

RFID-Based Smart Billing Trolley

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Abstract: This study presents the design and development of smart billing trolley using RFID. Radio Frequency Identification (RFID) technology offers a promising solution to these challenges. Unlike barcode systems, RFID does not require line-of-sight scanning. RFID tags embedded in products can be automatically read by an RFID reader, enabling faster and more efficient data collection. The system aims to revolutionize the shopping experience by automating the billing process and enhancing customer satisfaction. The concept of a smart trolley equipped with an RFID reader is an innovative approach to streamline the shopping and billing experience. By integrating RFID technology into shopping carts, items placed in the trolley can be automatically identified and billed in real time. This eliminates the need for manual scanning at the checkout counter and significantly reduces the time spent in queues. Additionally, this system provides an opportunity to enhance inventory management and reduce errors associated with manual data entry.

Keywords: RFID RC-522 , Aurdino UNO Board, 16x2 I2C LCD, load cells .

I. INTRODUCTION

Humans have always developed technology to support their needs and requirements. The basic need of alteration in technology, irrespective of the domain has been to simplify tasks and make everyday chores accessible and faster. Shopping at big malls has become a daily activity nowadays in cities. We can see huge rush during festive seasons in hyper and super markets. People purchase diverse products and rush to billing counters that causes problem of big queue at the end. The motive of the system of the system is to make a system that can solve the entire problem faced in malls by people. In the today's world, all super and hypermarkets should engage shopping baskets and shopping trolleys in order to aid purchasers to select and store the products which they have in mind to purchase. In the modern retail industry, shopping in supermarkets and large retail stores has become a frequent activity for consumers. However, one of the most common inconveniences faced by customers is the time spent waiting in long checkout queues. Traditional billing systems rely on barcode scanning, which involves manually scanning each item, making the process time-consuming and labor-intensive. This inefficiency can lead to customer dissatisfaction and increased operational costs for retailers.

II. LITERATURE SURVEY

SL. NO	AUTHOR NAME	TITLE	ADVANTAGES	CONCLUSION
1.	Ruinian Li, Tianyi Song, Nicholas Capurso, Jiguo Yu, Jason Couture, Xiuzhen Cheng. (2017)	IoT applications on Secure Smart Shopping System	<ul style="list-style-type: none"> They implement idea using UHF RFID reader so every smart cart is equipped with UHF reader. The final result, final billing can be done in the trolley. So the users don't have to wait in a queue for long time . 	To validate the feasibility of such a system, in this paper we identify the design requirements of a smart shopping system, build a prototype system to test functionality, and design a secure communication protocol to make the system practical.
2.	Vanitha Sheeba Brindha Rajkumari (2015)	RFID enabled smart billing system	<ul style="list-style-type: none"> This project relies on RFID devices which are placed in the products as well as the shopping carts. The project is implemented in real-time. Another objective of the project is to enable the customers to view the product details like MFD, expiry date, total amount and the quantity. 	The system's concept model consists of RFID and ZigBee which transmits generated bill to the server and then the bill is collected by the worker in the bill counter by identifying customers.
3.	Dhavale Shraddha (2016)	IOT based intelligent trolley for shopping mall	<ul style="list-style-type: none"> The payment details will be sent to the server by which central billing unit will deal with customer's payment. 	Applied RFID technology for billing during purchase in shopping malls and IOT is used for bill management by means of ESP module.

4.	C. Suganthi Evangeline (2016)	LOW COST MICROCONTROLLER BASED AUTOMATIC BILLING SYSTEM WITH PROTECTIVE SHIELDING FROM RF WAVES	<ul style="list-style-type: none"> The project is implemented in real-time. Another objective of the project is to enable the customers to view the product details like MFD, expiry date, total amount and the quantity. With the help of the innovative RFID-supported display on the cart, the customer can directly pay the total amount which she/he is already aware of, thus reducing the average time spent by a customer in shopping markets. 	The system with Smart Cart using newly evolved RFID Technology. In our proposed method, the bill is automatically generated in the trolley as the customer purchases the product.
5.	Parameswaran Ramesh, P.T.V. Bhuvaneswari (2021)	RFID Aided Intelligent Shopping Trolley with Child Care Unit.	<ul style="list-style-type: none"> This article outlines the design of an intelligent shopping trolley based on a Radio Frequency Identification (RFID) reader and it includes the child care unit model. The trolley is equipped with an RFID reader, QR scanner, Liquid Crystal Display (LCD) and a child care unit. Whenever a product is portrayed to the RFID reader, the product cost is displayed over the LCD screen. 	The primary benefit of this research would be that the compunction cares for children by integrating with the trolley. It consists of an RF module that serves as transceiver. The child care section will contribute to ensuring the safety of children visiting shopping malls with their parents. It generates an alert when the baby attempts to leave from the cart

III. METHODOLOGY

An RFID tag (of frequency 125khz) is attached to every product in the mall and the reader (RC-522) is attached to the trolley. At the time of purchase, the tag attached to the product is scanned by the reader. Each tag has a unique EPC. Based on the EPC received by the Arduino , the information of the product is displayed on the LCD along with the updated cost. This information is also sent to central PC with the help of HC-12 transmitter at the trolley and HC-12 receiver at the PC .If the customer wants to remove the added product, the product should be scanned again. Then the cost of the corresponding product will be deducted from the bill. The push button is provided at the trolley to indicate the end of the shopping. On pressing of push button, the final bill is displayed on the LCD and the payment through pre-charged card can be done. Recharged cards are unique RFID tags provided for each customer. These cards contain the information such as the customer identification number and the balance available in the card. By scanning pre-charged cards, payment is done at the trolley itself. Finally LCD shows the balance available in their card .This whole information is available on the serial monitor of central PC TRANSMITTER.

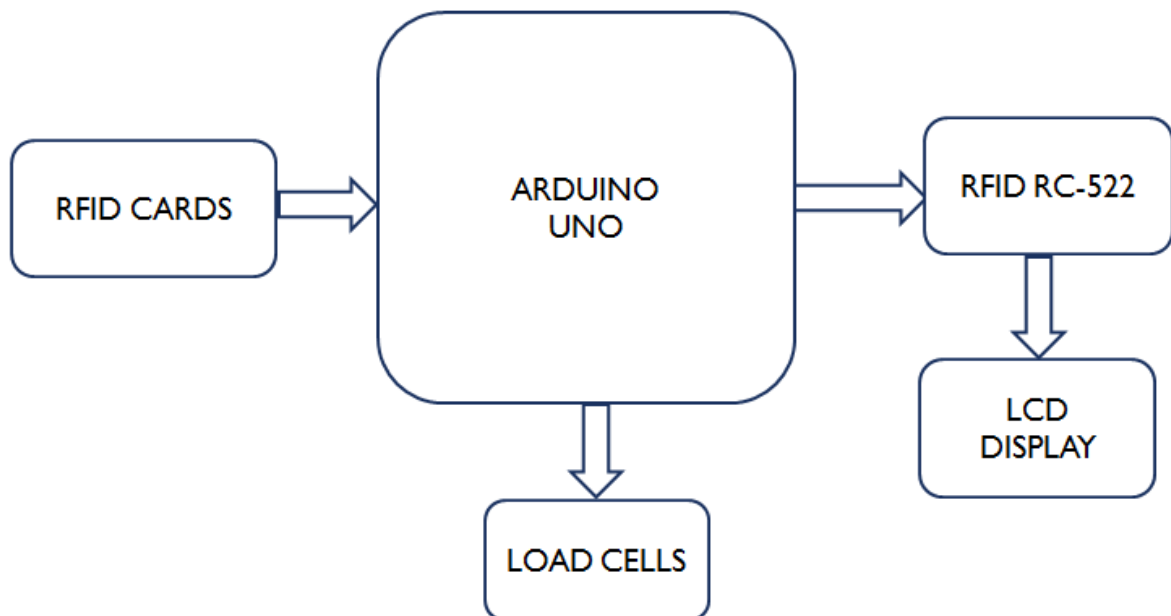
IV. BLOCK DIAGRAM

Figure 1:BLOCK DIAGRAM OF RFID BASED SMART BILLING TROLLEY.

V. FLOW CHART

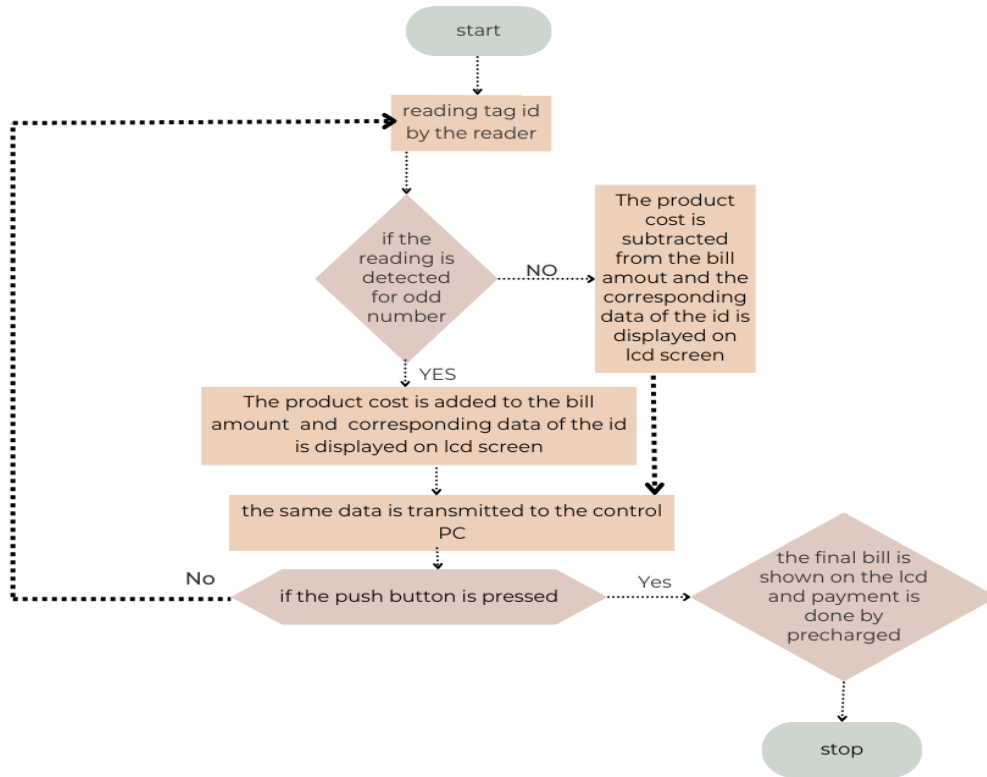
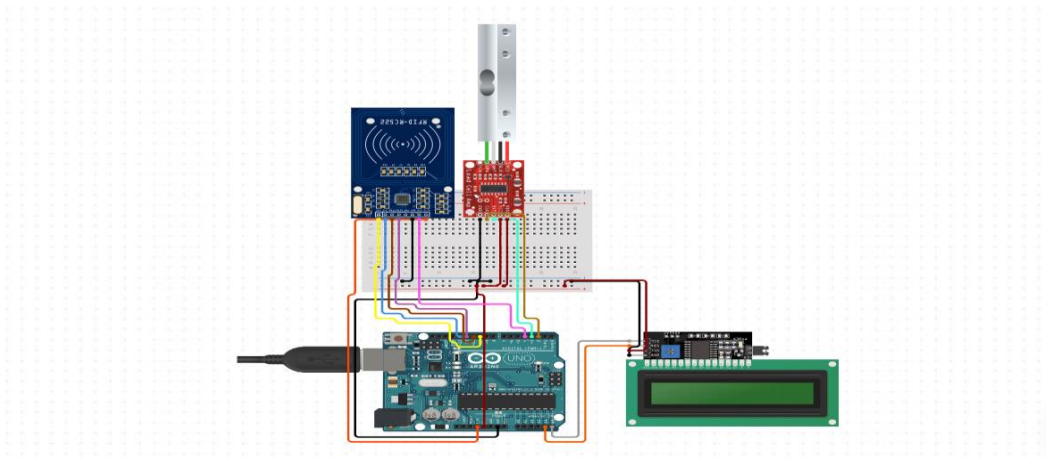


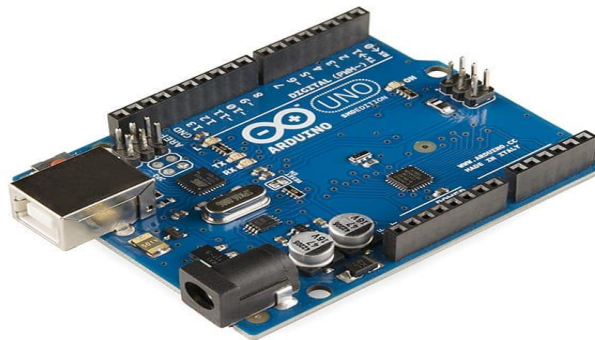
Figure 2:FLOW CHART OF RFID BASED SMART BILLING TROLLEY.

VI.CIRCUIT DIAGRAM



HARDWARE USED

1. **ARDUINO UNO BOARD:** Arduino UNO is open source micro-controller board that helps create interactive projects giving smart solutions by automation. It is based on the processor ATmega328p. It also comes with a variety of input and output pins that can be used to connect different electronic components.



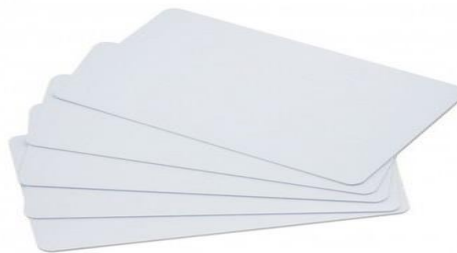
2. **16X2 I2C LCD DISPLAY:** 16x2 I2C LCDs are compact displays that show 16 characters on 2 lines. Each character is formed by a 5x7 pixel matrix. They are widely used for text-based information in electronics, robotics, and embedded systems. Operated at 4.7-5.3V, they interface with micro-controllers.



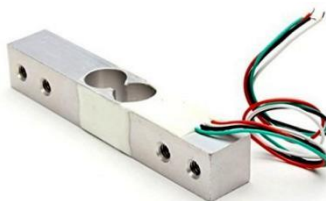
- RFID RC522:** The RFID RC-522 is a popular RFID reader module used to read/write data on RFID cards and tags. The RC-522 communicates with microcontrollers using the SPI, I2C, or UART interface.



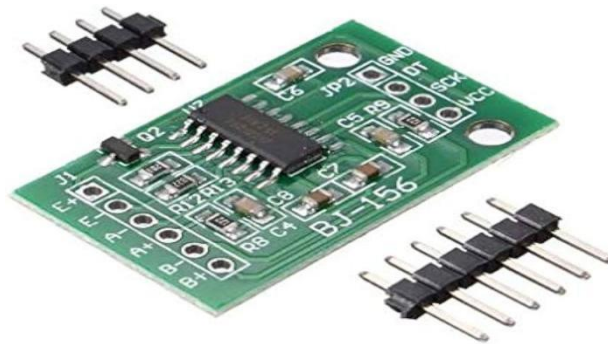
- RFID-CARDS:** RFID cards, or Radio-Frequency Identification cards, are used for tracking and identifying objects wirelessly. They consist of a small chip and antenna embedded in a plastic card, similar in size and shape to a credit card.



- LOAD CELLS :** Load cells are commonly used to measure weight in an industrial environment. They can be installed on hoppers, reactors, etc., to control their weight capacity, which is often of critical importance for an industrial process.

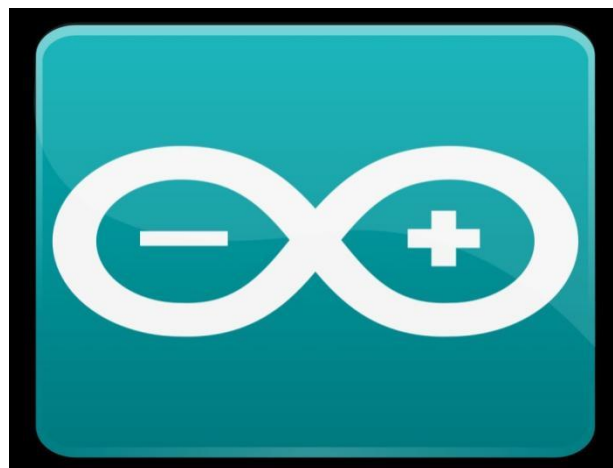


6. **HX711** : The **HX711** (Load cell Amplifier) is a precision 24-bit analog-to-digital converter (ADC) designed specifically for weighing scales and other applications that require high accuracy. It is commonly used in conjunction with a **load cell**, which is a sensor used to measure weight or force.

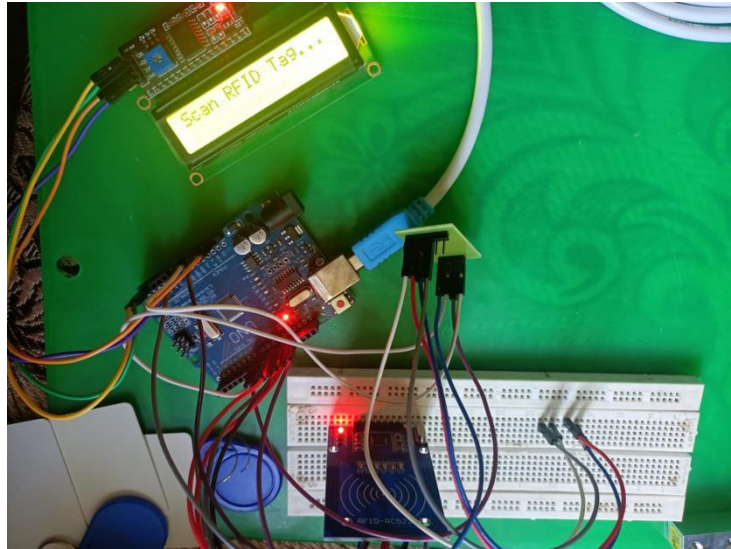


SOFTWARE USED

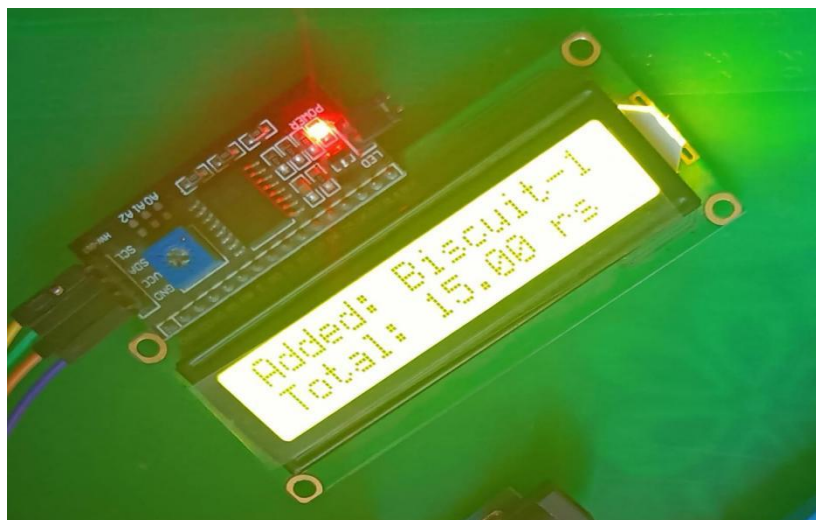
1.ARDUINO UNO IDE: The Arduino IDE (Integrated Development Environment) is used to write the computer code and upload this code to the physical board. The Arduino IDE is very simple and this simplicity is probably one of the main reason Arduino became so popular. An **integrated development environment (IDE)** is a software application that helps programmers develop software code efficiently. It increases developer productivity by combining capabilities such as software editing, building, testing, and packaging in an easy-to-use application.

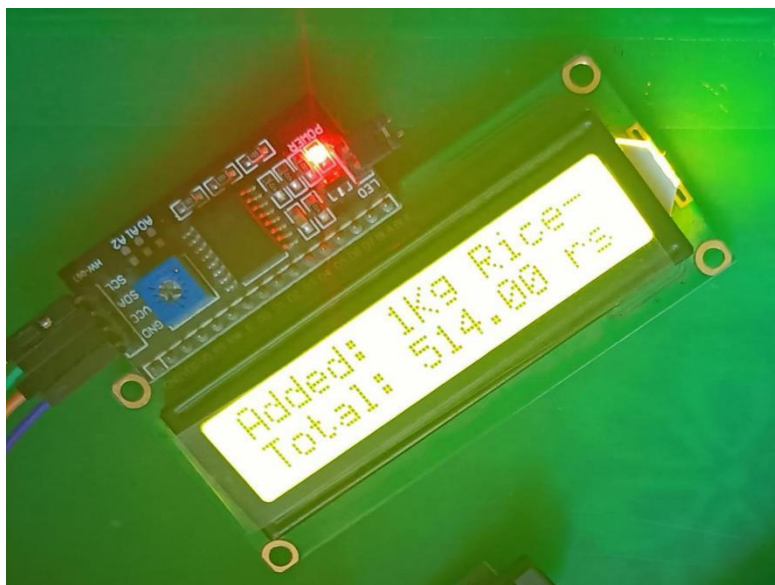
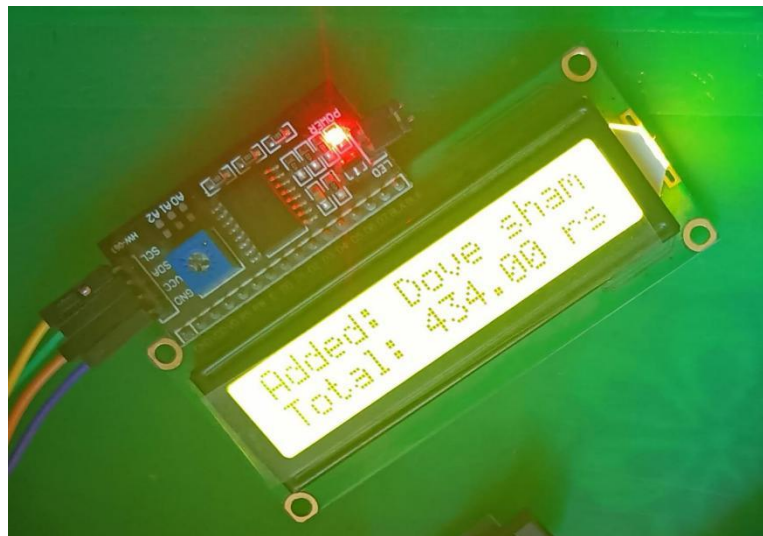
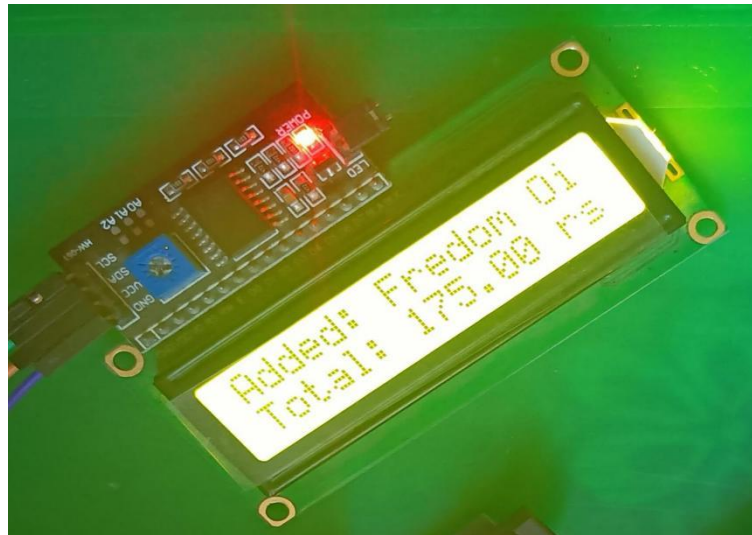


VII. RESULTS



When the RFID tag is scanned for odd number of times the product gets added :





When the RFID tag is scanned for even number of times the product gets subtracted :



APPLICATIONS

Retail and Supermarkets:

- **Automated Billing:** Speeds up the checkout process by scanning items as they are placed in the trolley.
- **Queue Reduction:** Eliminates the need for traditional checkout lines.
- **Improved Inventory Management:** Tracks items in real-time to update stock levels.
- **Enhanced Customer Experience:** Reduces shopping time and provides convenience.

VIII. CONCLUSION

- An RFID Based Smart Billing Trolley is an advanced system designed to revolutionize the traditional shopping and billing process in supermarkets and retail stores. By utilizing RFID technology, this trolley automates item identification and billing, eliminating the need for manual barcode scanning at checkout counters. Each product in the store is tagged with an RFID tag that contains essential details like product ID, name, and price.
- When a customer places an item in the trolley, the built-in RFID reader automatically reads the tag information, processes it through a micro-controller, and dynamically updates the total bill. The system features a 16x2 I2C LCD screen to display item details and the running total, while push buttons allow customers to confirm or cancel transactions. LED's and a buzzer provide feedback, ensuring the system is user-friendly and error-free.



- In some implementations, a load cell is integrated to verify the actual weight of the products, enhancing security and preventing theft. This innovative trolley significantly improves customer convenience by reducing checkout times, minimizing errors, and offering a seamless shopping experience. It also benefits store management through efficient inventory tracking and scalability for future needs.
- An RFID based Smart Billing Trolley is an innovative system designed to simplify and automate the shopping and billing process in retail stores and supermarkets. It integrates RFID (Radio Frequency Identification) technology with micro-controllers and other electronic components to eliminate the need for manual barcode scanning, making the shopping experience faster and more efficient.
- The RFID based Smart Billing Trolley addresses inefficiencies in the traditional shopping process, benefiting both customers and retailers. It is a cost-effective and innovative solution to modernize the shopping experience while enhancing accuracy and convenience.

IX. REFERENCES

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