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Smart Trolley Automation: Billing and Inventory Management

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Abstract

In our modern society, characterized by a growing reliance on advanced technology, the preference for streamlined and efficient processes is paramount. The Smart Trolley emerges as a noteworthy response to this demand, incorporating cutting-edge elements such as Arduino UNO, RFID reader, RF tags, and the EM-18 module. This innovative shopping companion optimizes the shopping experience by automating tasks—customers effortlessly place items in the trolley, while the embedded RFID reader captures crucial details like price and quantity. A distinctive feature of the Smart Trolley lies in its reimagining of the payment process, offering real-time transactions that eradicate the need for conventional checkout queues. This technological marvel extends its utility beyond the shopper, providing administrators with a tool to effortlessly oversee and manage stock details. The Smart Trolley thus stands as a comprehensive solution, enhancing convenience for customers and operational efficiency for administrators. Its integration of advanced features marks a departure from traditional shopping carts, underscoring its role as a pioneering and technologically superior asset in the retail landscape.

Keywords: Smart Trolley, Arduino Uno, Embedded RFID reader, RF Tag

I. Introduction

Throughout history, humans have consistently advanced technology to cater to their evolving needs and simplify daily tasks. This universal drive for technological innovation spans various domains and aims to enhance accessibility and efficiency. The contemporary era witnesses a remarkable surge in people frequenting large super and hypermarkets for their diverse shopping needs, turning this activity into a daily routine in urban settings. The influx of shoppers intensifies, especially during festive seasons, leading to congestion at billing counters.

To address the challenges posed by overcrowded malls, there is a compelling need for a system that streamlines the entire shopping process. Presently, all super and hypermarkets employ shopping baskets and trolleys to assist customers in selecting and storing their desired products. However, the bottleneck arises during the billing process, causing prolonged waiting times despite the deployment of numerous labor resources. In response, the "RFID-enabled Automatic Billing System" is proposed as a solution [1].

This innovative system, embedded within the shopping trolley, utilizes RFID tags affixed to every item in the mall. As customers place items in the trolley, the RFID reader scans their codes, instantly storing their prices in memory and displaying the comprehensive bill on an LCD

screen. The primary objective is to significantly reduce or eliminate waiting times, minimize labor requirements, cut down raw material expenses, and enhance the overall efficiency of the shopping experience. This integration of technology aims to simplify and expedite the shopping process, making it more convenient for customers in today's fast-paced world.

II. Literature Survey

Paper [2] introduces a novel approach to smart shopping carts designed to save significant time for shoppers. The cart is equipped with a sensor, RFID tag, and an LCD module, allowing products to be easily scanned and displaying the final amount on the LCD within the cart. This enables customers to pay in cash at the counter or swipe their credit cards. Notably, this system aims to address the issues associated with barcode technology during scanning, offering a more efficient and seamless shopping experience.

In Paper [3], the focus is on a "Smart shopping trolley for supermarkets using rechargeable smart card." The system is developed to reduce the time spent by customers during shopping. The proposed model requires customers to carry a smart card, which, when swiped in the trolley, initiates the shopping process. As products are added to the trolley, the RFID reader reads the Product ID, and related information is stored in Arduino UNO. At the end of shopping, pressing the end button automatically deducts the bill amount from the smart card balance, eliminating the need to wait in queues at the counter. The rechargable smart card adds a convenient and efficient dimension to the payment process.

Paper [4] presents an innovative shopping system emphasizing ease and financial security for customers. Implemented using Android with NFC support, the system eliminates the need for physical purchases and carrying cash or cards. Customers can read the product ID through NFC, add it to the application's cart, and edit the product quantity. The system offers an e-wallet facility for secure payments and provides OTPs for enhanced financial transaction security. This alternative method simplifies the shopping process and enhances customer satisfaction through technological convenience and financial security measures.

Paper [5] titled "The Development of Smart Shopping Cart with Customer-Oriented Service" by Hsin-Han Chiang, Wan-Ting You, ShuHsuan Lin, and Wei-Chih Shih, the authors introduce a smart shopping cart that automatically detects when an item is added to the shopping trolley. This Smart Shopping Cart (SSC) significantly enhances the efficiency of navigating and making purchases within a mall.

Paper [6] titled "Smart Trolley in Mega Mall" by Awati.J.S and S.B.Awati describes a microcontroller-based design intended for users who wish to avoid waiting in queues at billing counters and the associated challenges of managing a traditional trolley. The system incorporates an LCD display, Max 232, Barcode scanner, RF module, RF transmitter & receiver, and an Object counter to streamline the shopping experience and alleviate concerns related to crowds and cumbersome trolley handling.

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III. Existing System

The current system uses a microcontroller, RFID module, and LCD display. The shopping trolley employs an individual login system, causing user inconvenience. However, uncertainties exist regarding Wi-Fi, Zigbee, GPS communication, and payments limited to master cards. Furthermore, the motor consumes excessive power, demanding high maintenance [7]-[12].

IV. Proposed System

The smart trolley system represents a significant advancement in shopping technology, providing customers with a range of special features designed for enhanced convenience. One notable aspect of the proposed system is its flexibility in accommodating both online and offline payment methods, catering to the diverse preferences of shoppers.

At the core of our innovative system is the integration of RFID (Radio-Frequency Identification) technology. Each product within the mall is equipped with an RFID tag featuring a unique and authentic code. As customers add or remove products from the smart trolley, LED indicators provide instant confirmation, ensuring accuracy in the selection process.

The RFID reader embedded in the smart trolley seamlessly scans the RFID tags on the products. This process triggers the display of detailed product information on the screen, offering transparency and real-time data to the shopper. The screen not only showcases individual product details but also dynamically calculates the total price as items are added or removed [13]-[15].

Figure 1: Block diagram of the proposed method

One of the distinctive features of the smart trolley is its ability to track payment details after the purchase is made. This functionality provides both customers and store owners with a transparent record of transactions, enhancing accountability and streamlining the overall

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shopping experience.

V. Hardware Used

Radio-frequency identification (RFID) involves the application of an object, commonly referred to as an RFID tag, to or within a product, animal, or person for identification and tracking using radio waves. Some tags have the capability to be read from a distance of several meters and even beyond the line of sight of the reader. Typically, RFID tags consist of at least two components. One is an integrated circuit responsible for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, and performing other specialized functions.

The Arduino Uno serves as a microcontroller board based on the ATmega328 (datasheet). It boasts 14 digital input/output pins (with 6 usable as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. Simple connectivity to a computer through a USB cable or power from an AC-to-DC adapter or battery allows users to initiate operations. Featuring the Atmega8U2 programmed as a USB-to-serial converter, the Arduino Uno can be powered either via the USB connection or an external power supply.

VI. Software Used

The Arduino employs the Arduino IDE software, an open-platform application coded in Embedded C. Derived from the IDE for the Processing programming language and the Wiring project, Arduino IDE serves as a user-friendly tool for introducing programming to artists and newcomers unacquainted with software development. It features a code editor with functionalities like syntax highlighting, brace matching, and automatic indentation. Moreover, the IDE allows users to compile and upload programs to the Arduino board effortlessly with a single click, eliminating the need for manual editing of make files or running programs through a command-line interface.

VII. Results and Discussions

Figure 2: Automated Billing Smart Trolley and Stock Monitoring module

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RFID serves a vital role in identifying purchased items at shopping malls. Employing wireless communication through electromagnetic or electrostatic coupling in the radio frequency segment of the electromagnetic spectrum, it uniquely identifies objects, items, or individuals. Simplifying RFID's function, there is a receiver and transmitter end. The receiver captures signals and transmits them to the transmitter, connected to an LED, buzzer, or another output device for comprehension.

Figure 3: Working mechanism of the Module

Following steps provides the complete operating mechanism of the designed module:

Step 1: Switch on the power supply of the hardware kit and establish a connection between the Bluetooth module and the computer or mobile phone via hotspot. Attach RFID tags to the products in place of barcodes.

Step 2: Connect the RFID reader, Bluetooth module, and LCD to the Arduino Uno.

Step 3: The LCD displays "SMART TROLLEY." Add items to the cart by presenting the RFID card to the RFID reader. The LCD confirms, showing "Item is added."

Step 4: Remove an item from the cart by presenting the RFID card to the RFID reader. The LCD displays "Item has been removed."

Step 5: Display a push button (push button 1) to check the total items in the trolley and the overall

cost of the items.

Step 6: Upon completing the shopping, press push button 2. The total number of items and the cost are sent via Bluetooth to the phone, allowing the customer to conveniently pay and leave the shop.

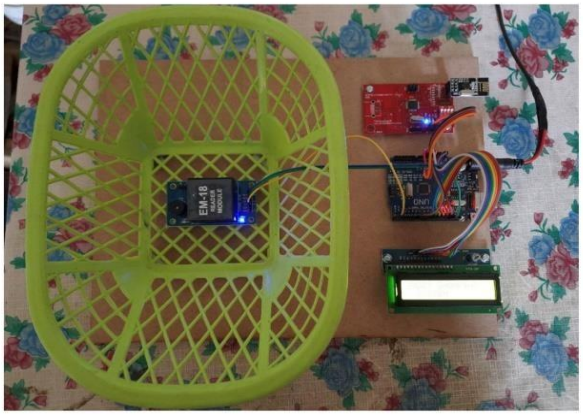

Figure 4: Final usable product

VIII. CONCLUSION

The integration of RFID technology, EM-18 reader, and Arduino has successfully streamlined the billing process, aiming to minimize customer wait times in bustling shopping environments. The core objective is to enhance customer convenience and facilitate seamless inventory management. This automated billing system proves especially beneficial in crowded shopping malls, promising increased efficiency. As we delve into the realm of automation, this technology emerges as a transformative force, poised to supplant the prevailing barcode system. Through this evolution, it not only fuels technological progress but also empowers individuals to lead more convenient and time-efficient lives.

REFERENCES

[1] Allanki Sanyasi Rao et. al. “Social Distancing based Smart Cart” in an International Journal for Innovative Engineering and Management Research, ISSN: 2456 - 5083, DOI: 10.48047/IJIEMR/V11/SPL ISSUE 06/02,Vol.: 11, Special Issue: 06, Jul 2022, Pages: 6-8

[2] Ankush Yewatkar, Faiz Inamdar, Raj Singh, Ayushya, Amol Bandal (2016), “Smart Cart with Automatic Billing, Product Information, Product Recommendation Using RFID & Zigbee with Anti-Theft”, 7th International Conference on Communication, Procedia Computer Science, Vol. 79.

[3] Prabha K.R, Sabari Manoj S, Sandeep C, Maniganda Dinesh M.R (2017), “Smart shopping trolley for supermarkets using rechargeable smart card”, International Journal of Scientific & Engineering Research Volume 8, Issue 7.

[4] Angeline Beryl. J et. al. “Automated Billing Smart Trolley and Stock Monitoring”, Journal of Emerging Technologies and Innovative Research (JETIR), Volume 9, Issue 8, Aug 2022.

[5] Hsin-Han Chiang, Wan-Ting You, ShuHsuan Lin, and Wei-Chih Shih, "The Development of Smart Shopping Cart with Customer-Oriented Service", International Conference on System Science and Engineering (ICSSE) National Chi Nan University, Taiwan, July 7-9, 2016

[6] J.S.Awati , S.B.Awati, et al, "Smart Trolley in Mega Mall",International Journal of Emerging Technology and Advanced Engineering,, Volume 2, Issue 3, March 2012.

[7] P.T. Sivagurunathan, P. Seema, M. Shalini, R. Sindhu Smart Shopping Trolley Using RFID International Journal of Pure and Applied Mathematics Volume 118 No. 20 2018, 3783-3786.

[8] TharinduAthauda, Juan Carlos Lugo Marin, Jonathan Lee, NemaiKarmakar Department of Electrical and Computer Systems Engineering Robust Low-Cost PRFID Based Smart Shopping Trolley IEEE Journal of Radio Frequency Identification DOI 10.1109/JRFID.2018.2866087.

[9] K.GogilaDevi,T.A.Kaarthik, K.Nandhini, S.Priya Smart Shopping Trolley Using RFID Based onIoT International Journal of Innovative Research in Computer and Communication Engineering Vol.5, Issue 3, March 2017.

[10] Sarika S. Pandey, Soumya R. Gupta, Meenaz M. Shaikh, Komal M. Rawat, Prof. Pravin Jangid,Prof. Ragini Mishra Smart Cart Using Arduino and RFID Volume: 05 Issue: 03 | Mar-2018.

[11] Vaishali Rane, Krutik Shah, Kaushal Vyas, Sahil Shah, Nishant Upadhyay Smart Trolley UsingRFID Volume: 06 Issue: 01 | Jan 2019.

[12] Akshay Kumar, Abhinav Gupta, S Balamurugan, S Balaji and Marimuthu R Smart Shopping CartSchool of Electrical Engineering, VIT University, Vellore.

[13] Manikandan T, Mohammed Aejaz M. A, Nithin Krishna N. M, Mohan Kumar A. P, Manigandan R RFID based Advanced Shopping Trolley for Super Market Journal of Chemical and PharmaceuticalSciences ISSN: 0974-2115.

[14] Mr.P. Chandrasekar, Ms.T. Sangeetha Smart Shopping Cart With Automatic Billing System Through RFID And ZigBee CICES2014 - S. A. Engineering College, Chennai, Tamil Nadu, India.

[15] Gaikwad Prerna, Kalekar Shital, Shete Renuka, Thorat Komal, Nita R. Mhaske Smart Billing Trolley Using RFID And LIF International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 6, Issue 9, September 2017.