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SMART SHOPPING CART WITH AUTOMATIC BILLING SYSTEM USING RFID AND ARDUINO

Dr. D V Divakar Rao, V.Akhil, N.Yashmitha, D.Anusha, M.Teja

Professor, Department of Computer Science and Engineering, Raghu Engineering College , Dakamarri, Andhra Pradesh ,Email: - divakararao.dusi@raghuenggcollege.in

B Tech Student, Department of Computer Science and Engineering, Raghu Engineering College, Dakamarri, Andhrapradesh, Email: - akhilvinnakota123@gmail.com

B Tech Student, Department of Computer Science and Engineering, Raghu Engineering College, Dakamarri, Andhrapradesh ,Email: - neyyalayashmitha123@gmail.com

B Tech Student, Department of Computer Science and Engineering, Raghu Engineering College, Dakamarri, Andhrapradesh ,Email: - anushadwarapureddy03@gmail.com

B Tech Student, Department of Computer Science and Engineering, Raghu Engineering College, Dakamarri, Andhrapradesh, Email: - tejamaturi26@gmail.com

Abstract : A shopping mall is a place where hundreds of customers visit every day to purchase many items. Nowadays shopping malls are increasing rapidly due to the availability of all the items ranging from groceries, clothes, vegetables, fruits, etc., in the commonplace. A trolley is required to collect the items in the shopping mall. The trolley has to be pulled forward or backward while collecting the items. After purchasing the product, the customer has to stand in a long queue for billing their products. To overcome this problem we are developing intelligent trolleys for shopping malls. Every product in the shopping mall contains an RFID tag andthe trolley is fitted with an RFID reader. When the customer drops the product in the trolley the reader reads thetag and displays the item and the amount in LCD which is fitted in the trolley. After the completion of shopping,the customer will press the finish button in the trolley, and the total bill is displayed on the LCD, and the bill is transferred to the main computer. The total bill of the customer will be received as a message through a GSM module.

Index terms *- Shopping Cart, RFID Tags, Arduino, RFID Scanner, Billing System.*

1. INTRODUCTION

In response to the evolving lifestyle and demands for convenience, shopping malls have become indispensable hubs for acquiring daily necessities. However, the traditional checkout process often entails long queues, leading to customer frustration and time wastage. To address this issue, innovative solutions like the Intelligent Trolley and Smart Shopping Cart have been proposed.

These systems leverage RFID (Radio Frequency Identification) technology to streamline the shopping experience. By affixing RFID tags to products and integrating RFID readers into shopping trolleys, the process of scanning items becomes automated and efficient. As customers add products to their carts, the RFID reader instantly detects each item, displaying its name and price on an LCD screen. This real-time visibility

allows shoppers to monitor their purchases and make informed decisions.

Moreover, the Smart Shopping Cart incorporates additional features such as a membership card system and automated billing. Customers are provided with personalized membership cards containing their account details. Upon scanning the card, the system retrieves the customer's information and displays their account balance on the LCD screen. As products are scanned, the total bill is dynamically updated, providing transparency throughout the shopping journey. Customers can easily remove items from their carts by rescanning them, ensuring accurate billing.

Once shopping is complete, customers can choose between cash or smart card payment options. The system deducts the bill amount from the customer's account balance, providing a seamless checkout experience. Furthermore, an SMS notification is sent to the customer's mobile phone, confirming the transaction.

These innovative systems not only enhance the efficiency of shopping malls but also improve the overall customer experience. By reducing wait times at checkout counters and empowering customers with real-time information, these technologies cater to modern consumer demands. Additionally, the implementation of RFID technology contributes to inventory management and reduces the reliance on manual processes.

In conclusion, the integration of RFID technology in shopping carts represents a significant advancement in retail automation. With its ability to streamline checkout processes, enhance customer satisfaction, and optimize inventory management, these systems pave the way for a more efficient and enjoyable shopping experience in malls.

2. LITERATURE SURVEY

In recent years, Radio-Frequency Identification (RFID) technology has gained significant attention in various domains, particularly in retail and shopping applications. RFID offers a wide range of capabilities, from enhancing product information retrieval to streamlining checkout processes. This literature survey aims to explore the evolving landscape of RFID-based shopping systems, focusing on advancements, applications, and challenges addressed by researchers and practitioners.

Fabian et al. [1] proposed Shardis, a privacy-enhanced discovery service for RFID-based product information. Their work addresses the concerns surrounding consumer privacy in RFID systems by implementing privacy-preserving mechanisms in the product information retrieval process.

Suryaprasad et al. [2] introduced a novel low-cost intelligent shopping cart, presenting an innovative solution to enhance the shopping experience. Their system leverages RFID technology to enable intelligent functionalities within the shopping cart, thereby improving efficiency and convenience for shoppers.

Zope and Limkar [3] explored the integration of RFID technology with mobile payment systems for bill generation and payment. This work contributes to the seamless integration of RFID-enabled transactions into mobile platforms, facilitating secure and convenient payment processes for consumers.

Karmouche and Salih-Alj [4] focused on aisle-level scanning for pervasive RFID-based shopping applications. Their research addresses the challenges associated with accurate and efficient RFID tag detection within retail environments, paving the way for enhanced inventory management and customer experiences.

Mayer et al. [5] investigated RFID tag acquisition via compressed sensing, presenting a novel approach to efficiently acquire RFID tag data. Their work contributes to improving the scalability and efficiency of RFID systems, particularly in scenarios with large-scale tag deployments.

Kamble et al. [6] proposed the development of a multitasking shopping trolley based on RFID technology. Their system enhances traditional shopping carts with RFID-enabled functionalities, such as automatic product identification and inventory management, offering increased convenience and efficiency to shoppers.

Chandrasekar and Sangeetha [7] introduced a smart shopping cart with an automatic central billing system powered by RFID and ZigBee technologies. Their research aims to streamline the checkout process by automating billing procedures through RFID-based product identification and communication.

Ali and Sonkusare [8] presented an RFID-based smart shopping and billing system, emphasizing the integration of RFID technology into the shopping experience. Their work focuses on enhancing the efficiency and accuracy of billing processes through RFID-enabled automation.

Collectively, the reviewed literature highlights the diverse applications and advancements in RFID-based shopping systems. Researchers have addressed various challenges, including privacy concerns, system scalability, and integration with other technologies. These efforts contribute to the continued evolution of RFID technology in retail environments, promising enhanced efficiency, convenience, and customer experiences.

3. METHODOLOGY

i) Proposed Work:

The proposed system aims to revolutionize the shopping experience in malls by introducing intelligent trolleys equipped with RFID technology. Each product in the store is embedded with an RFID tag, while the trolley is outfitted with an RFID reader. As customers place items in the trolley, the reader automatically scans the RFID tags, displaying the item details and prices on an LCD screen integrated into the trolley. Upon completing their shopping, customers can press a finish button to view the total bill on the LCD screen. The bill is then transmitted to the main computer system, and customers receive the total bill amount as a message through a GSM module. This system streamlines the checkout process, eliminates the need for traditional billing queues, and enhances overall efficiency and convenience for shoppers in malls.

ii) Block Diagram:

The block diagram consists of an RFID Reader (RPS) interfaced with an Arduino microcontroller. The Arduino processes the data from the RFID reader and controls the LCD display for item information and prices. Additionally, it communicates with the GSM module to send the total bill information to the customer's mobile phone. This setup enables seamless integration of RFID technology into the shopping experience,

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providing real-time information to customers and facilitating efficient billing processes in retail environments.

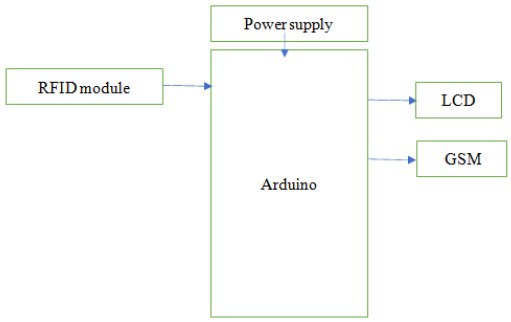

Fig 1 Block Diagram

iii) Components Used:

to implement this project we used the following components. They are Arduino UNO, RFID module, LCD, GSM and Power Supply.

RFID Module:

An RFID (Radio-Frequency Identification) module is a device that consists of an RFID reader and an antenna to read RFID tags.

The RFID module is used to read the unique identification information stored in RFID tags attached to products in the shopping mall. It communicates this data to the Arduino for processing.

Arduino Microcontroller:

Arduino is an open-source electronics platform based on easy-to-use hardware and software, typically consisting of a microcontroller board.

The Arduino microcontroller processes the data received from the RFID module, calculates the total bill based on the scanned items, controls the LCD display, and communicates with the GSM module for sending the total bill information.

LCD (Liquid Crystal Display):

An LCD is a flat-panel display technology that uses liquid crystals to display information.

The LCD display module is used to visually display information to the customer, such as the names and prices of scanned items, as well as the total bill amount. It is controlled by the Arduino microcontroller.

GSM Module:

A GSM (Global System for Mobile Communications) module is a device that allows communication between electronic systems and mobile networks.

The GSM module is used to send a text message containing the total bill amount to the customer's mobile phone. It receives the bill information from the Arduino and handles the communication with the mobile network.

Power Supply:

The power supply provides electrical power to the components of the system.

The power supply ensures that the RFID module, Arduino, LCD display, GSM module, and other components receive the necessary electrical power to operate effectively. It may consist of batteries or a mains power adapter, depending on the specific requirements of the project.

iv) Working Process:

The working process of the proposed system begins with the RFID reader (RPS) scanning the RFID

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tags embedded in each product as they are placed in the shopping trolley. The RFID reader communicates the scanned data to the Arduino microcontroller.

RFID Tag Scanning: As items are placed in the trolley, the RFID reader reads the unique identification information stored in the RFID tags attached to each product.

Data Processing: The Arduino microcontroller processes the data received from the RFID reader. It extracts information such as the product name and price associated with each scanned RFID tag.

Display on LCD: The Arduino then sends this processed information to the LCD display module. The LCD screen on the shopping trolley shows the details of each scanned item, including its name and price, allowing customers to keep track of their purchases in real-time.

Accumulating Total Bill: As customers continue to add items to their trolley, the Arduino continuously updates the total bill based on the prices of the scanned items.

Finish Shopping: Once the customer has finished shopping, they can indicate so by pressing a designated button on the trolley.

Display Total Bill: Upon pressing the finish button, the Arduino calculates the total bill based on the accumulated prices of the scanned items. It then sends this total bill information to the LCD display for the customer to view.

Transfer to GSM Module: Simultaneously, the Arduino also communicates with the GSM module to transfer the total bill information.

SMS Notification: The GSM module sends a text message containing the total bill amount to the customer's mobile phone. This provides the customer with a convenient way to keep track of their expenses and facilitates seamless payment.

In essence, this working process ensures that customers can easily and efficiently shop for items in the mall, with real-time updates on their purchases and a convenient billing process facilitated by RFID technology, Arduino control, and GSM communication.

4. EXPERIMENTAL RESULTS

Fig 2 Scan the first item with the price of Rs:6.00

Fig 3 Add another item priced at Rs: 6.00

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Fig 4 Total: 12.00

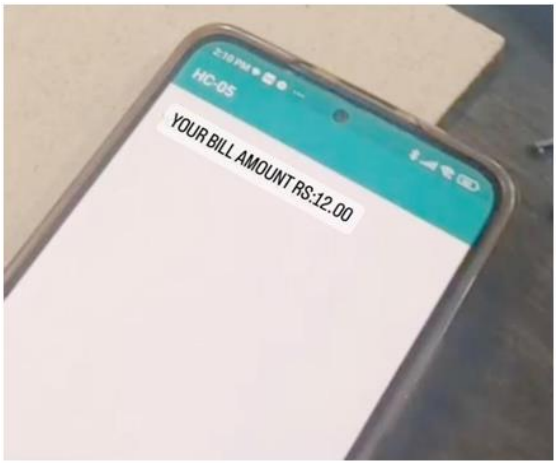

Fig 5 Amount Displayed on the screen as

Fig 6 Add another item priced at Rs: 4.00

Fig 7 Amount displayed in led as total: 16.00 (12.00+4.00)

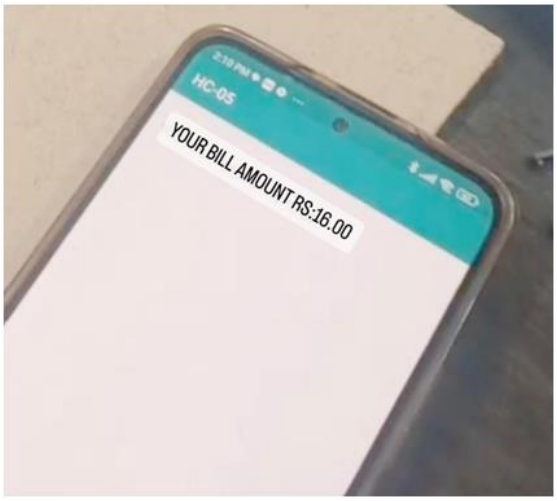

Fig 8 Amount Displayed on screen after adding item priced Rs: 4.00

5. CONCLUSION

The ongoing advancements in technology and science continually drive innovation across various sectors. In the context of shopping malls, the project implemented here introduces a transformative approach to streamline the purchasing process. By employing RFID technology integrated into shopping trolleys, automatic billing becomes a reality. As customers place items into the trolley, the system instantly displays the corresponding amount on the LCD screen, simplifying the billing process and saving valuable time for the customer.

This project leverages RFID cards to access product information, enabling seamless and efficient transactions. The displayed parameters, such as product name and cost, provide customers with essential details in real-time, enhancing their shopping experience.

In conclusion, the automatic billing system based on RFID technology represents a promising advancement in retail operations. Its compact design, efficiency, and reliable performance make it a viable option for the future of shopping malls. As technology continues to evolve, such innovative solutions will likely become more prevalent, further enhancing convenience and efficiency in retail environments.

6. FUTURE SCOPE

The future scope of the project lies in potential enhancements such as integrating machine learning algorithms for personalized product recommendations, implementing cashless payment options via mobile wallets, and expanding RFID technology to enable automated inventory management. Additionally, advancements in artificial intelligence could enable predictive analytics for demand forecasting and optimizing store layouts for improved customer flow. These developments promise to revolutionize the shopping experience, making it more convenient, efficient, and tailored to individual preferences.

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