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Auto Billing Follow me Shopping Cart

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ABSTRACT: The "AutoBilling FollowMe Shopping Cart" project presents a comprehensive solution to enhance the retail shopping experience by integrating automation for both cart mobility and billing. The system is built around an Arduino Uno microcontroller, which orchestrates two primary functionalities. First, the cart features an autonomous "Follow-Me" mechanism utilizing two IR sensors for line tracking and an ultrasonic sensor to maintain a safe following distance, automatically stopping when the user pauses. A dedicated ON/OFF switch provides user control over the trolley's movement.

Second, the project implements an automated billing system using RFID technology. Each product is tagged with a unique RFID card. A mode selection switch toggles between 'Add' and 'Remove' modes. In 'Add' mode, scanning an item adds it to the bill, displaying its name and price on an integrated LCD screen while updating the running total. In 'Remove' mode, re-scanning an item deducts it from the bill. This seamless process provides real-time bill management, eliminating checkout queues. By combining intelligent navigation with instant automated billing, this project significantly reduces manual effort, saves time, and paves the way for a futuristic "just walk out" shopping paradigm.

KEYWORDS: autobilling followme shopping cart, real time bill management, manual effort reduction, RFID tagged products, price display, item scanning, automation .

I. INTRODUCTION

The contemporary retail landscape, while increasingly digitized, still relies on a traditional in-store shopping model that presents significant inefficiencies for the end-user. Customers are required to manually navigate stores, push physical carts, and often endure lengthy queues at checkout counters. This process is not only time-consuming but also contributes to a less-than-optimal shopping experience. The final step of billing, in particular, represents a critical bottleneck, leading to customer frustration and operational delays for supermarkets.

To address these challenges, this project proposes the development of an "AutoBilling FollowMe Shopping Cart," an integrated system that leverages embedded systems and IoT technologies to automate two core aspects of the shopping journey: cart mobility and payment processing. The system is designed to liberate the user from the physical task of pushing a trolley and to provide a real-time, transparent billing process.

The project is centered around an Arduino Uno microcontroller, which acts as the central processing unit. The cart's autonomous mobility is achieved through a line-following mechanism using IR sensors, allowing it to trail behind the user on a predefined path. An ultrasonic sensor is integrated to ensure safety, automatically halting the cart when the user stops, thereby preventing collisions. Furthermore, the billing system is revolutionized using Radio-Frequency Identification (RFID) technology. Each product in the store is affixed with a unique RFID tag. A reader mounted on the cart, coupled with a mode toggle switch, allows items to be instantly added to or removed from a digital bill as they are placed in or taken out of the cart. A live itemized bill and running total are displayed on an LCD screen, providing customers with immediate financial feedback and eliminating the surprise of a final tally at checkout. By synthesizing these functionalities, this project aims to create a seamless, efficient, and futuristic shopping solution that enhances customer satisfaction and operational efficiency.

II. LITERATURE REVIEW

Recent advancements in smart retail systems have focused on automating billing and enhancing customer convenience through IoT, robotics, and embedded technologies. Several studies have proposed innovative solutions that align with the objectives of the AutoBilling FollowMe Shopping Cart.

An IoT-based smart trolley system was introduced in [1], leveraging RFID for product identification and cloud-based billing integrated with mobile payment applications to streamline checkout processes. Similarly, [2] presented an Autonomous Guided Vehicle (AGV) for retail environments, employing IR and ultrasonic sensors for navigation and obstacle avoidance, enabling safe customer following.

The integration of RFID with microcontrollers is explored in [3], where an Arduino Uno-based cart updates billing information in real-time and displays it on an LCD. A broader perspective is offered in [4], which surveys various automated billing technologies—RFID, QR codes, and computer vision—highlighting RFID's reliability despite cost considerations.

Human-following capabilities are further refined in [5], which details ultrasonic sensor arrays and tracking algorithms for mobile robots in semi-structured environments. Cloud connectivity and security are addressed in [6], proposing a cloud-enabled trolley system with anti-theft mechanisms and centralized payment processing.

Operational efficiency is the focus of [7], which introduces an energy-efficient path planning algorithm that minimizes cart travel based on the user's shopping list. From an economic standpoint, [8] evaluates the cost-benefit trade-offs of RFID deployment in retail, emphasizing long-term gains in inventory accuracy and labor reduction.

Alternative approaches to product identification are explored in [9], where computer vision and deep learning models are used for real-time object tracking under challenging visual conditions. Finally, [10] addresses privacy concerns by proposing a lightweight cryptographic framework to secure data exchange between smart trolleys and cloud servers. Collectively, these works underscore the growing convergence of embedded systems, IoT, and AI in transforming the retail experience. The AutoBilling FollowMe Shopping Cart builds upon these foundations by integrating autonomous mobility with real-time billing, offering a comprehensive and user-centric solution.

III. PROPOSED SYSTEM

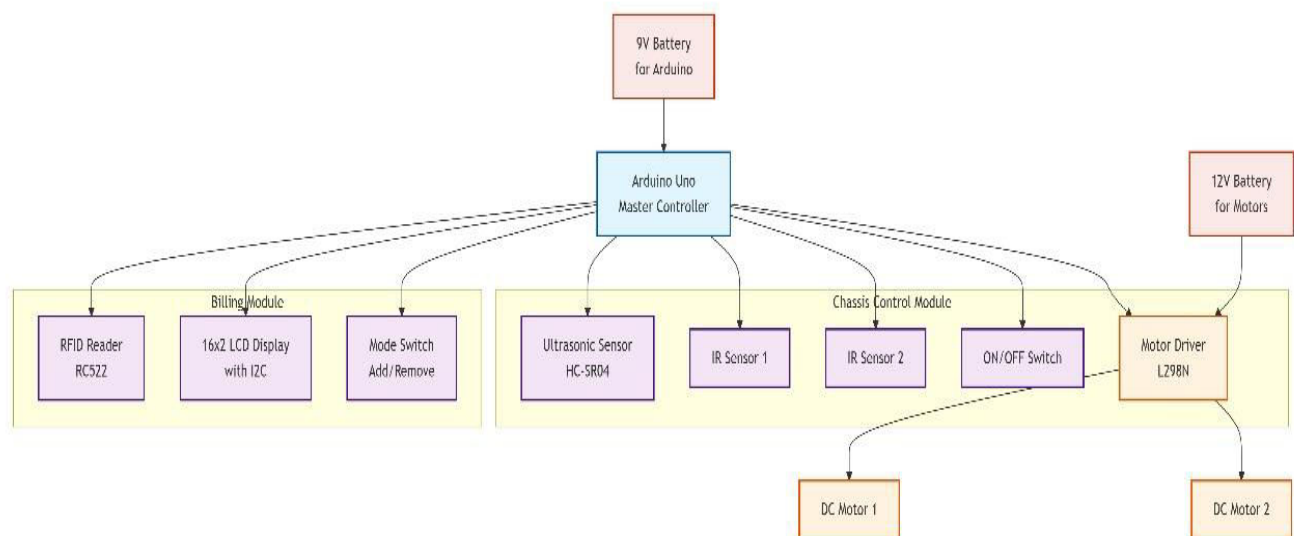
We propose an "AutoBilling FollowMe Shopping Cart," an integrated automated system designed to eliminate the identified shortcomings. This smart cart operates autonomously, following the user via a line-following mechanism and IR sensors, and intelligently stops when the user does, using an ultrasonic sensor to maintain a safe distance. The core innovation lies in its automated billing capability, which uses RFID technology. Each product has a unique RFID tag, and a reader on the cart, combined with an Add/Remove mode switch, instantly updates a running bill when items are placed into or taken out of the cart. An LCD display provides real-time feedback on product details and the cumulative total, ensuring full transparency. This "Follow-Me" and "Auto-Billing" approach fundamentally transforms shopping into a hands-free, queue-less, and efficient experience, moving towards a seamless "just walk out" model.

IV. METHODOLOGY AND WORKING

The project was executed using a structured design methodology, beginning with the conceptualization of the two core systems: the Chassis Control Module and the Billing Module. The hardware components were selected based on their specifications and compatibility with the Arduino Uno. The system integration was achieved by developing a unified circuit where all sensors, actuators, and modules are connected to the single microcontroller, which acts as the central brain.

The working of the prototype is a continuous loop of sensing, processing, and actuation. For movement, the Arduino constantly reads inputs from the two IR sensors to determine the cart's position relative to the guiding line and commands the motor driver accordingly to make steering corrections. Simultaneously, the ultrasonic sensor measures the distance to the user, overriding the motor commands to halt the cart if the user stops (distance falls below a threshold). This entire mobility function can be enabled or disabled by the user via the ON/OFF switch. In parallel, the

billing system remains active. The Arduino monitors the state of the mode switch (Add/Remove). When an RFID tag is presented to the reader, the system first identifies the tag's UID, cross-references it with a pre-stored database to fetch the product name and price, and then, based on the selected mode, either adds or subtracts the item's value from the running total. The LCD display is updated instantly after every action to provide continuous feedback to the user, thereby creating an intelligent and interactive shopping assistant.



V. RESULT

The '*AutoBilling FollowMe*' Shopping Cart project successfully integrates autonomous mobility and real-time billing into a unified Arduino-based system. The design began with two core modules: the Chassis Control Module and the Billing Module, both connected to a central Arduino Uno. The chassis module uses two IR sensors for line tracking and an ultrasonic sensor to maintain a safe following distance. If the user stops, the cart halts automatically. An ON/OFF switch allows manual control of movement.

Simultaneously, the billing module operates using RFID technology. Each product is tagged with a unique RFID card. A mode selection switch toggles between 'Add' and 'Remove' modes. When an item is scanned, the Arduino identifies the tag, retrieves product details from a database, and updates the total bill accordingly. The LCD screen provides real-time feedback, displaying item names, prices, and the running total.

The system functions in a continuous loop of sensing, processing, and actuation. Testing showed high accuracy in line tracking, quick response to user movement, and reliable RFID scanning. The prototype reduces manual effort, shortens checkout time, and enhances user convenience. It demonstrates a scalable model for smart retail environments, paving the way for future enhancements like cloud billing and mobile integration.

VI. FUTURE SCOPE

The current prototype lays the groundwork for several advanced enhancements. Future work can integrate IoT and Cloud Connectivity, allowing the cart to sync with a mobile app for digital payments, personalized offers, and shopping list integration. Computer Vision can be added alongside RFID to enable visual product recognition for items without tags and for theft prevention. Implementing Advanced Navigation using Wi-Fi/Bluetooth triangulation or SLAM (Simultaneous Localization and Mapping) would eliminate the need for physical line following, allowing for free movement in the store. Furthermore, incorporating Weight Sensors in the cart's basket could provide an additional layer of verification, ensuring that the RFID-scanned item has actually been placed inside. Finally, developing a Fleet

Management System for a network of smart carts would optimize store operations, including self-charging capabilities and traffic control.

VII. CONCLUSION

The "AutoBilling FollowMe Shopping Cart" project successfully demonstrates a viable and innovative prototype that addresses key inefficiencies in the traditional retail shopping model. By seamlessly integrating an autonomous line-following and obstacle-avoidance system with a real-time, RFID-based automated billing mechanism, the project provides a tangible solution to reduce manual labor, eliminate checkout queues, and enhance overall customer convenience. The use of a centralized Arduino Uno microcontroller to coordinate all hardware components, including sensors, motors, and the display, proves the feasibility of such an integrated system. While the current model has limitations, such as dependence on a predefined path, it effectively serves as a foundational platform. The project conclusively validates the potential of embedded systems to transform conventional practices, paving the way for smarter, more efficient, and user-friendly retail environments in the future.

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