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Smart Shopping Trolley

AsifAli Jamadar[1], Mohammad Saad Momin[2], Mahmad Avais Kittur[3], Muskaan Gove[4]

[1]Assistant Professor, Electronics and Communication Engineering, Maratha Mandal's Engineering college Belagavi
[2,3,4]UG Scholar, Electronics and Communication Engineering, Maratha Mandal's Engineering college Belagavi

Abstract
The modern technology has increased the standard of living for the humans. This resulted in large crowds at shopping malls. To handle the large crowd, we must reduce the process of the billing time. This is done using smart shopping system based on RFID. Items that are put in a smart shopping cart are read one by one and the bill is generated and displayed. After the final bill is generated, the customer pays the bill by using their Pre charged cards provided by the shopping mall. The aim is to reduce the time consumption needed for the billing system.

Keywords: Cloud Smart Card ,Scanner, RFID reader, Arduino

1. Introduction

Technology has been an enlightening path for innovative new ideas and connecting the world in which Modern world has brought us many possible ways of connecting people with technology such as IoT and industrial automation. Right from the start when innovations started in the world of technology the meaning was to reduce unnecessary hardship and increase the productivity of humans. One of the most important modern world leisure activities is spending time shopping in malls, shopping complexes etc. .Thus, an upbringing innovation in the field of shopping and retail stores can be the inclusion of smart shopping trolley systems in which the person has to just register with the help of his/her phone number and enjoy shopping with personalised billing system which helps the customer to view his total amount anytime while shopping which helps to maintain the budget, as well as automatic billing, helps in did you see the hardships required for waiting and standing in long queues in the shopping malls. Our project consists of RFID tags which can be attached to the required products, an RFID reader which is used for scanning the products after putting them in the trolley while dropping them in the trolly the product will be scanned by EM-18, an LCD which will be used to show the items added in the trolley along with the total.

Also, automated the movement of the trolley with the help of ultrasonic sensors, Arduino and motors. Using a GSM module which helps us in connecting the mobile phone of the registered customer with the trolley and after the billing is done a message will be sent to the registered customer's mobile number with the total description of the bill. Furthermore, smart trolleys can collect valuable data on customer behavior, preferences, and shopping patterns, providing retailers with actionable insights to optimize store layouts, inventory management, and marketing strategies. By streamlining the shopping process,

enhancing customer engagement, and driving business efficiency, smart trolleys are transforming the retail landscape and redefining the future of shopping.

Impact on Retail Industry

1. Enhanced Customer Experience: Smart Trolleys provide a seamless and personalized shopping experience, increasing customer satisfaction and loyalty.
2. Increased Efficiency: Automated scanning and payment processes reduce checkout times, improving operational efficiency.
3. Improved Sales: Personalized recommendations and real-time promotions can increase sales and drive revenue growth.
4. Competitive Advantage: Retailers adopting Smart Trolleys can differentiate themselves from competitors and establish a leadership position.

2. Problem definition and objectives

Problem Definition

The traditional shopping experience is often marred by inefficiencies, such as:

- Long checkout lines: Customers spend excessive time waiting to pay.
- Lack of product information: Customers lack access to detailed product information.
- Inefficient shopping process: Shoppers often rely on store employees for assistance.

Problem Statement:

"How can we enhance the shopping experience by streamlining the shopping process, reducing wait times, and providing customers with relevant product information and personalized recommendations?"

Solution:

The Smart Trolley addresses these issues by integrating technology, such as:

- Product information: Display of product details.
- Personalization: Recommendations based on shopping history.

By addressing these pain points, Smart Trolleys aim to:

- Improve customer satisfaction
- Increase efficiency
- Enhance sales

Objectives

- Automate the billing process: Streamline checkout to eliminate the need for manual billing.
- Enhance the shopping experience: Improve the overall shopping process with seamless functionality.
- Reduce human effort: Minimize manual tasks for customers and staff.
- Minimize waiting time at the billing counter: Speed up the checkout process by reducing queues.
- Integrate IoT technologies: Use advanced technologies to create a smarter, more efficient shopping experience.

System Overview

The Smart Cart system is based on RFID technology, offers an efficient solution for product scanning, bill generation, and payment Components such as RFID reader, LCD display, are utilized, along with RFID tags attached to the products. The RFID reader scans the tags on the products, and the information is sent to the touch display (Android/iOS tab) Customers can easily scan and remove products from the

cart. Additionally, a weight machine is available to calculate product weight. Barcode reader is also present in case RFID tag is not available. The total bill amount is generated and displayed on the LCD screen and payment can be completed using various payment options on the LCD screen itself, it eliminates the need for customers to wait in queues at billing counters This smart shopping with the trolley application aims to automate and centralize the billing process in malls and supermarkets. The system offers benefits such as enhanced customer satisfaction without queues, bill calculation/Payment at the trolley itself, reduced chances of traffic and mismanagement, decreased support staff, cost efficiency, and the inclusion of a weight machine for product weight calculation.

Hardware Components:

- ✓ Trolley-mounted terminal: A user-friendly interface with a touchscreen display.
- ✓ Scanner: For scanning items.
- ✓ RFID reader: For tracking items (optional).

Software Components:

- ✓ Inventory management system: Tracks product availability and updates inventory levels.
- ✓ Payment gateway: Facilitates seamless checkout.

3. METHODOLOGY

The methodology for the Smart Trolley project involves several stages, starting with research and planning. The first step is to analyze existing smart trolley systems, identify gaps, and determine the objectives of the project. This includes understanding user needs, technical feasibility, and potential cost implications. Following this, the hardware and software components are selected. The trolley is integrated with sensors, RFID or barcode scanners, a microcontroller, and a display system. The choice of technology depends on factors such as accuracy, speed, and ease of use. Embedded programming is then implemented to enable communication between hardware components and ensure seamless operation.

Once the system is built, testing is carried out to evaluate its efficiency and reliability. This involves checking the accuracy of item detection, billing functionality, and user interface responsiveness. Any errors or inefficiencies found during testing are corrected through debugging and optimization.

Block Diagram:

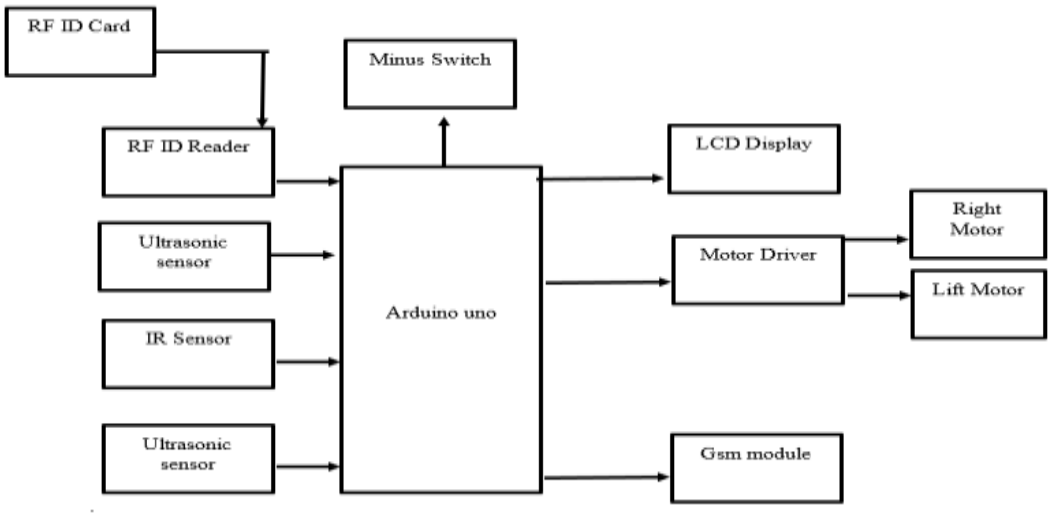

Fig.1 Block Diagram

WORKING

The smart trolley system at the mall utilizes the power of RFID technology to streamline the shopping experience for customers. Each product in the mall is equipped with an RFID tag operating at a frequency of 13.56MHz, which stores a unique Electronic Product Code (EPC). Weights of each product will also be considered simultaneously after scanning. If the weight of the current item scanned and the previous weight is equal to the weight of the trolley the process continues, else the buzzer is turned on indicating that the customer is cheating. If a customer wants to remove a product that was previously added to their bill, the product should be scanned again and its cost should be deducted from the total bill. Now again the weight is checked. If the total weight of the cart is equal to the previous weight – the weight of removed item, the process continues else the buzzer is turned on. To signal the end of their shopping experience, customers are provided with a conveniently placed push button on the trolley.

Upon pressing the button, the system knows that the customer has finished shopping, and it initiates the checkout process. To make payment easy and convenient, the smart trolley system offers the option of using pre-charged master cards, which are unique RFID tags assigned to each customer. These cards contain important information such as the customer's identification number and the available balance. By simply scanning their master card at the trolley, customers can complete their payment in a hassle-free manner. If the customer's master card does not have enough balance to cover the total bill amount, a buzzer will sound to alert them that they need to recharge their card before proceeding with the payment. Once the payment is complete, the LCD display will show the updated balance available in their card after deducting the total bill amount. Furthermore, the details of the scanned products and the corresponding bill will be available on the central PC's serial monitor for record-keeping purposes.

IMPLEMENTATION TOOLS

IOT : Arduino uno, Arduino nano

Arduino is an Italian open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its hardware products are licensed under a CC BY-SA license, while the software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially from the official website or through authorized distributors.

Libraries:

To develop a Smart Trolley system using Arduino Uno and Nano, you'll need to utilize various libraries. Here are some essential libraries:

- **RFID Library**
- MFRC522: For RFID reader module (e.g., RC522)
- Usage: Read and write RFID tags
- **Scanning Library**
- Software Serial: For serial communication with barcode scanner
- Usage: Read RFID card data
- **Display Library**
- LiquidCrystal_I2C: For I2C LCD display
- Usage: Display product information, prices, and messages

- **Wi-Fi Library**
  - WiFi: For Wi-Fi connectivity (if using Arduino Uno WiFi or external Wi-Fi module)
  - Usage: Send and receive data to/from server or cloud
- **Weight Sensor Library**
  - HX711: For weight sensor module (e.g., load cell)
  - Usage: Measure weight of items in trolley

Program:

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <SoftwareSerial.h>

// I2C LCD setup
LiquidCrystal lcd(12, 11, 10, 9, 8, 7);

// RFID and GSM serial
SoftwareSerial rfid(2, 3); // RX, TX for RFID
SoftwareSerial gsm(8, 9);  // RX, TX for GSM

const int buttonPin = 7;

// RFID tag database (add your own tags here)
String tags[12] = {"54006DC3966C", "5400711EFAC1", "0D0052C8D3"};  String items[12] =
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <SoftwareSerial.h>

// I2C LCD setup
LiquidCrystal lcd(12, 11, 10, 9, 8, 7);

// RFID and GSM serial
SoftwareSerial rfid(2, 3); // RX, TX for RFID
SoftwareSerial gsm(8, 9);  // RX, TX for GSM

const int buttonPin = 7;

// RFID tag database (add your own tags here)
String tags[12] = {"54006DC3966C", "5400711EFAC1", "0D0052C8D3"};  String items[12] =
{"five_star_chocolate", "vaseline_cream", "Soap"}; int prices[12] = {50, 100, 50}; bool added[3]
= {false, false, false};

String inputTag = ""; int totalBill = 0; bool readingTag = false;

void setup() {
```

```
pinMode(buttonPin, INPUT_PULLUP);
lcd.setCursor(0, 0); lcd.print(" AUTOMATIC BILL"); delay (2000); lcd.setCursor(0, 1);
lcd.print(" SHOPPING CART "); delay (2000); lcd.clear(); lcd.setCursor(3, 0);
lcd.print("WELCOME TO"); delay (2000); lcd.setCursor(3, 1); lcd.print("SUPER
MARKET"); delay (2000); lcd.clear(); lcd.setCursor(0, 0); lcd.print("Plz Add Item");
lcd.print(" ");
Serial.println("Welcome supper market ");
//delay(2000);
Serial.println("pick you are requide products ");

rfid.begin(9600); gsm.begin(9600); Serial.begin(9600);

sendSMS("Smart Cart Started!");
}

void loop() { // Read RFID input if (rfid.available()) {
char c = rfid.read(); if (c == '\n') { processTag(inputTag); inputTag = ""; readingTag
= false;
} else { inputTag += c; readingTag = true;
}
}

// Checkout on button press if (digitalRead(buttonPin) == LOW) { delay(300); lcd.clear();
lcd.print("Final Bill:"); lcd.setCursor(0, 1); lcd.print("Rs. "); lcd.print(totalBill);
//sendSMS("Checkout: Total = Rs. " + String(totalBill));
sendSMS("PAY BILL AMOUNT-https://easebuzz.in/upi-payment-gateway/ Total = Rs." +
String(totalBill)); delay(5000); resetCart();
}
}

void processTag(String tag) { tag.trim(); for (int i = 0; i < 3; i++) { if (tag == tags[i]) {
lcd.clear(); if (!added[i]) { // Add item added[i] = true;
totalBill += prices[i]; lcd.print("Added: "); lcd.print(items[i]); sendSMS("Added "
+ items[i] + ": Rs." + String(prices[i]));
} else {
// Remove item added[i] = false; totalBill -= prices[i]; lcd.print("Removed: ");
lcd.print(items[i]); sendSMS("Removed " + items[i] + ": Rs." + String(prices[i]));
}
lcd.setCursor(0, 1); lcd.print("Total: Rs."); lcd.print(totalBill); break;
}
}
}
```

```
void sendSMS(String msg) {  gsm.println("AT");  delay(1000);  gsm.println("AT+CMGF=1");
delay(1000);  gsm.println("AT+CMGS=\"+919008661392\""); // Replace with your number
delay(1000);  gsm.println(msg);  delay(100);
gsm.write(26); // Ctrl+Z to send  delay(3000);
}
void resetCart() {  for (int i = 0; i < 3; i++) added[i] = false;  totalBill = 0;  lcd.clear();
lcd.print("Scan to Add Item");
```

4. TESTING , RESULT AND EVALUATION

Testing:

- **Functional Testing: Verify that Smart Trolley features work as expected, including:**
  - RFID scanning
  - Product information display
  - Payment processing
- **User Testing: Conduct usability testing with customers to gather feedback on:**
  - Ease of use
  - Intuitive interface
  - Overall experience
- **Performance Testing: Evaluate system performance under various conditions, including:**
  - High traffic
  - Multiple user interactions
  - Network connectivity

Results:

1. Accuracy: Smart Trolley accurately scans products and displays relevant information.
2. Efficiency: Reduced checkout time and improved shopping experience.
3. User Satisfaction: Positive feedback from customers on ease of use and intuitive interface.

Evaluation:

1. **Success Metrics: Evaluate success based on metrics such as:**
   a. Reduced checkout time
   b. Increased customer satisfaction
   c. Improved sales
2. **Comparison to Traditional Trolleys: Compare Smart Trolley performance to traditional shopping carts.**
3. **Areas for Improvement: Identify areas for improvement, such as:**
   a. Enhancing user interface
   b. Improving system reliability
   c. Expanding product offerings

Fig 2 Smart Trolley

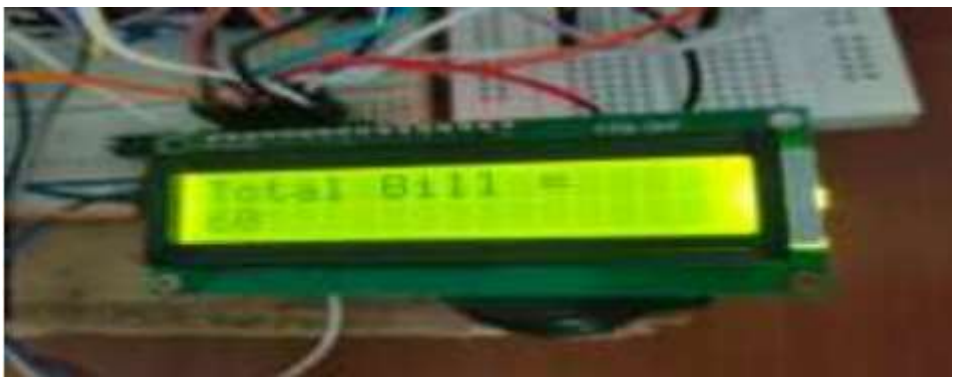

Fig 3 Showing Total Bill

Fig 4 Item is added.

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