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E-Trolley with Cloud Billing System Using IOT Technology

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Abstract **- The E-Trolley with Cloud Billing System is designed to revolutionize the conventional shopping experience by integrating modern automation and IoT technologies. The system combines an ESP32 microcontroller, barcode scanner, LCD display, and WiFi connectivity to enable real-time product scanning and automatic billing. Shoppers can conveniently scan items as they shop, with the product details and total bill being displayed instantly on the trolley's LCD screen. The ESP32 microcontroller processes the barcode data and communicates with a cloud platform, powered by Blynk software, to store billing information securely. This eliminates the need for manual billing at checkout counters, drastically reducing queue times and improving the overall efficiency of supermarket operations.**

Keywords: E-Trolley, ESP32, IOT, Blynk, Proteus, software.

I. INTRODUCTION

The E-Trolley with Cloud Billing System is an innovative solution designed to transform traditional shopping methods by automating the billing process and enhancing customer convenience. At its core, the system integrates key hardware components such as an ESP32 microcontroller, barcode scanner, LCD display, voltage regulator, motors, and a 12V battery. These components work together to create a selfservice, real-time billing platform within a supermarket environment. The trolley allows customers to scan products directly as they shop, providing immediate feedback on product details and their total bill. This reduces dependency on manual checkout counters, which are often bottlenecks during peak shopping hours.

The ESP32 microcontroller plays a vital role in managing the entire operation of the system. It is programmed using Embedded C via the Arduino IDE, making it highly efficient in real-time processing. As the customer scans each product using the barcode scanner, the ESP32 processes the barcode data and retrieves product details such as name, price, and quantity. The retrieved information is instantly displayed on an LCD screen mounted on the trolley, offering shoppers a transparent and interactive shopping experience. Any errors during scanning prompt the customer to rescan the item, ensuring accuracy throughout the process.

One of the standout features of this system is its seamless cloud integration. The ESP32 uses its built-in Wi-Fi capabilities to connect to the cloud platform through Blynk software. Each scanned product's data is transmitted to a centralized cloud database, which stores the information securely. This enables customers to track their ongoing purchases not only on the trolley's display but also via a mobile application or web dashboard linked to the Blynk cloud. Real-time data synchronization ensures that customers and store management have access to updated billing information anytime, making the entire system efficient and transparent.

1.1 Scope of Project

The E-Trolley with Cloud Billing System has a wide and impactful scope, both in current retail applications and in future technological advancements. Its primary scope revolves around revolutionizing the conventional shopping experience by providing customers with a selfservice trolley capable of real-time billing and inventory management. By incorporating essential components such as the ESP32 microcontroller, barcode scanner, LCD display, and Blynk cloud platform, the system streamlines the checkout process and reduces human intervention. This not only minimizes long queues at billing counters but also enhances the efficiency of retail store operations, especially during peak shopping hours when customer footfall is high. The use of cloud-based integration allows for easy scalability and adaptability in various retail environments, ranging from supermarkets and hypermarkets to departmental stores

1.2 Challenges Ahead

One of the primary challenges encountered during the development and implementation of the E-Trolley with Cloud Billing System was the integration of multiple hardware

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components and ensuring seamless communication between them. The system incorporates various elements, including the ESP32 microcontroller, barcode scanner, LCD display, battery, voltage regulator, and SPST switch. Each of these components has its specific voltage requirements, communication protocols, and interfacing techniques.

Ensuring smooth and stable data transmission between the barcode scanner and the ESP32, especially over serial communication, required careful calibration and configuration. Additionally, power management posed a significant hurdle; the system needed to provide adequate power to all components without voltage drops or interruptions, making the design and stabilization of the power supply circuit crucial.

II. LITERATURE REVIEW

The 'E-Trolley with Cloud Billing System' represents a significant advancement in retail technology, aiming to streamline the shopping experience by integrating automation and realtime data processing. This system addresses common challenges in traditional retail environments, such as long checkout lines and inefficient billing processes, by empowering customers to manage their purchases directly through a smart shopping cart equipped with advanced technologies.

The concept of smart shopping carts has been explored extensively in recent years, with various studies proposing innovative solutions to enhance the retail experience. A notable example is the development of a smart shopping cart integrated with IoT-based automatic billing systems, utilizing RFID technology to automate the billing process. In this system, each product is equipped with an RFID tag, and the shopping cart is fitted with an RFID reader that scans items as they are placed into the cart. This real-time scanning updates the total bill on an LCD display attached to the cart, allowing customers to monitor their expenses as they shop. The integration with IoT platforms facilitates seamless data management and enhances inventory tracking for retailers.

2.1 Historical Perspective

The evolution of shopping methodologies has been profoundly influenced by technological advancements, leading to the development of systems like the 'E-Trolley with Cloud Billing System.' Traditionally, shopping involved manual processes where customers selected items and proceeded to checkout counters staffed by cashiers who manually scanned each product and processed payments. This conventional approach, while functional, often resulted in long queues and extended waiting times, especially during peak shopping periods. The inefficiencies inherent in this system highlighted the need for more streamlined and automated solutions.

The advent of barcode technology in the late 20th century marked a significant shift in retail operations. Barcodes allowed for faster and more accurate recording of products at checkout, reducing human error and speeding up the billing process. However, despite this improvement, the dependency on cashier-operated terminals remained, and the overall shopping experience still involved considerable waiting times during the payment phase.

III. METHODOLOGY

The development of the E-Trolley with Cloud Billing System began with identifying the challenges faced in traditional retail shopping, particularly the bottlenecks during the checkout process. The methodology aimed to address this problem by creating a smart, automated trolley system that integrates real-time product scanning, billing, and cloud synchronization. The first step involved selecting appropriate hardware components, starting with the ESP32 microcontroller, chosen for its low power consumption, builtin Wi-Fi capabilities, and suitability for embedded systems. The ESP32 serves as the central controller, interfacing with the barcode scanner, LCD display, motors, and cloud server to process and manage all functions.

The next phase involved setting up the barcode scanner interface with the ESP32. The barcode scanner is responsible for capturing the product's unique identification code, which is sent to the ESP32 for processing. The microcontroller, programmed in Embedded C using the Arduino IDE, decodes the scanned data and cross-references it with a pre-loaded or cloud-based database to retrieve the corresponding product details such as name, price, and quantity. These details are then displayed to the customer via the LCD screen, ensuring transparency and providing real-time of the feedback about each scanned item and the cumulative bill.

IV. BLOCK DIAGRAM

The block diagram of the E-Trolley with Cloud Billing System illustrates the seamless interaction between various hardware and software components designed to automate and simplify the shopping experience. At the heart of the system is the ESP32 microcontroller, which acts as the central processing unit, coordinating all operations. Connected to the ESP32 are the barcode scanner for scanning product barcodes, and an LCD display that shows product details, prices, and the running total bill to the customer in real-time. The system is powered by a battery regulated through a voltage regulator to ensure stable power supply to all components. A SPST switch is included to control the power on/off state of the trolley system. Through the built-in Wi-Fi module of the ESP32, the trolley communicates with the Blynk Cloud Platform, transmitting billing data to a central database and customer

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mobile application. This integration allows both the customer and supermarket operators to track purchases and inventory in realtime. The block diagram provides a clear, structured overview of how each component functions in coordination to streamline billing and enhance the shopping process.

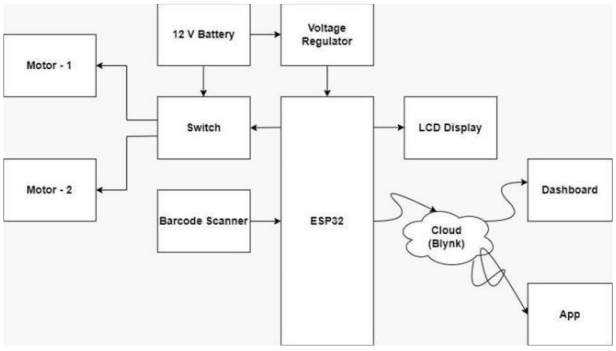

Figure 1: Block Diagram of E-Trolley

V. COMPONENTS

1. ESP32 Microcontroller

The ESP32 microcontroller is the central processing unit of the system. It is a highly versatile, low-power microcontroller with built-in Wi-Fi and Bluetooth capabilities, making it ideal for IoT applications like the E-Trolley. The ESP32 manages data communication between all hardware components and facilitates real-time data transmission to the cloud. It receives product information from the barcode scanner, processes the scanned data, calculates the cumulative bill, and sends this data to the cloud using Wi-Fi connectivity. Its ability to handle multiple input/output pins allows it to control the LCD display, motor drivers, and switches efficiently.

Figure 2: ESP32 Microcontroller

2. Barcode Scanner

The barcode scanner is a critical component used to identify each product uniquely. When a customer scans a product, the barcode scanner reads the barcode printed on the product packaging, which contains product information such as product ID or Universal Product Code (UPC). The scanner sends this information to the ESP32 for decoding. Once decoded, the corresponding product name, price, and other details are fetched from a pre-loaded database or cloud server. The barcode scanner thus eliminates manual entry errors and speeds up the billing process, ensuring accuracy and efficiency.

Figure 3: Barcode Scanner

3. Battery (12V Rechargeable Battery)

The system is powered by a 12V rechargeable battery to make the trolley self-sufficient and mobile. The battery supplies power to all electronic components, including the ESP32, barcode scanner, LCD display, and motors. Its rechargeable nature ensures long-term usability, and the battery can be charged during non-peak hours. A reliable battery source allows the trolley to operate wirelessly without being tethered to a power outlet, providing flexibility and ease of movement within the supermarket.

4. Voltage Regulator

A voltage regulator is used to stabilize and regulate the voltage supplied by the battery. Since the battery provides 12V, but sensitive components like the ESP32 and LCD display typically require 5V or 3.3V, the voltage regulator steps down and maintains a constant voltage level suitable for each component. This prevents voltage fluctuations that could damage the microcontroller or peripherals, ensuring smooth and safe operation of the entire system.

5. LCD Display

The LCD display serves as the user interface for the customer. It displays real-time information about scanned products, including product name, price, and the total amount due. Customers can view their ongoing bill, which enhances transparency and convenience. The display is directly controlled by the ESP32, and updates dynamically as new products are scanned or removed. This display reduces confusion and improves customer satisfaction, as shoppers are always aware of their purchases and running total.

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Figure 4: LCD Display

6. SPST Switch

The Single Pole Single Throw (SPST) switch is used to control the power and operation of the trolley. It acts as an on/off button for starting or stopping the system and may also be used to reset the billing process. It simplifies the trolley's operation, allowing customers or store staff to control the system manually when required. The switch enhances user accessibility, especially for non-technical users.

Figure 5: SPST Switch

7. Motors

Motors are integrated into the trolley to aid in its movement and navigation within the supermarket. Controlled by the ESP32 via motor driver circuits, the motors can help in reducing the physical effort required to push the trolley. Depending on future enhancements, motors could be programmed to follow the customer, stop at designated zones, or assist in automated parking of the trolley. This motorized functionality adds a modern touch and improves the overall customer experience.

8. Blynk App (Cloud Integration)

The Blynk app acts as the cloud platform interface for both customers and store management. It is used to sync real-time data from the trolley to the cloud, allowing customers to access their bills on their smartphones. Store managers can also use Blynk's dashboard to track inventory levels, monitor sales data, and oversee billing activities. The app enhances transparency, facilitates paperless billing, and supports data driven decision-making for supermarket operators.

In summary, the E-Trolley system combines powerful microcontrollers, reliable power management, efficient user interfaces, and seamless cloud connectivity to create a smart and user-friendly shopping solution. Each component plays a specific role in ensuring real-time product scanning, accurate billing, and enhanced customer convenience, all contributing to a more modern and efficient retail environment.

VI. CIRCUIT DIAGRAM

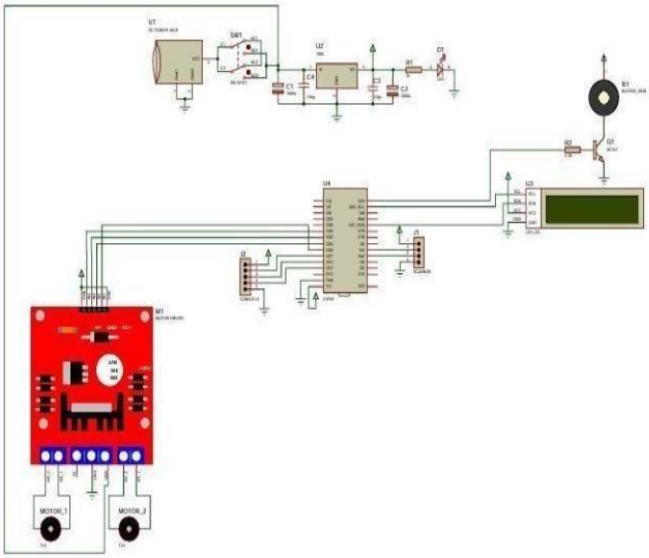

Figure 6: Circuit Diagram of E-Trolley

VII. RESULT

The E-Trolley with Cloud Billing System yielded significant and measurable results upon implementation, underscoring its effectiveness in revolutionizing the conventional retail experience. One of the primary outcomes observed was a notable reduction in customer wait times at checkout counters. Traditional shopping environments are often plagued by long queues during peak hours, which can lead to customer dissatisfaction and lost sales opportunities. However, with the E-Trolley system in place, customers were able to self-scan products in real time as they navigated the store, thereby eliminating the need for manual checkouts. This autonomy not only increased operational efficiency but also improved customer throughput, allowing more individuals to complete their purchases in a shorter time frame.

The integration of an ESP32 microcontroller, barcode scanner, and LCD display proved to be effective in facilitating seamless interaction between the customer and the trolley system. Customers could easily scan items, view product names and prices on the display, and monitor their cumulative bill as they continued shopping. This real-time visibility empowered shoppers to better manage their budgets and purchase decisions, reducing instances of surprise or confusion at checkout. Additionally, store staff was relieved from some of the manual labor associated with billing, enabling them to focus on customer service and inventory management, thereby enhancing overall store workflow.

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VIII. PROJECT PHOTO

Figure 7: Project photo

IX. CONCLUSION

The E-Trolley with Cloud Billing System represents a significant step forward in transforming the traditional retail environment into a smart, efficient, and customer-friendly ecosystem. Through the strategic integration of cutting-edge components such as the ESP32 microcontroller, barcode scanner, LCD display, and cloud-based applications, the system successfully addresses the long-standing challenges faced in supermarkets, particularly those related to long queues, manual billing errors, and inventory mismanagement. The system allows customers to actively participate in the billing process by self-scanning items as they shop, giving them complete control and real-time visibility over their purchases. This empowers shoppers, making their experience more interactive, seamless, and time-saving.

From the store management perspective, the system introduces a new level of efficiency by automating billing processes and streamlining data handling through cloud connectivity. This eliminates the need for manual entry, reduces human errors, and enables real-time inventory updates, which is crucial for stock management and demand forecasting. Furthermore, the cloud integration ensures scalability, making it easier for store operators to adapt the system across multiple branches without the need for substantial.

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