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RFID TAG-BASED SMART TROLLEY SYSTEM FOR AUTOMATED BILLING AND CONTACTLESS SHOPPING

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Abstract— **The RFID Tag-Based Smart Trolley is an innovation designed to change the way people shop, as it is able to automate the entire billing process. The system is able to combine RFID technology with an intelligent trolley that automatically scans each item added to the cart by customers. The system then displays real-time pricing for every product, meaning that customers will be able to see the total cost of their purchases instantly while shopping. Moreover, through the integration into the store payment gateway, payments can be accomplished directly from the trolley of the smart self-service cart: contactless with no human mediation. This dispenses with laborious manual entry at the end of the lines at the exit counters, saving on human fault and accelerating check-out time; besides, having fewer cashiers and checkout counters makes the shops safer and nicer to shop for, especially with a high consumer traffic.**

Keywords— **Real-time pricing, total cost, store payment gateway, contactless payments, self-service cart, check-out time, consumer traffic, safer shopping, fewer cashiers and exit counters**

I. INTRODUCTION

Most often, retail outlets encounter long checkout lines, unattractive billing methods, and even high labor expenses, which really affect customer satisfaction and performance for the outlet itself. Generally, long checkout line times have angered customers as well as spoiled the shopping experience with a tendency for them to turn to alternative shopping destinations. These inefficiencies do not only affect customer retention but also increase operational costs for businesses, thereby making it important for retailers to embrace more advanced and automated solutions.

To address this concern, such a system merges radio frequency identification to make buying easier and improve the billing processes involved. To execute this scenario, RFID-enabled items are carried while an RFID reader is deployed on a 'smart trolley', which upon detection of item tag, identify what has just entered the shopper's cart.

Unlike traditional barcode scanning, RFID can detect several products at a rapid pace, therefore saving time associated with manual scanning at the cash counters. On adding an item to the shopping trolley, the system reflects the same addition in the real-time purchase list, showing its details and price on an integral display unit. This real-time tracking allows customers to keep track of their expenditures as they go about shopping, thus increasing transparency and convenience.

II. PROPOSED ALGORITHM

A. Hardware Set-up –

In Fig.1 This illustrates the Architecture for the proposed When an RFID tag comes into the range of the RFID reader, the RFID reader reads data from the tag. The Arduino microcontroller then processes the data and decides on the action it needs to be taken, whether it is switching the LED ON or OFF, or sending the data to the web page. The Arduino microcontroller sends commands to the appropriate LED and IoT module. The IoT module sends the data to the web page. The web page displays data to the user.

Automated trolley shopping system consists of a number of important components functioning in coordination with each other. The RFID tags containing product data are attached on products and the RFID reader along with the antenna is used for reading the tags for real-time updating of shopping list. All the inputs of various sensors and components are managed at the central point by the microcontroller.

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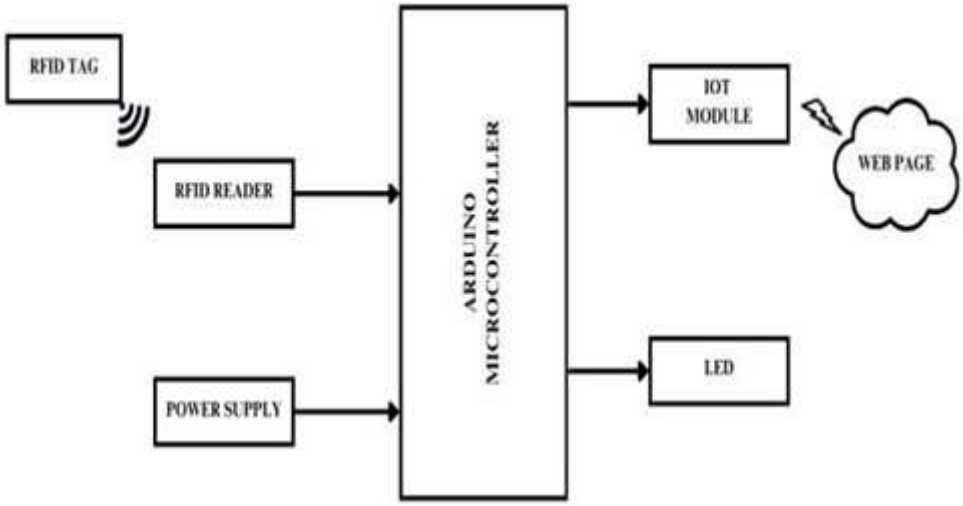

Fig. 1. Architecture for proposed Approach

The LCD or touch screen provides a user-friendly interface for clients to track purchase and overall expenditure. An active power source provides steady power to all the electronics, while a WiFi / Bluetooth module can be used for data sharing with external systems like billing and inventory management.
A weight sensor as an optional feature confirms the quality and security by checking the availability of products in the cart to prevent theft and miscalculation. Integrating these elements generates a smart, efficient, and consumer-friendly shopping experience.

B. Workflow –
In Fig 2. is the process wherein the shopping takes place. The self-shopping system using auto-cart is a relaxed process to enhance the shopping experience. The shopper selects an item from the shelf of the supermarket, and every product is tagged with an RFID tag containing identification information.
Placing the product in the RFID cart, the RFID reader captures the product and adds or deletes it automatically from the cart without scanning the product manually. The LCD display indicates a running tally of what has been added or taken away and the prices, allowing consumers to know what they have done.
Meanwhile, transaction data is sent to the store, where it updates the inventory and allows for billing. The final amount is shown on a web page, complete with item details, prices, offers, and tax for maximum openness. When the customer continues to checkout, he checks his previous bill before a secure online payment through cards or e-wallets, such that the transaction is encrypted.
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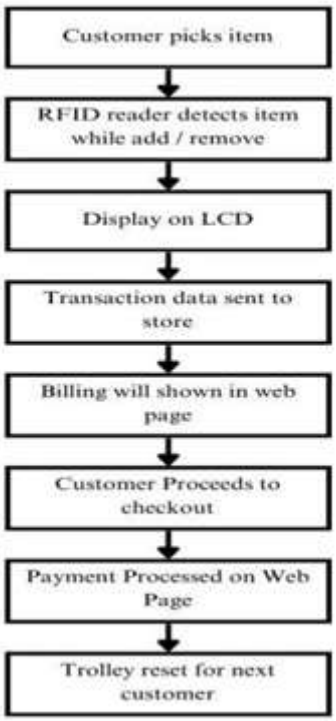

Fig. 2. Architecture diagram for Workflow

Lastly, the trolley is reset for the next user, clearing previous transaction records and restoring the system to default settings, such that the shopping experience is smooth, seamless, and user-friendly

III. EXPERIMENT AND RESULT

The Smart trolley kit Fig 3 has core elements comprise of an RFID Reader (EM-18 Module) which captures and transmits tag ID from attached tags on the product to a microcontroller

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that can be any Arduino or embedded board. It takes the details about the products in a database for processing to finally compute the amount to be charged.

Along with this, there is a 16x2 LCD Display for displaying names and prices of all products along with the amount totalled at hand. The system also contains a Bluetooth module, either HC-05 or HC-06 for wireless communication to a smartphone or a central billing system to make online payments and automatically checkout. The DC barrel jack or battery serves as a power source, while multiple jumper wires connect various components.

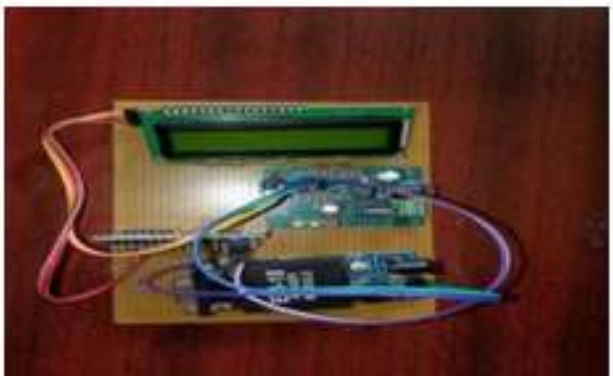

Fig. 3. Smart Trolley Kit

In the Billing page Fig 4. The technology in the above statement is automatic shopping and billing using it, or RFID, thus making the experience in retail more swift and efficient. The interface for the website will be something like "RFID Smart Trolley System", with a heading underneath that might say "Automated Shopping Experience" - really all about bringing checkout into its simplest form. Under the heading, the "Delete Data" button will clear all previous records of transactions so that the system resets the billing, or clears out the user or store staff from misentries to ensure correct data updating is accessible.

The three columns of the billing table are Bill No, which is a unique number assigned to a particular transaction for easy tracing; Date & Time, which records the time at which the purchase was made for maintenance of logs of the transaction; and Purchase Details comprise RFID tagged products and the details of the same present in the cart. There also exists a "Print Bill" button on the bottom so that the customers do not have to scan the bar codes at the counter in order to print the final bill. This system is on RFID tags attached to every product carrying unique identification codes.

Fig. 5. Billing Page

Every time the customer puts the product in the trolley, it captures the tag read by the RFID reader, fetches all details regarding the product from a predefined database, and then updates the bill in real time. In case a customer takes out a product from the trolley, it detects the difference and adjusts the bill. Bluetooth or Wi-Fi enable the transfer of data wirelessly, allowing for the direct bill to be sent to a mobile app or the store's billing server for online payment and automatic checkout.

Avoiding the bar code manual scan saves lots of time at the checkout counter, reduces errant human mistakes, and offers an enjoyable shopping experience. It also allows retailers to manage their inventories more effectively by tracking sales in real-time, hence ensuring effective stock management. In general, this system represents an aspect of smart retail automation and offers a modern, customer-friendly, and time-saving solution for shoppers as well as the management of stores

IV. CONCLUSION

Even beyond assisting with the customer experience, the RFID Tag-Based Smart Trolley System also benefits retailers in a number of ways by optimizing retail store functions and overall efficiency in operating processes. The traditional checkout counter demands manifold manpower and increases labour costs and human mistakes made while preparing bills and inventories. Because it automates this checkout process, it reduces the reliance on cashiers, and many retail workers are diverted to assist customers or manage their stores instead.

Further, real-time inventory tracking ensures that the stock levels get automatically updated in case customers are adding or removing items from their trolleys and helps retailers minimize discrepancies in stock, prevent theft, and manage their supply chain effectively. Cashless payment includes mobile wallets and contactless cards, which can increase convenience in that they do not take long to complete the transaction and leave room for an easy, no- queueing shopping environment.

With this, the system may be used along with loyalty programs and personalized promotions that allow a store to have an analysis of shopping patterns, thus giving specific discounts on items to make the customers go back and stick to the place. And so the trolley system based on RFID, armed with the development of IoT, AI, and smart automation, is good to go to create the most fully digital and integrated shopping experience possible, one that maximizes efficiency, accuracy, and convenience to the consumers and businesses

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