the actual inventory on the shelf. This test’s measurable criterion for success is that the shelf inventory represented in the SQL database matches the actual inventory on the shelf at all points during the test.

3.2Procedure

1. Complete hardware and software set up procedures according to sections 2.2 and 2.3
2. Open mydb.shelf in MySQL Workbench and ensure that the stored weights of each item to be placed on the shelf are correct
3. Remove all items from the shelf before running the testing sequences
4. Run Sequence 1
    a. After each item is placed on or removed from the shelf, click the update button in the browser to update the UI
    b. Mark “Yes” only if the expected inventory matches the inventory in the UI
5. Run Sequence 2 in the same manner as Sequence 1
6. Run Sequence 3 in the same manner as Sequence 1
    a. After all items have been placed on the shelf, click the update button in the browser and mark whether or not the inventory in the UI is accurate

b. Remove all items from the shelf, click update, and note the accuracy

3.3Measurable Criterion

Table 1: Item Name and Weight

Item Name	Weight
Apple Juice	4.15 lbs
Peanut Butter	1 lbs
Chips	0.39 lbs

Table 2: Sequence 1

Item Name	n/Off Shelf	Expected Inventory of Apple Juice	Expected Inventory of Peanut Butter	Expected Inventory of Chips	Accurate Inventory (Yes/No)
Apple Juice	n	1	0	0	
Apple Juice	ff	0	0	0	
Peanut Butter 1	n	0	1	0	
Peanut Butter 2	n	0	2	0	
Peanut Butter 1	ff	0	1	0	
Peanut Butter 2	ff	0	0	0	
Chips	n	0	0	1	

Chips	ff	0	0	0	

Table 3: Sequence 2

Item Name	n/Off Shelf	Expected Inventory of Apple Juice	Expected Inventory of Peanut Butter	Expected Inventory of Chips	Accurate Inventory (Yes/No)
Apple Juice	n	1	0	0	
Peanut Butter 1	n	1	1	0	
Peanut Butter 2	n	1	2	0	
Peanut Butter 1	ff	1	1	0	
Peanut Butter 2	ff	1	0	0	
Chips	n	1	0	1	
Apple Juice	ff	0	0	1	
Chips	ff	0	0	0	

Table 4: Sequence 3: All On, All Off

Item Name	n/Off Shelf	Expected Inventory of Apple Juice	Expected Inventory of Peanut Butter	Expected Inventory of Chips	Accurate Inventory (Yes/No)
All items	n	1	2	1	
All items	ff	0	0	0	

3.4Schematic Diagrams

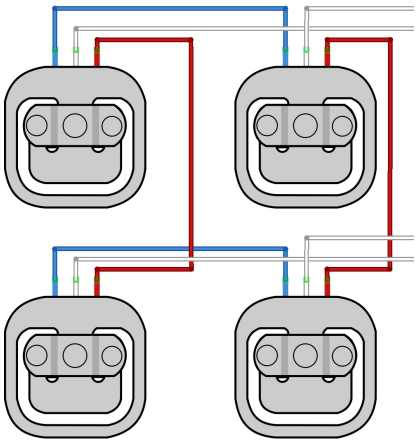

Figure 1: Load Cell Wiring Schematic

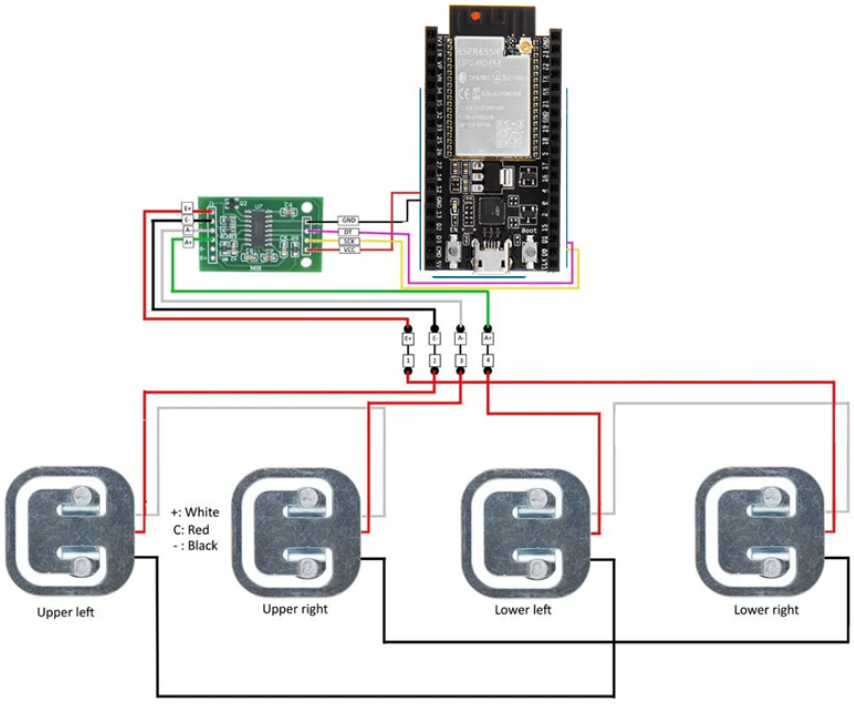

Figure 2: Load Cell, HX711, and ESP32 Wiring Schematic

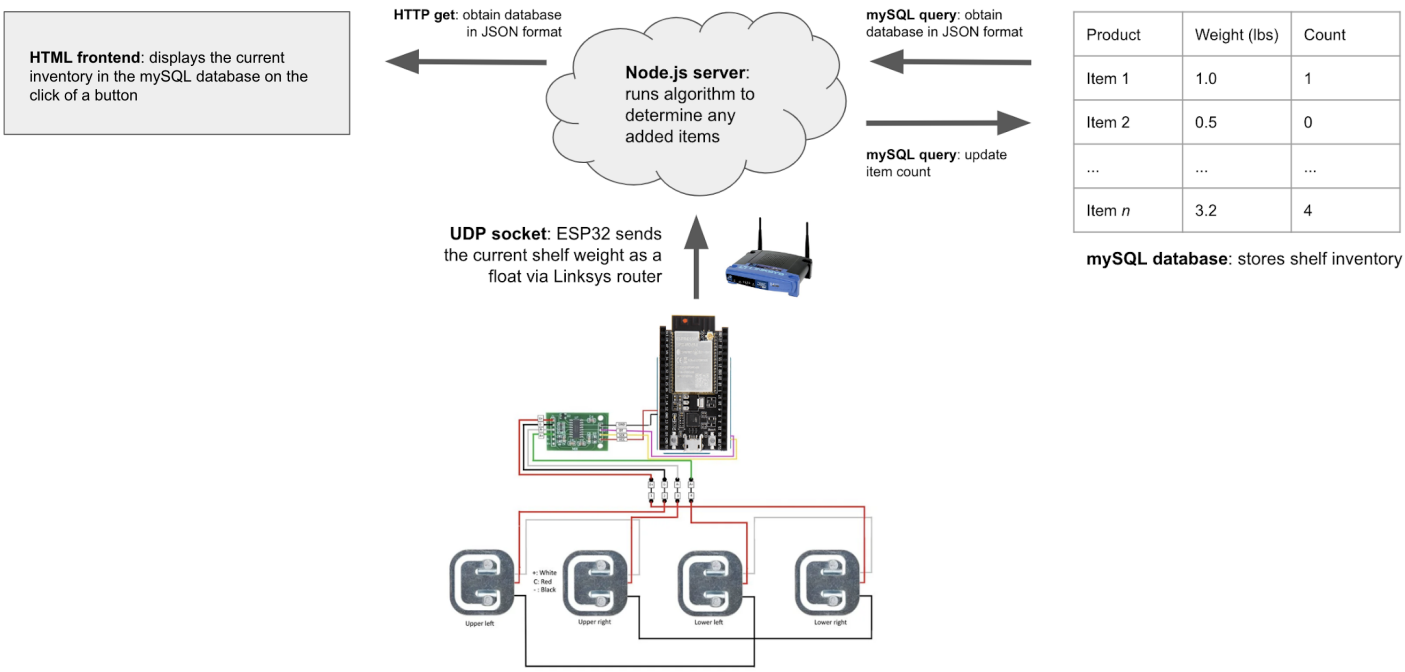

Figure 3: System Overview

2.5Pinout

Table 1: ESP32 Pinout

Signal	Pin
VCC (from HX711)	3V
DT (from HX711)	Digital Pin 6
SCK (from HX711)	Digital Pin 5
GND (from HX711)	GND

Table 2: HX711 Pinout

Signal	Pin
Lower Right Load Cell Data	E+
Upper Left Load Cell Data	E-
Upper Right Load Cell Data	A-
Lower Left Load Cell Data	A+