

Innovative Retail Solutions: The Implementation and Impact of Smart Billing Trolleys using Design Thinking Approach

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Abstract:

The majority of families in the twenty-first century enjoy going shopping at malls and shopping centers. Shopping is simple, but the process of waiting at a bill counter thereafter is rather dull and monotonous. In stores, traditional billing processes frequently suffer from inefficiencies and a lack of real-time data integrating, which can cause problems including lengthy lines, human error, and sluggish transaction processing. To optimize billing, improve customer experience, and give retailers accurate and current sales data, a Smart Billing Trolley solution that seamlessly combines cutting-edge technologies is required. In the end, this solution should improve the overall operational efficiency of the retail institution by addressing concerns with billing process speed, accuracy, and customer happiness.

Keywords —Smart trolley, RFID , Arduino , billing system.

I. INTRODUCTION

overall operational effectiveness of the retail establishment by resolving issues with the accuracy, timeliness, and satisfaction of the billing process. The project's primary goals are to please the client and cut down on the amount of time spent on billing by completing the procedure in the cart rather than standing in queue, even for a single item or two. After a quick scan of the cart, customers must add the items. The total will appear in the trolley once the shopping is complete. The consumer had two options for paying their bill: using the shop-provided pre-recharged customer card. Ultimately, the entire data set will be transmitted to the mall's central computer. Here, we've created a creative project.

II. LITERATURE SURVEY

A. The retail industry is experiencing a notable metamorphosis, propelled by the assimilation of digital technology to optimise consumer

experiences and optimise processes. The smart billing trolley is one cutting-edge idea that is gaining popularity. This review of the literature is to investigate the creation, application, and consequences of smart billing trolleys, especially from the perspective of the design thinking methodology, which prioritises user-centred and iterative design.

B. Evolution of Retail Technology

The following technology developments have signalled the transition from traditional retail to digital solutions:

Point-of-Sale (POS) Systems: By digitising transactions, increasing accuracy, and decreasing manual errors, POS systems first transformed the retail industry.

Self-Checkout technologies: By enabling customers to scan and pay for things on their own, these technologies further expedited the checkout process and cut down on labour expenses and wait times.

Mobile Payment Solutions: Contactless and mobile wallets have made payments more convenient for consumers and sped up transaction times.

III. DESIGN THINKING APPROACH

When creating smart billing trolleys, the design thinking methodology is essential since it emphasises user needs analysis, design iterations, and solution testing. Usually, the process consists of five steps:

Empathise: Recognise the difficulties consumers encounter in typical retail settings, such as protracted checkout queues and challenging product placement.

Define: Putting the issue in clear terms, such as the need for a more effective and pleasurable purchasing environment.

Ideate: Coming up with a broad range of feasible fixes, such as incorporating different features and technology into a smart tram.

Prototype: Creating smart tram prototypes to test with actual users and get their input on usability and efficacy.

Test: Iterating through the design in response to user feedback until a solution that satisfies the needs is found

IV. FLOW DIAGRAM AND ITS DESCRIPTION:

This flowchart represents the typical operation of a smart billing trolley system. It illustrates the sequence of operations from system initialization to scanning products, displaying information, adjusting for item removal, and calculating the total cost. The flowchart ensures that the system operates efficiently, providing real-time updates and an accurate total amount for the user's purchases.

RFID Tag:

An RFID (Radio Frequency Identification) tag is attached to each item in the trolley. These tags store unique identification information about the items.

RFID Reader:

The RFID reader scans the RFID tags to read the information stored in them. It transmits the data to the Arduino Uno for processing. The reader uses

radio waves to communicate with the tags and retrieve their stored information.

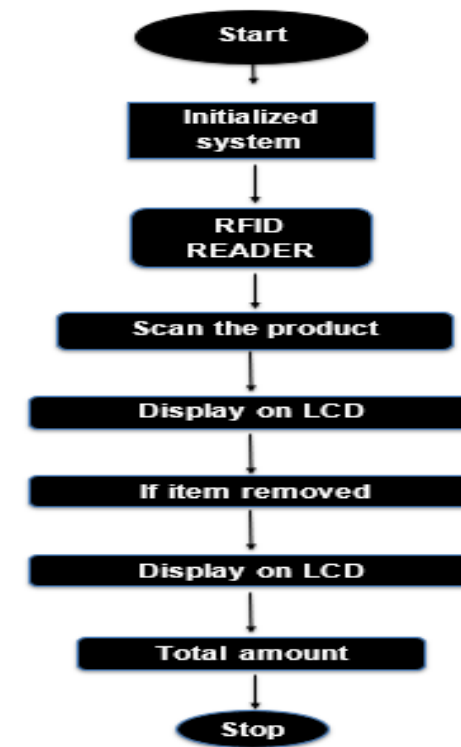


Fig. 1Flow diagram of smart trolley working principle

Arduino Uno:

Arduino Uno is a microcontroller board that acts as the brain of the system. It receives data from the RFID reader, processes the information, and sends appropriate commands to the LCD display. The Arduino Uno can be programmed to handle various tasks, such as calculating the total bill and keeping track of the items in the trolley.

LCD Display:

The LCD (Liquid Crystal Display) displays the information processed by the Arduino Uno. It shows details such as the names of the items, their prices, and the total bill amount. This allows customers to keep track of their purchases in real-time.

Working Principle :

When an item with an RFID tag is placed in the trolley, the RFID reader detects the tag and reads its information. The RFID reader sends the item information to the Arduino Uno. The Arduino Uno

processes the data, such as identifying the item and retrieving its price from a pre-stored database.

The Arduino Uno then sends the relevant details to the LCD display. The LCD display shows the item's name, price, and updates the total bill accordingly. This system simplifies the shopping experience by automating the billing process, reducing the need for manual scanning at checkout counters, and providing real-time updates to the customer.

RESULTS

The image consists of two bar graphs comparing customer checkout times before and after the implementation of smart billing trolleys, as shown in Fig. 2.

Key Observations:

Before Implementation:

It takes 25 minutes to process 100 customers.

There is a slower increase in the number of customers processed as time progresses.

After Implementation:

It takes only 10 minutes to process 100 customers.

There is a much faster increase in the number of customers processed within a shorter time frame.

Interpretation:

Efficiency: The smart billing trolley significantly reduces the checkout time, enhancing the overall efficiency of the billing process.

Operational Improvement: The deployment of smart billing trolleys demonstrates a marked improvement in the throughput of the checkout process, indicating a successful implementation of technology in retail operations.

Customer Satisfaction: With faster processing times, customers experience shorter wait times, likely leading to higher satisfaction levels.

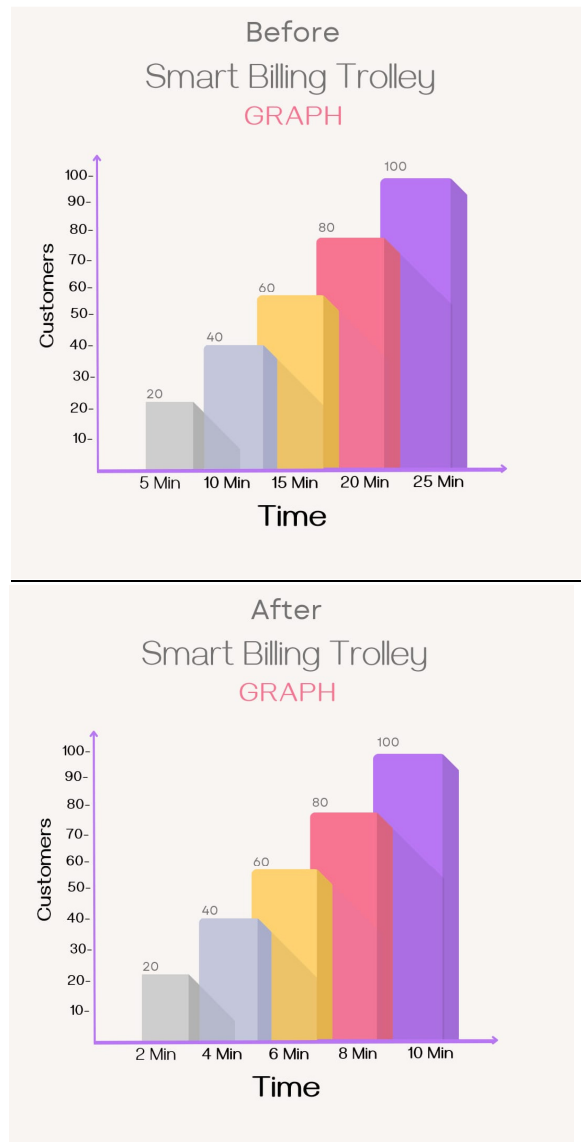


Fig. 2 A sample bar graph represent customer vs Time for smart billing trolley mechanism before and after implementation in shopping

This comparative analysis illustrates the substantial impact of smart billing trolleys on reducing checkout times and improving the customer experience in retail environments.

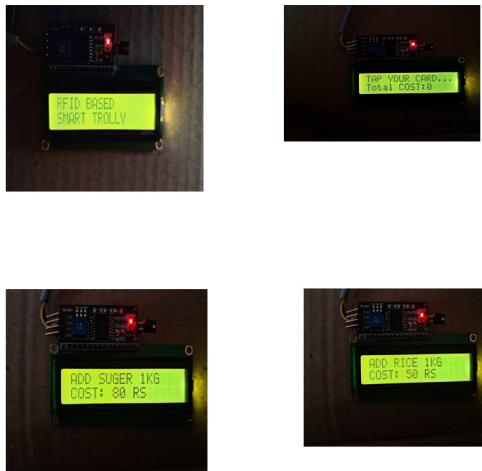


Fig. 3Results of smart trolley system in LCD Display

The image displays various stages of an RFID-based smart trolley system using an LCD display and microcontroller setup. Here is a detailed description of each section:

Top Left:

Message: "RFID BASED SMART TROLLY"

Description: This display likely shows the initial startup or welcome message when the smart trolley system is powered on. It indicates that the system is ready for use.

Top Right:

Message: "TAP YOUR CARD... Total COST: 0"

Description: This display instructs the user to tap their RFID card. The "Total COST: 0" indicates that no items have been scanned yet, and the initial total cost is zero.

Bottom Left:

Message: "ADD SUGAR 1KG COST: 80 RS"

Description: This display shows the details of an item that has been added to the trolley. It indicates that 1 kilogram of sugar has been scanned and added to the cart, with a cost of 80 rupees.

Bottom Right:

Message: "ADD RICE 1KG COST: 50 RS"

Description: Similar to the previous display, this shows that 1 kilogram of rice has been added to the trolley, with a cost of 50 rupees.

V. CONCLUSIONS

By utilizing digital technologies to close the gap between traditional and digital retail, smart billing trolleys are a major achievement in the retail industry. In order to create solutions that are both efficient and focused on the needs of the user, design thinking is essential. Smart billing trolleys are a promising invention in the changing retail landscape, even though there are several issues that need to be resolved. The potential advantages for both customers and retailers are substantial.

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