ME354 Project
Group - 13
Report

NexGen Cart

Unveiling the Future of Retail with Smart Shopping Trolleys

Aim : To provide insights into how smart trolleys enhance the shopping experience for customers and improve operational efficiency for retailers.

Introduction :

Shopping is easy, but waiting in line at the checkout can make the experience dull and tedious. Crowds and the time it takes for the cashier to prepare bills often lead to long queues. During the ongoing pandemic, standing in line for billing at malls or shopping centers can increase the risk of spreading the virus. The current billing system takes up too much time, disrupting people's busy schedules and causing frustration.The evolution of smart trolley technology in the retail industry has been driven by a focus on improving customer experience, streamlining operations, and leveraging advanced technologies such as RFID, IoT, AI, and mobile connectivity.

Functionality :

- **Automated Item Scanning :** Smart trolleys are equipped with RFID (Radio-Frequency Identification) readers or barcode scanners that allow customers to scan items as they place them in the cart. This eliminates the need for manual scanning at checkout counters, speeding up the shopping process.

- **Interactive Displays :** Many smart trolleys feature interactive displays, such as LCD screens, where customers can view item details, prices, promotions, and personalized recommendations. These displays can also provide navigation assistance within the store.

Components and their Functions :

Hardware:

- **LCD Display with I2C Module:** Provides a visual interface for displaying item information, total cost, and promotional messages.
- **Arduino Uno:** Acts as the central processing unit, controlling and coordinating the functions of the smart trolley.
- **RC522 RFID Reader:** Allows for RFID-based item scanning and identification, improving checkout efficiency.
- **Buzzer and LEDs:** Provide audio and visual feedback to the user, indicating successful item scans, low inventory alerts, and other notifications.
- **Push Buttons:** Enable user interactions such as starting the scanning process, confirming purchases, and accessing additional features.
- **Jumper wires:** Jumper wires are wires used to make connections between different points in a circuit, often for testing or prototyping.

Software:

- **Arduino Ide:** Arduino code to control the functionality of the smart trolley system, including RFID scanning, display output, user interactions, and feedback mechanisms.
- **Embedded C++**

Procedure :

Initialization:

- Set up the LCD display using the I2C library.
- Set up the RFID reader using the RC522 library.

- Define and initialize the GPIO pins for the LEDs, buttons, and buzzer.
- Define a dictionary or array to map RFID card UIDs to their corresponding costs.
- Initialize a variable to keep track of the total cost.

RFID Scanning:

- Continuously check if an RFID card is present.
- If a card is detected, read its UID and check against the dictionary to find the corresponding cost.
- Light up the red LED and sound the buzzer during the scanning process.
- Once scanning is done, turn off the buzzer and red LED.

Cost Adjustment:

- If the "add cost" button is pressed, add the cost of the scanned card to the total.
- If the "subtract cost" button is pressed, subtract the cost of the scanned card from the total.
- After adjusting the cost, light up the green LED for 1 second to indicate successful adjustment.

Display:

- Continuously update the LCD display with the current total cost.

Loop:

- Continuously execute the above operations in the loop function.

Circuit Diagram :

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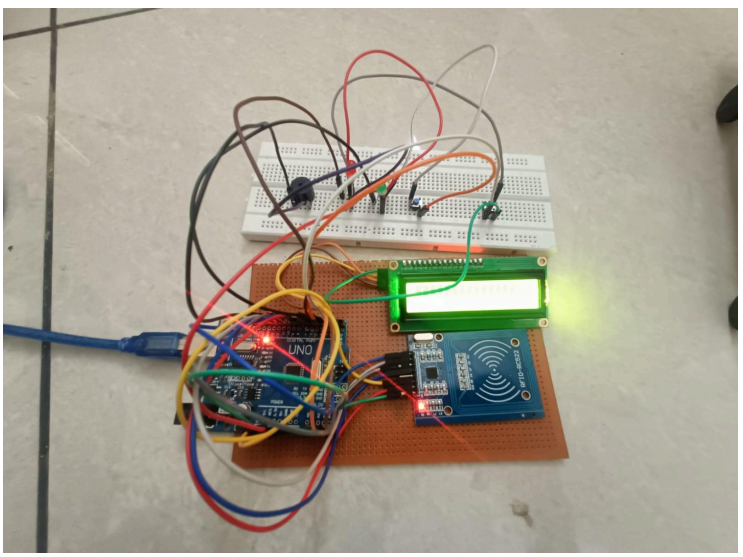
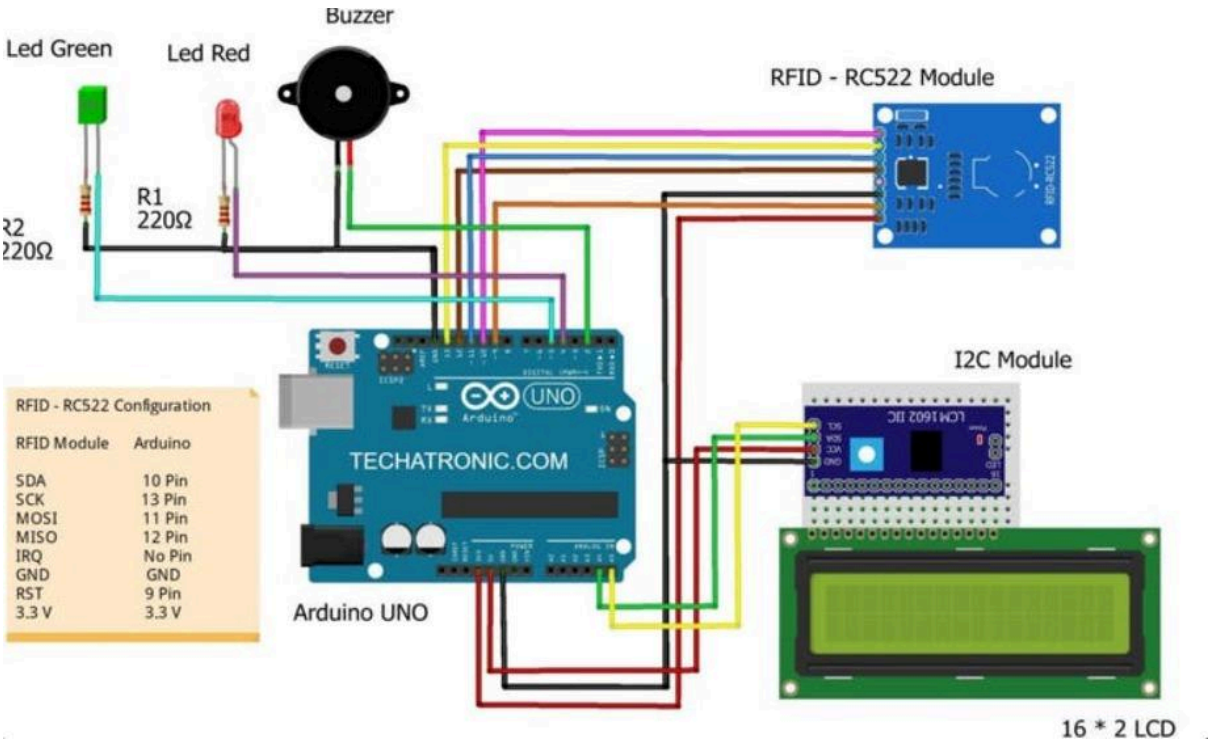
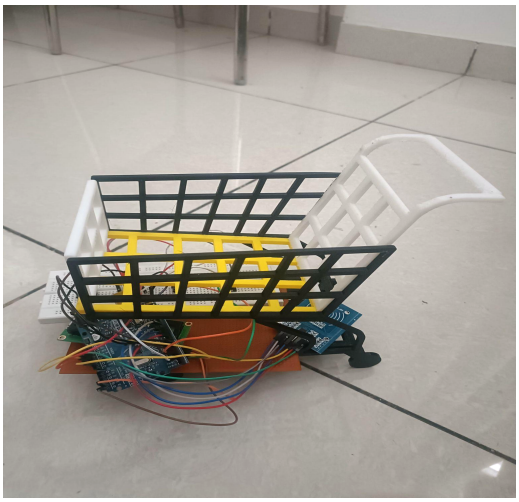



Buzzer
Led Green
Led Red
RFID - RC522 Module
R1
220Ω
R2
220Ω
I2C Module
RFID - RC522 Configuration
RFID Module Arduino
SDA 10 Pin
SCK 13 Pin
MOSI 11 Pin
MISO 12 Pin
IRQ No Pin
GND GND
RST 9 Pin
3.3 V 3.3 V
TECHATRONIC.COM
Arduino UNO
16 * 2 LCD



3D Model

Video :
https://drive.google.com/drive/folders/1R8T2axXH2jQgBE-Gf_Je7_TT7l1JzZov

Challenges encountered :

- Integration Issues: Challenges in connecting and synchronizing multiple components.
- Software Bugs: Encountering errors and unexpected behavior in the Arduino code.
- Sensor Calibration: Difficulty in calibrating RFID reader and other sensors for reliable performance.
- The malfunction of the components necessitated inspecting each one individually.

Solutions Implemented :

- Prototyping and Iteration: Conducting iterative testing to identify and resolve integration issues.
- Code Debugging: Thoroughly debugging the Arduino code to address software bugs and improve stability.
- Real time inventory updates which helps to monitor the stack levels.
- We can integrate with AI (Artificial Intelligence) algorithms that analyze a customer's shopping history and preferences based on this data. We can also recommend products, enhancing the customer's shopping experience.
- Weight sensors can be equipped to verify scanned items, calculate total purchase weights, and deter theft.
- GSM (Global System for Mobile Communications) or Wi-Fi, allowing them to connect to the store's backend systems. This connectivity enables real-time data transmission, including inventory updates, promotional messages, and transaction processing.
- We can use anti-theft tags, alarms, and tamper-proof mechanisms for security features.

Uses:

- Enhanced Shopping Experience: Smart trolleys automate tasks like scanning, checkout, and payment, reducing waiting times and queues. They also provide personalized

recommendations based on customer preferences, making shopping more convenient and enjoyable.

- Efficient Inventory Management: By providing real-time inventory updates, smart trolleys help retailers monitor stock levels accurately and prevent out-of-stock situations, ensuring better customer satisfaction and sales performance.
- Reduced Errors and Theft: Smart trolleys verify scanned items against their actual weight or RFID tags, minimizing billing errors and preventing theft or shoplifting incidents, thereby improving security and product integrity.
- Improved Customer Engagement: With interactive displays and personalized recommendations, smart trolleys engage customers actively during their shopping trip, enhancing communication and overall satisfaction.
- Contactless Payments: Integration with mobile payment systems enables contactless payments directly from the trolley, adding convenience and reducing transaction times at checkout, leading to a smoother shopping experience.
- Data-Driven Insights: Data collected from smart trolleys inform targeted marketing strategies, optimize store layouts, and improve operational efficiency based on customer behavior patterns and preferences, ultimately boosting sales and customer loyalty.

Conclusion :

Smart trolleys address common challenges faced in retail environments, such as long checkout lines, inventory inaccuracies, theft, and limited customer engagement. By leveraging technology and data analytics, they offer a more efficient, personalized, and enjoyable shopping experience for both customers and retailers alike.

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