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Smart Shopping Trolley: A New Revolution

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Abstract: ***Urban areas, shopping malls experience significant crowds during holidays and weekends, especially when there are substantial offers and discounts available. Currently, shoppers tend to select a variety of items and place them in their shopping carts. After completing their selections, they proceed to the checkout counter for billing. The cashier utilizes a barcode reader to prepare the bill, which can be a time-consuming process, often leading to long lines at the payment counters. This initiative proposes a solution to address this challenge. The plan involves equipping all merchandise within the mall with RFID tags, while each shopping cart will be fitted with an RFID reader and a digital display screen. As items are placed in the cart, their codes will be automatically recognized, and the name and price of each item will be displayed on the screen, consequently adding the cost to the total bill. Additionally, if a shopper wishes to remove an item from the cart, they will have the option to do so seamlessly.The measurement of the specific item is subtracted from the total amount, and equivalent data is transmitted to the central billing unit via the ZigBee module. Consequently, billing can be performed directly from the trolley, which significantly saves time for the customers.***

Keywords: RFID tag, LCD, RFID reader, Barcode reader, Trolley, Zigbee, Central billing unit.

I. INTRODUCTION

As the global demand for retail space continues to grow, shopping malls are increasing in numbers, leading to long queues of frustrated customers waiting at checkout. As a result, shopping centers face financial losses due to unsold inventory. To reduce these challenges and optimize the existing system, a “Smart Shopping Cart” has been designed. This system involves entering data into a digital interface connected to an LCD screen on the cart during utilizing a barcode scanner for seamless transactions. When a customer is done to their shopping, they just need to press the checkout button near the counter. This instantly sends the total bill and other necessary details to the central server using the RF module. This approach minimizes the need for additional staff and significantly reduces customer times. The proposed Smart Shopping Trolley system is designed to make shopping easier by providing a flexible, easy-to-use, and affordable system that can seamlessly fit into an IoT-enabled smart mall. RFID, a rapidly advancing technology, has gained increasing attention in research circles due to its distinct advantages over conventional identification and data sensing systems.

Radio Frequency Identification (RFID) utilizes radio waves to identify objects uniquely, enabling information exchange between tags and readers over readers over distances ranging from a few meters to several tens of meters, depending on the type of tag used. Unlike traditional methods, RFID does not require a direct line of sight for data transmission. This section explores the latest developments in RFID technology, tracing its progress over time and highlighting the challenges in its infrastructure, from its early implementation to the recognition phase. The modern retail sector can be classified into two main categories: (i) in-store purchases, where customers physically select items, and (ii) remote purchases facilitated by ICA, often in the porous of powder.

II. MATERIALS

The proposed framework is structured into two key sections. The first phase involves configuring the Microcontroller to integrate the RFID Reader and Zigbee module. The Second part is the label detecting of items by RFID Reader when products are placed in the shopping cart and transmitting of collected item data from cart to Central billing unit through ZigBee and Wi Fi Module. The overview working of this system is as follows- When a customer enters the shopping center, they pick up a trolley equipped with an RFID reader, a microcontroller, and an LCD screen. At the point when the client begins dropping items into the trolley, labels will be read by the RFID reader and the reader sends the corresponding data to the microcontroller. This section aims to review the existing a literature review on state-of-the-art and to investigate the issues plaguing the current RFID infrastructure, beginning with its transformation and continuing through the recognition phase [2]. In the event that the client wishes to expel any item from the cart, at that point they can remove that item from the trolley and the expense of that specific item will be subtracted from the

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aggregate sum quickly and subsequent to shopping the item information with aggregate sum gets transmitted to the local billing station through ZigBee. The RFID Reader is strategically positioned within the trolley, and the external portion of the cart is shielded with radiofrequency protection to prevent the reader from unintentionally scanning items outside the cart. Smart User Interactive Interface Design Modern smart shopping cents require supplementary wireless communication systems to enable indoor location and product information broadcasting in addition to the SSC's user interface features like product searching, map information, and automated billing [5]. In order to distinguish between things within (read by the cart's internal antenna) and outside of (read by the exterior antenna) the cart, the designed SSC makes use of a dual-antenna RFID reader (see Figure 2). In order to lessen detection mistakes and interference, directional antennas are used, and the output power of each antenna is optimized. The external antenna operates of 27dBm, allowing a range of about 4 meters, while the internal antenna functions at 10dBm, covering roughly 30cm. In addition, the external antenna is employed for interior placement, with the latter's identification of the area serving to help the former in proposing the shopping rituals. When an item's ID matches the retailer's database, its details are display on the SSC's user interface. A tally of purchases can be generated



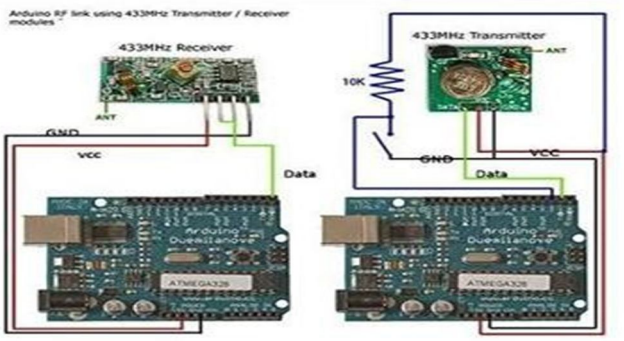
mechanically and transmitted to the shopping center's billing system. [6]. Fig. 2. Depiction of SSC with RFID module fitted. The queued message handler (QMH) based buffered state machine is employed [7] to facilitate the flexible design of the user interface. Barcode Systems These implementations use a double code that consists of a series of bars and spaces laid out in a parallel fashion. A large sequence of numbers and letters is displayed with minimal spaces or breaks, making it ideal for optical laser scanning. Optical laser scanning is used for this purpose. This system is recognized as one of the automatic identification technologies [8]. It is considered one of the automatic identification systems.

RFID Usage Challenges All the shopping carts will be equipped with a framework that includes an RFID reader. RFID tags should be affixed to everything in the mall. As soon as a customer adds an item to their shopping cart, the product's unique code is read and the item's price is recorded. The costs are calculated and added to the total as you continue placing things in your cart. The computing is handled by the shopping cart itself. The LCD displays information about the product. An additionally, Earbuds will also provide information on the product's label and pricing. All billing information is wirelessly sent to a PC close to the payment center [9]. Table I shows the comparison of various automatic identification systems in terms of different parameters.

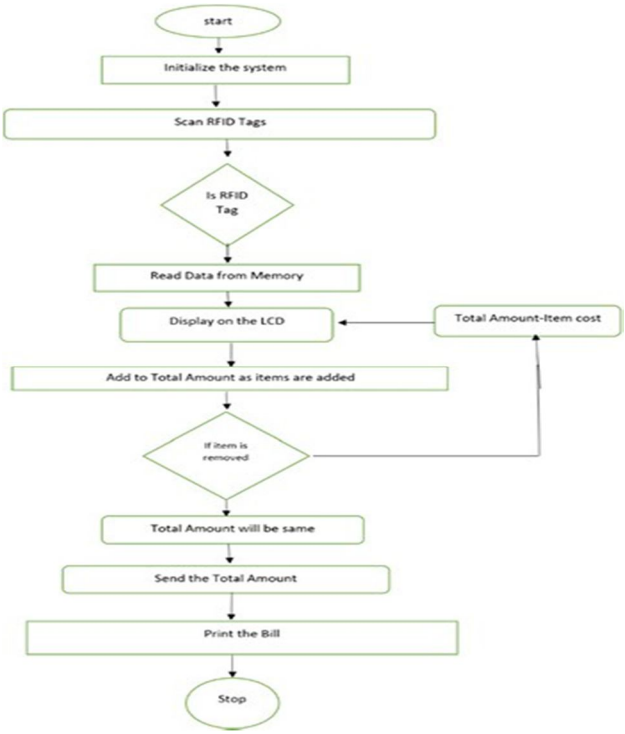
III. TESTING METHODS

The proposed system in this research will be developed and implemented in two parts. The first part is the setting up of the Arduino, which serves as the core processing unit for this project, along with configuring the RFID reader and RF communication modules. The second phase involves an RFID reader picking up on cart contents and transmitting that data to a central billing unit using radio frequency. Customers check in at the front desk and are given a trolley, each of which is equipped with an RFID reader, a microcontroller, and an LCD screen. As soon as customer begins placing items in the trolley, the reader will begin to read the tags and relay that data to the microcontroller. The data is compared to what's already stored in the microcontroller. The price of the item will be shown on the LCD screen if the information checks out. After making a purchase, the information about the items in the cart, along with the total price, is sent using radio frequency (RF) to the store's central billing system, where any subtracted items will be immediately refunded to the customer. Inside the trolley, the RFID reader will be fitted in the middle of the bottom. To prevent the

RFID reader from picking up data from tags on objects outside the cart the design incorporates RF shielding into the trolley's exterior. The suggested system is seen in Figure 3; the reader is linked to an Arduino, which is linked to an LCD and RF, which transmits billing information to a centralized billing system. The above chart is a step-by-step explanation of the basics of a smart shopping cart. Where the diagram is divided into two parts, one representing the part for sending and the other for receiving. The transmitter part consists of a barcode reader, a USB host, and an Arduino Mega, which in turn is connected to an LCD screen and a power source. The Arduino Uno connects to the Rf433, which sends the information to the receiving section. When we pass the barcode reader over the product code, it reads the price and displays it on the LCD screen. At the same time, this data is sent to the receiving section via RF433, and the receiving section contains the RF433, Arduino Mega, and a computer, which, in turn, is the cashier in the store. Arduino Mega is used in this project since it meets the requirement of the project and is considered a good balance between price and performance. This project also uses a 433 MHz RF transmitter and receiver module to enable wireless communication between electronic devices. The transmitter module sends data which is then pick up by the receiver module, allowing seamless data exchange through radio waves. A schematic design is shown in the following figure.



This system relies on a number of moving parts in order to function properly. The system is built around an Arduino Mega microcontroller, which acts as the main controller, managing all its operations with a 28 pin IC that runs on 5V. It also includes a 16x2 Liquid Crystal Display (LCD) that presents essential product details such as name, price, quantity, and total cost, ensuring clear and easy readability for users. •Barcode scanner. It reads product IDs from Barcodes. • RF 433 module. • Keypad. The reset Vol. 46 No. 4 October-December 2023 5 button is used to reset the LCD screen.



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IV. RESULTS AND DISCUSSIONS

A. *Result*

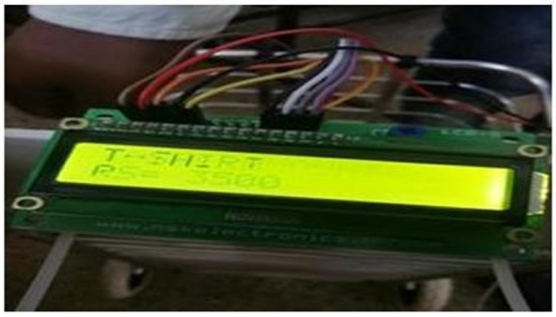
This project entitled “Modernizing The Shopping Experience: The Smart Shopping Cart” is completed and the results obtained are satisfactory. With the completion of "The Smart Shopping Cart," we have received good results. This work was inspired by a demonstration. It may be easily adopted by those who wish to make adjustments or add new features. Overall efficiency will go up, the number of people needed to staff markets will go down, and client wait times will be cut or eliminated thanks to this effort

B. *Conclusions*

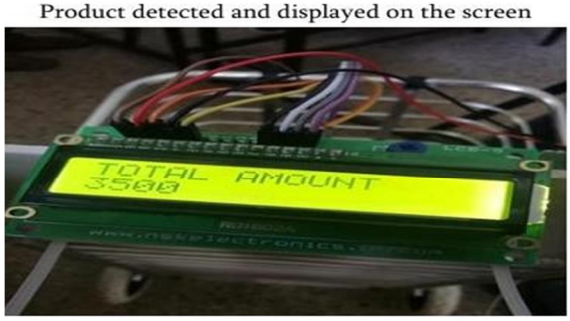
Conclusion Automated shopping carts will eliminate lines. And it speeds up the buying process overall. By using an automated billing system, both the buyer and the retailer will benefit; customers will have a better idea of the entire cost and will be able to evaluate it in the context of their financial plan. A shopkeeper in return will have much more time to do other necessary things in the shop instead of working as a cashier or having to hire a cashier to do

C. *Future Works*

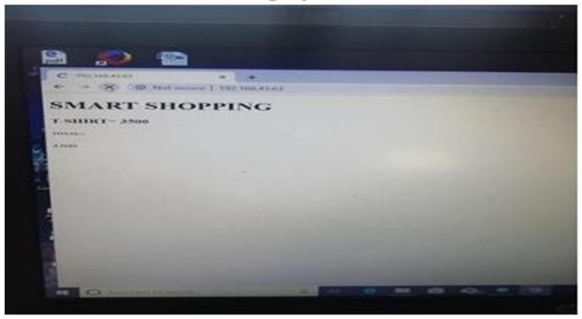
There are many modification and enhancements that can be done in this work here are some points that can be added in the futue: • Integration with mobile devices, smart shopping carts could be designed to integrate with shoppers' mobile devices to provide personalized offers and recommendations based on past shopping history, preferences, and loyalty program data. • Contactless payment, smart shopping carts could be designed to enable contactless payment using mobile wallets or other digital payment methods, providing shoppers with a more seamless and convenient checkout experience. • Interactive displays, smart shopping carts could be designed with built-in interactive displays that allow shoppers to access product information, view promotions, or watch videos related to products in real-time.



Product detected and displayed on the screen



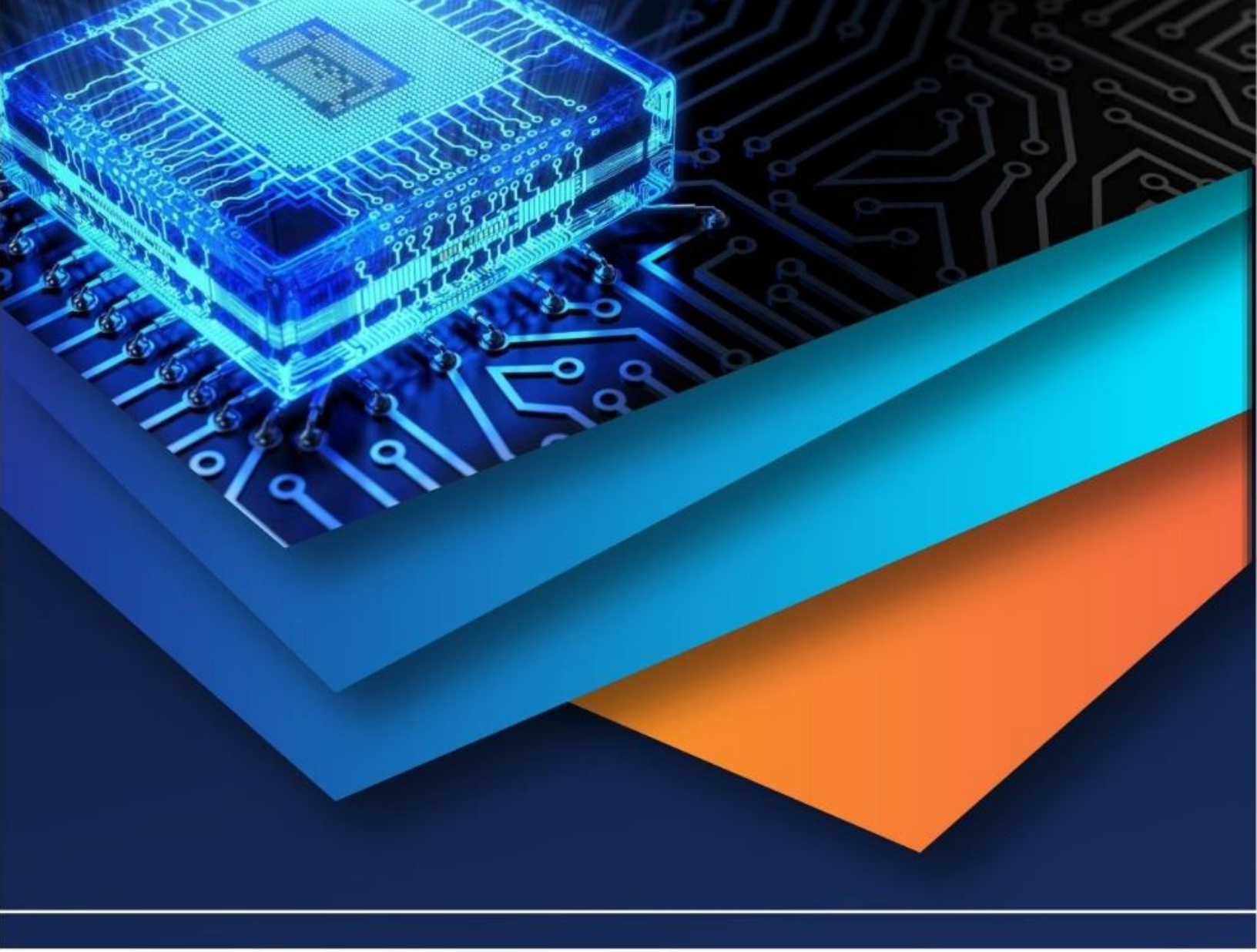
Total Amount displayed on the screen



Bill displayed on in the central billing station

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