Boston University
Electrical & Computer Engineering
EC463 Capstone Senior Design Project

Second Prototype Testing

Blitz

Team 7
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1.0 Required Materials

1.1 Hardware

1. 3 x ESP32 Modules
2. 3 x HX711 AD Modules
3. 12 x 50kg Half Bridge Load Cells
4. 12 x 3D Printed Load Cell Mounts
5. 3 x Breadboards
6. Jumper Wires
7. 6 x 3’ x 1.5’ Plywood Boards (Shelves)
8. Objects of known weight (apple juice and 2 x peanut butter jars)
9. USB to Micro USB (for power and data transfer)
10. Linksys N300 Router
11. Ethernet cable
12. Raspberry Pi 3 Model B
13. 2.4 Amp Micro USB charger (to power Raspberry Pi)
14. HDMI Cable
15. USB Mouse
16. USB Keyboard

1.2 Software

1. Arduino IDE Weight Testing Sketch
2. Node.js Server (server.js)
    a. This server receives data from the ESP32s through a UDP socket and updates the mySQL database

2.0 Setup

2.1 Overview

Hardware setup consists of the physical positioning of load cells on their 3D printed mounts 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 mySQL database are connected via UDP following the initialization of the Node server. This should be repeated for all shelves.

2.2 Hardware Procedure

1. Assemble the shelves
2. Upload the First_Prototype_Testing_Sketch.ino to the ESP32

2.3 Software Procedure

1. Open a terminal and start the node server on the Raspberry Pi (node ./20-07-Storemap/CPU/node.js)
2. Open another terminal and log into the mySQL interface using “mysql -u root -p EC464Team7”
3. Run “use store” to access the database
4. Observe current weight on shelves using “select * from shelves”

3.0 Testing

3.1 Overview

Initial system testing primarily focuses on the validation of basic hardware and software functionality, as well as each system’s ability to interface with the other. Hardware functionality will be tested through the addition and removal of grocery store items. Two 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 shelves’ recorded inventories in the mySQL database will be compared with the actual inventory on the shelves. This test’s measurable criterion for success is that the shelves’ inventory represented in the mySQL database matches the actual inventory on the shelves 90% of the time.

3.2 Procedure

1. Complete hardware and software set up procedures according to sections 2.2 and 2.3
2. Run “select * from products” in the mySQL terminal to ensure that the stored weights of each item to be placed on the shelves are correct
3. Remove all items from the shelves before running the testing sequences
4. Run Sequence 1
    a. After each item is placed on or removed from the shelves, run “select * from products” to view inventory updates.
    b. Mark “Yes” only if the expected inventory matches the inventory in the database
5. Run Sequence 2 in the same manner as Sequence 1
    a. After all items have been placed on the shelves, run “select * from products” to see if the inventory is accurate
    b. Remove all items from the shelves, run “select * from products”, and note the accuracy

3.3 Measurable Criterion

Table 1: Item Name and Weight

Item Name	Weight
Apple Juice	4.15 lbs
Peanut Butter	1 lbs
Goldfish	0.40 lbs
Oatmeal	1 lbs
Cheerios	0.70 lbs

Table 2: Sequence 1

Expected Shelf 1 Inventory	Expected Shelf 2 Inventory	Expected Shelf 3 Inventory	Accurate Inventory In Database (Yes/No)
Peanut Butter: 4 Apple Juice: 2	Goldfish: 2 Oatmeal: 2	Cheerios: 2	
Peanut Butter: 3 Apple Juice: 1	Goldfish: 1 Oatmeal: 1	Cheerios: 1	
Peanut Butter: 0 Apple Juice: 0	Goldfish: 0 Oatmeal: 0	Cheerios: 0	

Table 3: Sequence 2: All On, All Off

Expected Shelf 1 Inventory	Expected Shelf 2 Inventory	Expected Shelf 3 Inventory	Accurate Inventory In Database (Yes/No)
Peanut Butter: 4 Apple Juice: 2	Goldfish: 2 Oatmeal: 2	Cheerios: 2	
Peanut Butter: 0 Apple Juice: 0	Goldfish: 0 Oatmeal: 0	Cheerios: 0	

3.4 Schematic Diagrams

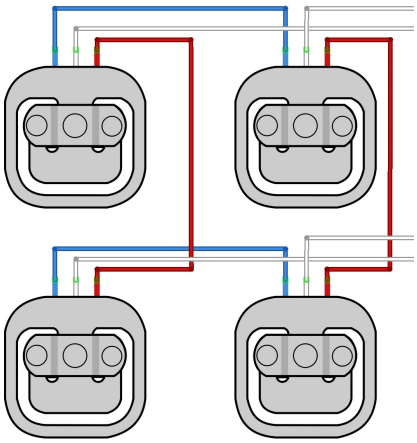

Figure 1: Load Cell Wiring Schematic

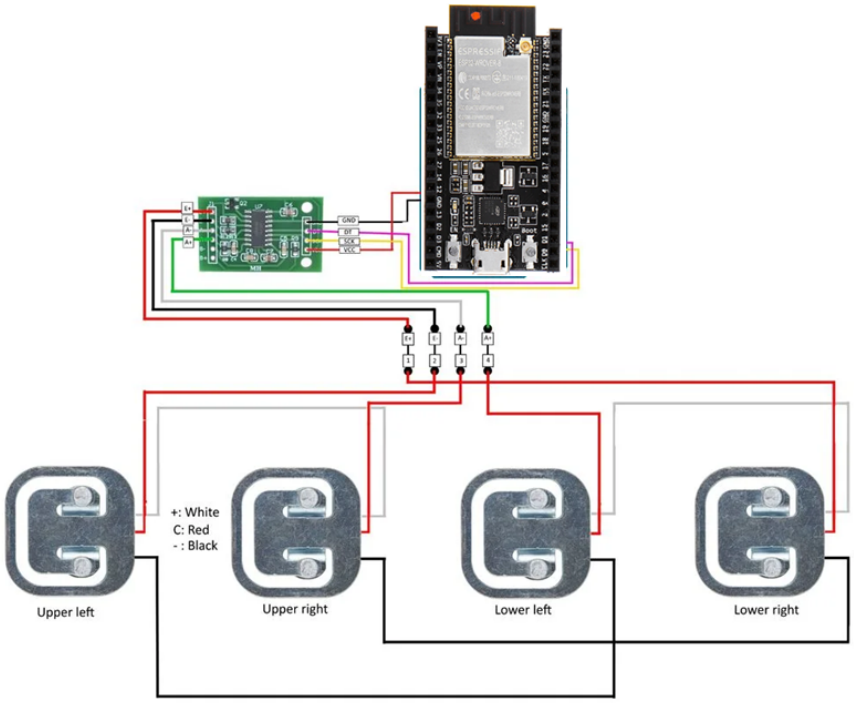

Figure 2: Load Cell, HX711, and ESP32 Wiring Schematic

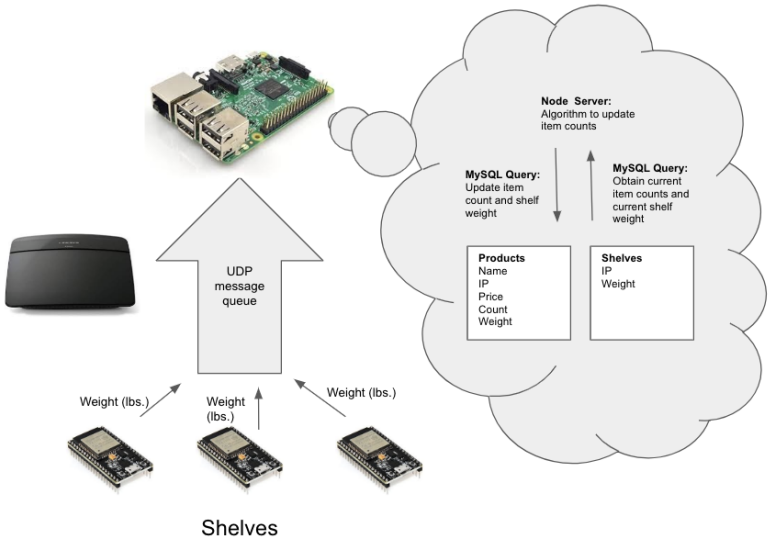

Figure 3: System Overview

3.5 Pinout

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+