Smart Shopping Cart with Automated Billing Using Arduino

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Abstract: In this research paper we present the creation and development of a shopping cart that incorporates an automated billing system using Arduino microcontroller technology. The main goal of this system is to enhance efficiency and convenience in the shopping experience by integrating technological features. The smart shopping cart includes sensors and modules such as RFID technology for product identification, weight sensors for real time inventory management and a user friendly interface for interaction. The automated billing system, synchronized with the cart enables calculation of the purchase cost making the checkout process swift and hassle free. By exploring both hardware and software components and incorporating algorithms we outline a comprehensive implementation of this smart shopping cart system. Experimental results demonstrate how effective our proposed system is, in optimizing the shopping experience by reducing checkout time and ensuring billing. This research contributes to advancing retail automation technologies by providing insights into integrating systems within the retail industry.

Index Terms:- Smart Shopping Cart, Automated Billing System, Arduino Microcontroller, RFID Technology, Sensor Integration, Inventory Management, User Interface Design, Retail Automation.

1. INTRODUCTION

The transformation of conventional shopping experiences into modern ones through the utilization of progressive technologies is a major topic in the domain of retailing. It focuses on designing, developing and deploying a 'Smart Shopping Cart' incorporating Arduino–based automated billing systems for re-defining traditional shopping procedures. By incorporating Arduino, a common microcontroller, this smart and user-friendly cart gives consumers the convenience of shopping while improving business operations.

IoT has enabled integration of physical and digital retail environments thus leading to connected retail. Using RFID technology, the intelligent shopping cart can automatically identify and add items into the billing system and thus, speed up the checking procedure at the tills and avoid mistakes made during the manual inputting of price tags. In addition, Smart shopping cart uses embedded systems that enable real-time data processing allowing for instantaneous transaction updating and inventory management.

The objective of this study is to add value to the burgeoning area of smart retail solutions by offering a detailed description of the technological installation and operational benefits of the envisioned platform with an automated accounting system. Using the interface between Arduino and RFID technology to improve retail store shoppers' experience, customers' satisfaction, store efficiency, as well as sales.

The study will consider the technical aspects including the system architecture, hardware components, software interfaces and operating capabilities of smart cart with intelligent billing in providing solutions to improve the existing shopping process by considering the contemporary environment where digitalization is the new norm.

I. EASE OF USE

This article is written to address the development process of smart shopping carts with automated billing systems that will facilitate ease of usage and operations for customers within the retail sector. The shopping cart checkout has traditionally been a tedious process. However, by incorporating Arduino technology the paper describes how one can create an automated shopping cart checkout with ease. This paper gives detailed but easy to understand guidelines on setting up and using the system, making it easy for customers and vendors to understand and use it. It also shows the friendly interface that was developed for easier navigation through shopping. The paper systematically presents how the data is collected and trained, plus how it makes recommendations in clear terms that are understandable not only to technical but also, nontechnical users. Therefore, this research paper acts as an essential tool for the retailers looking forward to incorporating the updated technology in their working systems and offer their customers better shopping experience.

II. LITERATURE SURVEY

[1] S Deepa et.al., As a result of the research developed, the intelligent smart trolley with RFID was successfully launched. RFID modules are used to search the RFID reader, which contains product details. These details will be sent to Arduino and then shown on the LCD.

[2] K Krishnan et.al., developed a model that has easy access, is economical and showcases an intelligent and easy shopping experience to reduce time, energy of the consumers.

[3] M Shahroz et.al., developed a system using proposed technology through which customers can search and effectively get the best quality product. As a lesson, a proposed system can easily be implemented in real-life scenarios to support the shopping process by automation of shopping carts.

[4] K Machhirke et.al., build a technology that develops a smart shopping cart which can be applied for supermarkets and malls. The user interface provides whole information to promote the shopping service for customers.

[5] R Li et.al., proposed a secure smart shopping system utilizing RFID technology. This is the first time that UHF RFID is employed in enhancing shopping experiences and security issues are discussed in the context of a smart shopping system.

[6] RK Megalingam et.al., The application was tested on emulators and smartphones. In both cases, the app performed efficiently with no errors. The application did not crash at any point in time. The app was able to control the smart shopping cart without any delays. Based on the commands received from the smartphone, the shopping cart was able to move in the preferred directions.

[7] MK Dev et.al., build a new technology that allows the customers to shop efficiently. This is designed in such a way that the data of the customer is sent to the counter through the wi-fi module, which reduces standing in long queues at the bill counter. On the other hand, the admin can monitor the stocks and plan in advance.

[8] HM Kotresh et.al., proposed a system which helped to reduce the time of billing for the customers and to ease the process of shopping so that the customers get benefited. It can be implemented in shopping malls where there is a large crowd and huge rush into malls.

III. EXISTING SYSTEM

The traditional retail stores use complete manual interaction to carry out all the processes. They deploy certain helpers at different sections to help customers and also the customers need to carry a trolley throughout the store as they continue to shop.

These system has many flaws like:

1. Stock management is very difficult.
2. More man resources resulting in more pay outs for the owners.
3. Slow and ineffective process as it always has a scope for manual error.
4. The check out section is always flooded with users as the billing process is fully manual and takes a lot of time.

This cumbersome process was resulting in customer displeasure and hence many times customers pulled out of the queue and discards shopping in such an environment.

To overcome these businesses, they introduced an electric system to carry out this process using barcodes. In this scenario the user needs to scan the product's barcode and hence the product gets added to users cart. Although it helped reducing some man resources but again it had some flaws like:

1. The user needed to scan the products manually as the process was not automated
2. The barcode needed to be in line of sight else it wouldn't get detected.
3. Still the problem was long and the slow moving queue was not resolved.
4. Stock management was still not updated in real-time.

IV. PROPOSED SYSTEM

Our proposed system (Shown in Fig.1) is an IoT based smart cart that utilizes RFID mechanism to automate the whole process of retail. There are unique RFID tags associated with each product which will help us to gain necessary product information like product name, category, price etc. As soon as the customer puts a particular product into the cart, The RFID reader detects it and adds the product's information in the required schema into the customer's online cart. The customer can even manipulate with its online cart like removing some items or simply having a view of the added items. Once the customer has finished shopping then they can move on to checkout. The checkout counter is equipped with an RFID reader which detects all the RFID readers of products present in the customer's cart. Then our backend process will compute the final billing cost after ensuring all the taxes and other metrics and reflect the final amount to be paid. This amount can be paid using any payment method like cash, card etc.
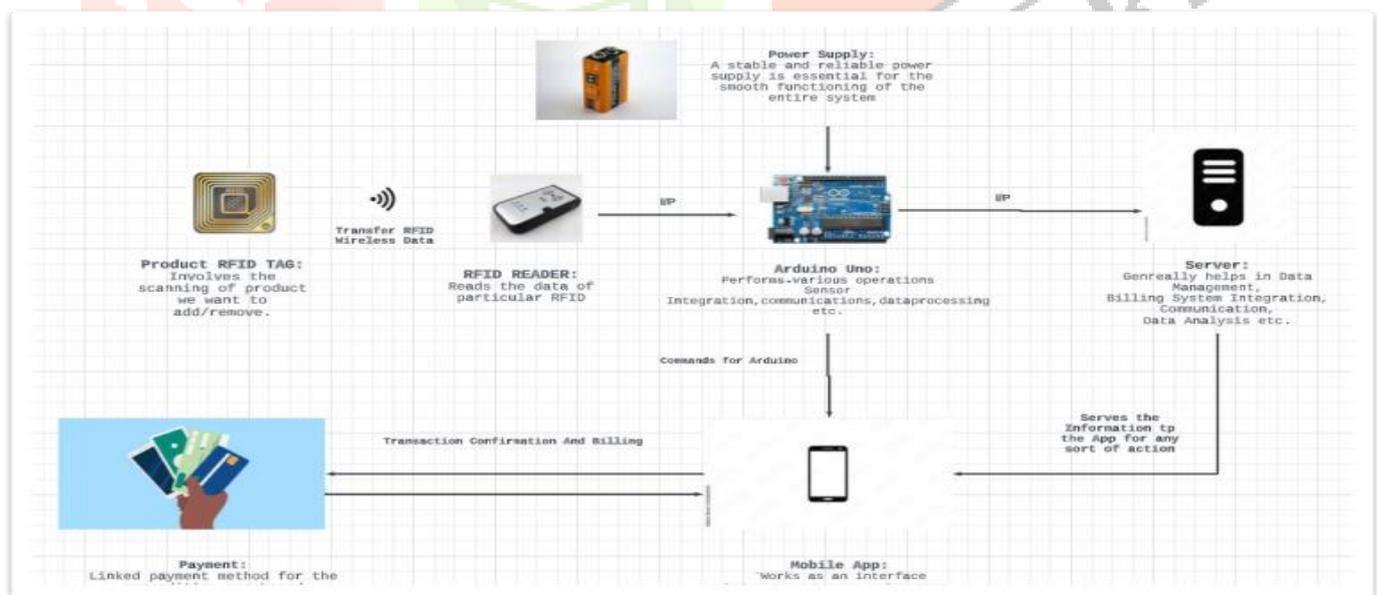

Fig.1 Proposed System for Smart Cart

Our proposed system benefits both the Business authorities as well as the customer. Business authorities no longer need to deploy a person to individually scan each product and complete the billing process. Hence saving the manual resources for the retailers and Customers no longer need to wait in long and slow-moving queues as the process is now fully automated and throughput is highly increased.

We Also have some added perks for retailers as our proposed system will help them have utmost accuracy in the billing process as our fully automated process will help eliminate manual errors. Also, further this system can be integrated with the inventory management system or stock management system of the shop to sync the data and reflect real-time information to the customer.

 Personalized recommendations can be given on the customer's interface based on their past purchases. Also targeted advertisements can be done based on this information.

Hence we can say that our proposes system i.e. An IoT based smart cart which utilized RFID mechanism provides various advantages over the existing traditional and manual retail cart system. Making the customer shopping experience rapid, well organized and more user-friendly.

Components Used :-

A.   Hardware -

1.   Esp32 – A module which is a low cost, low power system based on a chip microcontroller which is unified with Wi-Fi and dual mode Bluetooth.

It will be used in our project to help connect our system to other devices through the local network or internet which provide us real-time data transfer and remote control.

2. RFID Reader– It is a wireless composition comprising two parts: tags and readers. The reader is the part that has one or more antennas that emit radio waves and receive signals back from the RFID tag.

w.r.t our system, it will help us to detect products when inserted in our cart with the help of RFID reader attached on each product.

3. RFID tag - Each product is associated with a tag which helps us gain necessary information about products like product name, category, price etc.

4. Battery – To power and enhance functionality of our system. It helps our system to gain mobility and become independent of constant power source constraints.

5. LED – help us achieve a better user experience and enhance functionality by providing following features –

a. Status indicator – to gain knowledge about whether our system is in active state, inactive state or alarming situation.

b. RFID read confirmation – will provide us an acknowledgement whether the RFID read operation was successful or not and whether the product was read successfully.
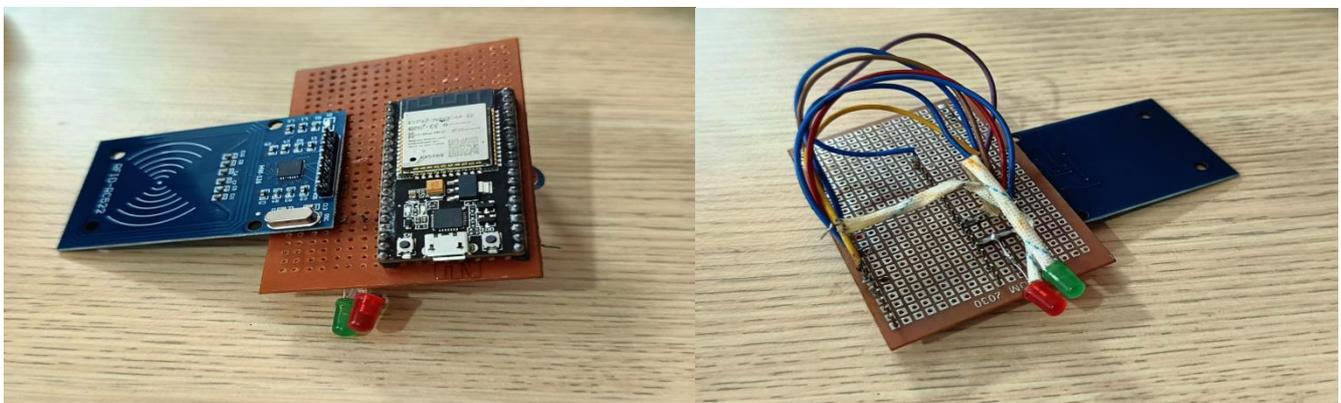

Fig.2 Smart Cart Component Architecture

V. RESULTS AND DISCUSSION

A straightforward but effective approach for improving the effectiveness and accuracy of billing in various types of setups can be achieved by developing a smart billing system utilizing Arduino and RFID tags. This is achieved through attaching RFIDs on all goods. The system comprises an RFID tag that is connected to a reader linked to an Arduino when a customer puts a product into their shopping basket. It identifies the product and charges the customer's bill thereafter.

When the customer is done with shopping, he or she will scan his/her RFID tag at the cashier desk and pay. When all is said and done, Arduino will come up with a sum total that will be displayed on the billing screen. Upon receipt, the customer pays with a convenient type of payment.

The smart billing system has a number of benefits, including:

1. Reduced queues: This allows customers to pay quickly for purchases and get out fast without waiting in line.
2. Improved accuracy: It ensures that there is no room for human error in billing.
3. Increased efficiency: It has also enhanced efficiency and allowed processing of transactions much quicker compared to conventional billing techniques.
4. Reduced costs: The system, for instance, could enable businesses to cut down on their labor costs thereby increasing profit margins.

The smart billing system also boasts of being user friendly as it is easy to install and operate. The two components like the arduino microcontrollers and RFIDs also come cheaply but are equally efficient as well. Consequently, the smart billing system is an appropriate choice for businesses in different sizes.

Here is an example of how the smart billing system could be used in a retail store:

1. The RFIDs would be put into every product, which could then be tracked.
2. An RFID tag would be provided to the customers as they entered the store.
3. It is anticipated that arduino interfaced with RFID readers will scan RFID labels on items within such shopping carts as consumers make them.
4. The Arduino system identifies the products and updates the bill of the client.
5. A customer could then get his tag scanned as he is ready for an exit from the store.
6. At the check out, the Arduino would work out the total price and display it on the screen.
7. The customer could then use his favorite method of paying.
8. A flexible and effective smart billing system for multiple applications. It has proven that it can be implemented easily and maintained with little effort. A business organization can also leverage on the SCRM model in order to improve its customer services and eventually cut down the cost of production thereby increasing profitability.

VI. FUTURE SCOPE

Undeniably, studies have been carried out on the idea of smart carts that is automated billing through Arduino which is the basis of advanced technology in the retail business sector. Therefore, there are a number of directions on which the future research might be focused. The first step in this regard would be to increase the system's scalability towards bigger retailers and various products. For instance, this could entail optimization of the hardware and software elements to facilitate uninterrupted operation in a busy shopping environment.

Further, reengineering of the user interface in order to address a wider range of users' demographics as well as the level of expertise would greatly enhance user experience. User-centered journey for smart shopping could be achieved by designing simpler interfaces, and collecting customer feedback directly.

Additionally, it is possible to look at other technologies with regard to integrating additional in real time inventory management and product traceability. Predictive analytics can also be used to predict customer preferences and optimize product placement within the cart would take the system a notch higher.

Moreover, incorporating contactless payment options while assessing interoperability with mobile apps could modernize the checkout method that accommodates current shopper tastes and business practices.

Moreover, carrying out comprehensive feasibility tests that take into account factors like cost, maintenance and replication to confirm the economical advantage in different retail environments is lastly important for the validation of this system's market success.

Future research can focus on these elements that will add onto the already existing framework. These will continue shaping how smart shopping carts with automated billing can be implemented in the retail industry for transformation of this sector.

VII. CONCLUSION

The research culminates in an insightful analysis of the integration of an Arduino-based automated billing system within a smart shopping cart, highlighting its transformative impact on the contemporary retail landscape. The study underscores the system's efficiency in expediting the checkout process and minimizing errors, ultimately leading to heightened customer satisfaction and operational efficacy. By emphasizing the seamless amalgamation of advanced technology and user-centric design principles, the research underscores the potential of the smart shopping cart to significantly enhance the overall shopping experience for consumers. The comprehensive exploration of the system's implementation and user interface design solidifies its practicality and accessibility, laying a robust foundation for further advancements in the realm of modern retail technologies. As the paper draws to a close, it illuminates the promising trajectory of such innovations, encouraging continued exploration and refinement within the domain of smart retail solutions.

VIII. ACKNOWLEDGEMENT

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