

SMARTCART

USER MANUAL

A new sense of shopping



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About the Manual



SmartCart offers you a new retail experience by bringing efficiency and innovation to your store aisles!

This [user manual](#) covers a clear guide to install, deploy, and maintain the SmartCart system in your store.

About us



AMERICAN
UNIVERSITY OF BEIRUT
MAROUN SEMAAN FACULTY OF
ENGINEERING & ARCHITECTURE

SmartCart is a project developed as a part of the EECE461-Instrumentation course under the supervision of Dr. Imad El Hajj at the American University of Beirut.

Designed and implemented by:

Mazen Abou Said - CCE fourth year - mra60@mail.aub.edu

Hadi Elham - ECE third year - hre07@mail.aub.edu

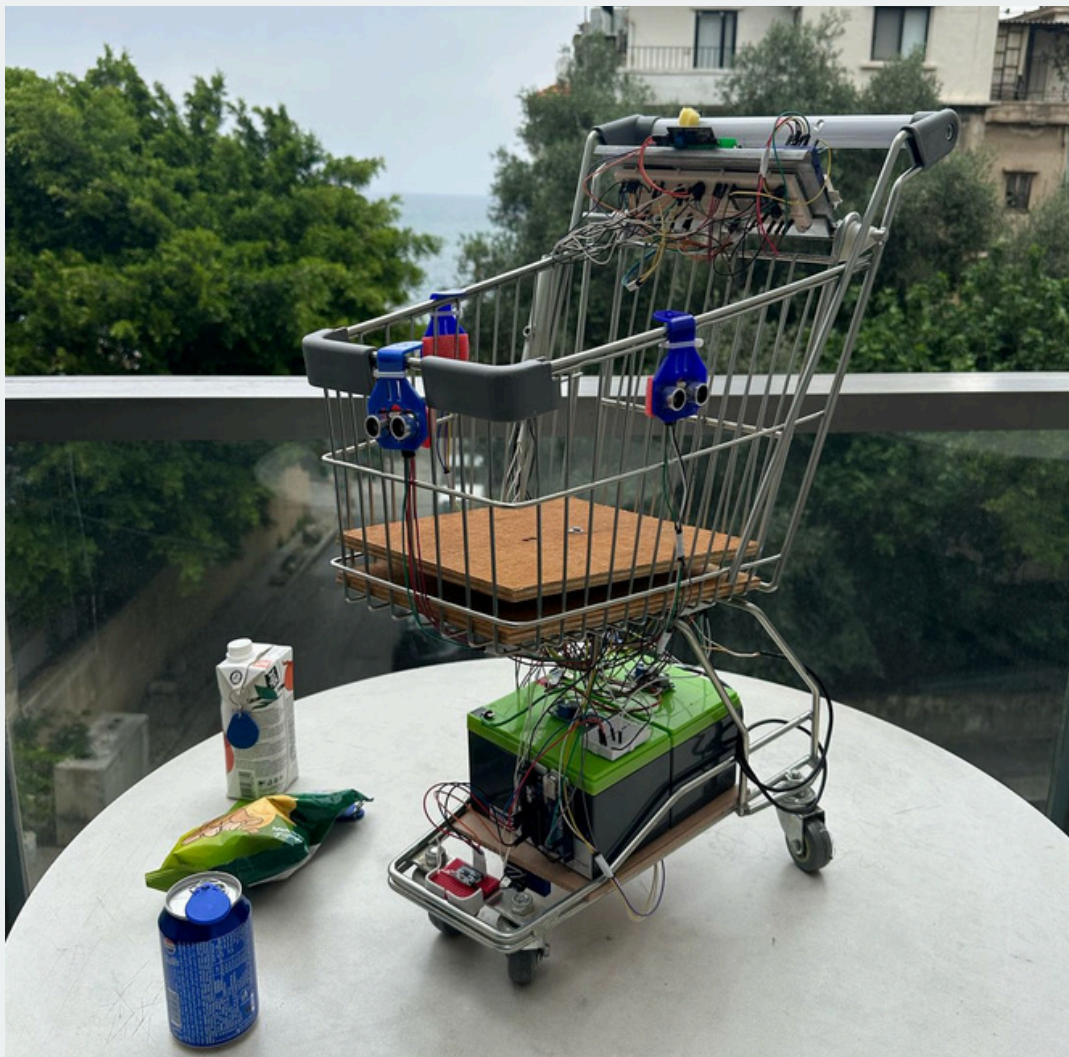
Rawan El Hakim - ECE third year - rme92@mail.aub.edu

Amjad Khaddaj - ECE third year - ayk09@mail.aub.edu

Tia Tarabay - ECE third year - twt00@mail.aub.edu

Why SMARTCART?

SmartCart is an advanced system that improves the shopping experience through the incorporation of several sensors and systems. By integrating SmartCart to your store, you are ensuring smoother processes not only from your side, but from the user's side as well. This sensor-based innovation simplifies procedures of traditional shopping by providing automatic billing, personalized assistance, and user-specific interaction. Moreover, it provides a safe, seamless, and secure navigation in every aisle of the store until the exit door.



Key Features



Billing and Verification

- Using RFID based scanning, a user instantly checks items' price and adds to cart. Total price updates automatically.
- Verification of the equivalence between expected weight if billed items and actual weight of items in the cart.
- Instantly updating user of all billings details using LCD displays.



Interaction and User Experience

- Gesture-controlled user interface to delete, view, and scroll between items.
- Automatic startup of the cart upon touching the handle.
- Saving energy by powering off the system after a period of inactivity.



Intelligent Shopping Assistance

- Staff alert for assistance or possible intervention.
- Smart aisle identification and item recommendations.



Theft Prevention and Security

- Cart lock mechanism upon suspicious behavior.
- Unauthorized store exit identification using hall effect sensor.
- Weight mismatch detection to ensure billing items added to cart.
- Immediate Employee Alerting through MQTT Communication with Buzzer
- Wheel Locking on Theft

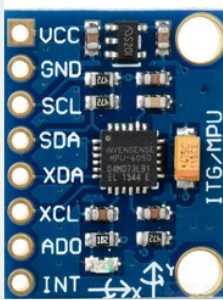


Safety and Monitoring

- Obstacle detection using ultrasonic sensors to avoid collisions or accidents.
- Monitoring navigation by preventing excessive speed or tilting of the cart.
- Ensuring safety by monitoring internal temperature of the cart system.

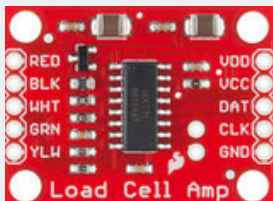
System Components

1- Sensors



Accelerometer and Gyroscope(MPU6050):

Detects the acceleration of the cart for safe stopping/slowing down. Also detects if a cart is flipped over. Alerts store Employees of any wrongdoing or possible fall of a customer.



Load Cell (HX711): Monitors the weight of items present in the cart for effective item management.



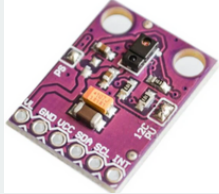
IR Sensor: Senses whether a customer is holding the cart handle, allowing it to save power by turning off the LCD when not in use.



Temperature Sensor (DS18B20):

Provides monitoring of the system temperature to avert overheating. A temperature above 45 °C will stop the carts and shut down the system.

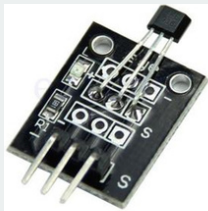
System Components



Gesture Sensor: Enables the user to navigate the LCD screen using hand gestures. After scanning an item swipe Left to see the items details. Right then Left to delete an item. Swipe up and down to scroll and view different items



RFID Sensor: Scans items for identification and verifies when an item is put in the cart.



Hall Effect Magnetic Sensor: Senses the exit of the cart from the supermarket by a magnet placed at the exit door.



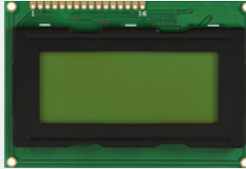
Color Sensor (GY 13): Identifies the aisle the cart is in and shows the product recommendations on the LCD screen.



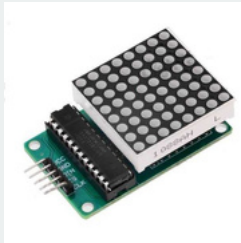
Ultrasonic Sensors: Detects obstacles around the cart to alert the user of potential collisions.

System Components

2. Output Devices



LCD Display: Shows information like item names, prices, and notifications regarding the cart's status.



LED Matrix Display: Show cart price total.

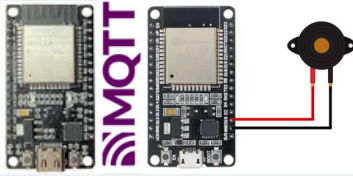


Solenoid and Spring System: Springs into Action To stop the cart when there is possible theft.



Buzzer: To sound an alarm for various purposes, such as when the cart runs the risk of collision with an object or when items need to be emptied/placed.

System Components



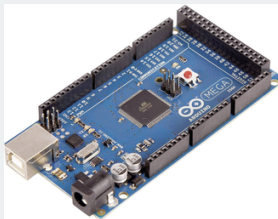
3. Communications

ESP32 Modules (x2): One ESP32 is used in the cart, and the other is used to communicate remotely with store staff for inventory management and cart tracking.



4. Power Supply

12V Batteries (x2): Powers the system, including the solenoid and sensors.



5. Controllers

- Arduino Mega: manages sensor data, controls output devices, and displays information and prompts on LCD screens.



- Arduino Uno for accelerometer.

Installation

Most features of the cart are made to be PnP(Plug and Play) out of the box.

1. Plug-in Battery Power to turn on the Cart
2. All systems on the cart will be powered up*

WiFi Setup

1. After power is supplied the on board Wi-Fi chip will go into AP(Access Point) Mode which allows you to connect to the cart via your PC/Phone
2. Once connected please input the IP 192.168.137.1 into your browser
3. Webpage to select your router will be displayed. Select your Wi-Fi Router and Input your password to connect
4. Repeat these steps for the Remote ESP32

MQTT Broker Setup

1. Upon Purchase we will provide a configuration file that can Run on a Standby/Linux PC to setup an MQTT server. This is a necessary step for ESP communication

*Features like Wi-Fi and ESP32 Connection Need Further Setup

In-Store Setup Requirements

1. A magnet must be placed on the exit door.
2. First few tiles of both ends in every aisle must be marked by colors detected by the color sensor.
 - red: beverages aisle
 - white: snacks aisle
 - green: veggies aisle
 - black: detergents aisle
 - blue: meat aisle
3. The receiver ESP32 and a buzzer must be installed at the corresponding staff counter.
4. Items must be tagged.



Operational Workflow

1. When you touch the cart's handle, the LCD display and LED matrix display turn on and show "Hello, cart ready! Happy shopping" and a smiley face respectively.
2. Hold the tag of your item close (about 1-5cm) and parallel to the RFID sensor to show item's details.
3. By scanning another time, you will hear a beep. This means that the item is billed and must be added to cart within 10 seconds. Otherwise, the load cell senses the difference between expected and actual weight, which triggers a buzzer and displays the corresponding warning.
4. The LED matrix automatically updates and displays the total price of items in your cart.
5. Place your finger near the gesture sensor and swipe (up/down) to scroll between billed items and (right/left) to view details or delete an item respectively. Deleting an item must be directly followed by removing it from the cart to avoid weight mismatch alert as well.
6. Push the cart within walking speed to avoid cart lock. You will hear a buzzer if you're about to collide with any obstacle.
7. The LCD tells you which aisle you're in and displays suitable item pairing based on the your purchase.

Enjoy a new sense of shopping!

Warning Scenarios

Indications of warnings that might be displayed on LCD:



Weight Mismatch! Check the cart

The actual weight of the items in your cart doesn't match the total weight of items scanned. You must either add or remove the last item.



Slow down!

You're pushing the cart too fast.



Bill not paid! Return to cashier

It seems you were in a hurry and forgot to pay before you exit. Alert will sound on Remote ESP's Buzzer After ESP and MQTT Broker Setup(see page 8)



Cart Overheat! Shutting down

System overheated and resulted in shutting down. Staff will be alarmed and help you.



Caution ! Tipped cart

You had an accident and will you will be assisted. Alert will sound on Remote ESP's Buzzer After ESP and MQTT Broker Setup(see page 8)

Troubleshooting

1. You can find the reset button on the Arduino Mega placed on the bottom of the cart to restart the whole system.
2. In case the buzzer is on with nothing in cart and no items scanned, please restart the system to setup and calibrate the weight sensor properly.
3. In case the LCD screen is stuck on the "Slow Down!" text, or the tilt feature is not functioning properly, check power and connections to Arduino Uno. If the problem persists, reset the Arduino Uno and wait 5 seconds for calibration.
4. In case the solenoid is damaged or permanently locked after retrieval of stolen cart, please reach out to us.
5. If the buzzer for theft alert isn't working please check the hall effect sensor found in the bottom of the cart. Else, check if the exit still has the magnet on the correct pole side. Else, check the esp32 connection to the network and the buzzer.
6. In case the gesture sensor isn't responding well, check connections. Else, clean the sensor due to it being sensitive to dirt and not highly IP rated.
7. In case the item isn't being scanned by RFID despite being tagged, make sure it's not wet or has a metal. Approach tag to RFID in a parallel manner and try again.
8. In case your problem is not mentioned in this document, please contact us(see page two).

Maintenance

To ensure the optimal operation of SmartCart on the long run, the following procedures are recommended:

1. Inspect power supply regularly to recharge or replace empty batteries.
2. Disconnect power when the cart isn't being used.
3. Clean sensors with a dry microfiber cloth to remove dust accumulation.
4. Avoid exposing the system to water, liquids, or high humidity.
5. Check for Arduino software updates.
6. Store the cart in a cool, dry place. Keep away from direct sunlight and moisture.
7. Do not overload the cart.
8. Do not tamper with sensor wiring.
9. Contact us(see page 2) for monthly calibration of sensors.

Work Division

- **Tia Tarabay:** Key Features-Document Design and Outline
- **Rawan Hakim:** System Components
- **Hadi Elham:** User Guide
- **Mazen Abou Said:** SmartCart Deployment
- **Amjad Khaddaj:** General Guidelines