

SHOPPING TROLLEY FOR AUTOMATED BILLING SYSTEM WITH PICK AND PLACE MECHANISM USING IMAGE PROCESSING

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Abstract:- In the realm of individual E-business transactions, many people engage in purchasing various items from markets and shopping centers to fulfill their basic needs. Despite the numerous challenges faced by customers, a prevalent issue is the time-consuming process of waiting in line for billing, even when the purchase involves only a couple of items. This traditional method of queuing up, handling cash transactions, and the average time spent on each customer becomes particularly burdensome in crowded grocery stores and shopping malls. Customers, especially those inclined towards embracing new technologies, are eager for innovations that streamline the billing process, reducing waiting times and overall transaction duration. The primary objective is to meet the essential needs of customers and, importantly, alleviate the time spent on the billing process. The proposal is to transition from the conventional waiting-in-line approach to a system where the billing is completed within the shopping trolley itself. Supermarkets and general stores, having been in operation for decades, serve as go-to destinations for purchasing fresh fruits, vegetables, and a wide array of daily necessities. Various ways to detect shop lifting and enhance the overall shopping experience, the bottleneck of waiting in line for billing remains a significant drawback. This paper introduces a technological solution that facilitates a seamless shopping experience, utilizing Raspberry Pi and other advancements. The proposed system is well-

suited for implementation in general shopping centers such as supermarkets, D-mart, Big Bazaar, and Walmart. The technology aims to significantly reduce time consumption, offering an enhanced shopping experience for customers.

Keywords:- Smart-Shopping, Raspberry-Pi, Shopping Trolley, Image Processing, Machine Learning, Artificial Intelligence.

I. INTRODUCTION

Technological advancements have reached unprecedented levels, driven by the centralization and modernization of Industry 4.0 technologies. Researchers and scientists are diligently working to make our surroundings smarter and more contemporary. The concept of supermarkets, shopping marts, and shopping malls emerged to enhance the shopping experience, providing a centralized location for obtaining essential items. With the advent of shopping centers like Walmart, D-mart, and Big Bazaar, coupled with the rise of online shopping, the economy experienced a significant boost during the Industry.

Traditional billing processes, marked by slow and Paper billing under went a transformation with the introduction of bar code scanners. However, as the volume of customers utilizing these billing systems increased, frustrations grew due to long waiting times in line for the billing process. Recent projects, such as smart carts using RFID and NFC, have been introduced, but many lacked the effectiveness

required to keep up with modernization. In response to this, Amazon pioneered its own smart grocery store known as 'Amazon Go,' employing cutting-edge technologies such as computer vision, deep learning, and machine learning algorithms.

In light of these developments, our objective is to construct a comparable framework utilizing image processing and Raspberry Pi in a cost-effective manner. This initiative seeks to address the limitations of existing technologies and provide an efficient and modernized solution for the billing process in shopping environments.

II. LITERATURE REVIEW

A. Amazon-Go

The "Amazon Go" stores have been established in cities worldwide, representing a ground breaking concept where traditional checkouts are eliminated. User can visit the store using this application and shopping cart, select products, simply leave without the need for a cashier or checkout process. This partially automated and human-supervised store utilizes the "just walk in and walk out" technology, combining ceiling cameras, computer vision, and weight sensors for shopping experience [2]. However, it's essential to acknowledge certain limitations. The estimated hardware costs for implementing such technology range from \$1-1.5 million, posing a potential barrier for widespread adoption, especially in stores around the world or in economically disadvantaged regions. Addressing these limitations would require innovative approaches to reduce cost and make the technology more accessible to a broader demographic.

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In [3], the proposed model introduces the use of NFC or RFID tags as an alternative to traditional printed barcodes and QR code scanners. This approach helps to address the long waiting time problem during the billing process, thereby facilitating for customers in malls or supermarkets. The model suggests incorporating NFC reader displays on shopping trolleys or carts to keep track of the running total and the cumulative cost of the items selected by the customer. Furthermore, the paper advocates for the various systems, connecting all the shopping trolleys to a central server. This networked system facilitates online payment options, contributing to a more seamless and positive shopping experience

for customers. The emphasis is on reducing frustration associated with waiting times and introducing technological advancements to enhance customer satisfaction in retail environments.

C. RFID or NFC cart system

Utilizing RFID or NFC technology for the billing process of purchased items is proposed in [4]. The system involves the incorporation of a PCB (Printed Circuit Board), a Wi-Fi module, and a power supply within the shopping cart. The envisioned smart trolley is designed to autonomously generate a bill directly from the trolley, offering a centralized and automated billing system. This innovative approach aims to streamline and enhance the billing process for a more efficient and convenient shopping experience.

D. Trolley with automatic billing process

In [5], the authors introduce a novel system featuring a smart shopping trolley for an automated billing process, incorporating Raspberry Pi and an integrated billing system. The system is designed with additional functionality to calculate the total cost of products within the trolley and update this information on display screens for customers. When customers make purchases, the product information, including cost and other details, is displayed. After completing their shopping, customers press a key to signal the end of their shopping process. Subsequently, the billing counter displays the total items and specific products inside the trolley on an LCD screen, prompting customers to finalize their billing process near the counter. The system ensures that the billing process only initiates if customers remove items from the trolley. However, the authors note certain drawbacks. Affixing RFID or NFC tags to some products can be challenging. Additionally, the communication relies on ZIGBEE, which has distance limitations, posing potential barriers to seamless communication between the two components.

E. Automated billing for shopping.

In this study automated trolley system is proposed, employing Raspberry Pi for wireless communication between customers and data servers. Each individual trolley is given with a user-specific reader, and information about the trolleys is stored in the data servers. The operational framework involves customers selecting and inspecting products. The Raspberry Pi embedded in the trolley retrieves product details and displays them on an LCD screen for the customers. The LCD provides real-time product information, including the total cost of the items

within the shopping trolley, enabling customers to stay within their budget constraints. Upon approaching the counter, the database sends a notification to the counter's database, initiating the billing process. This wireless communication system improves shopping experience and facilitates the billing process.

III. PROPOSED WORK

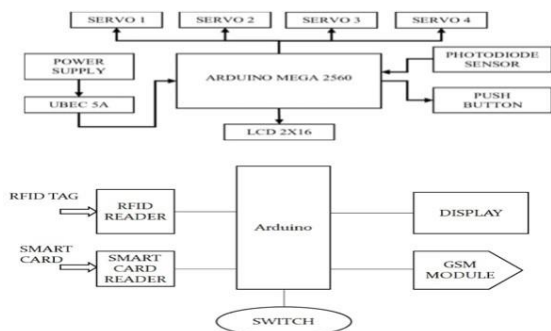


Figure 1 :- Block Diagram of Smart trolley

The primary aim of this trolley is to provide customers with cost-effective and easily accessible expertise and information about products, incorporating a streamlined process for shopping and billing. The electronic shopping store powered by Raspberry Pi is designed to enhance the overall shopping experience for both customers and consumers.

Upon entering the store, customers register themselves in the database, receiving a Raspberry Pi basket for their shopping. Registration details include personal information such as name, billing address, contact details, email ID, and identity proof, along with transaction-related information like bank account and card details. Once registration is completed, customers can proceed with their shopping in the store. This system is also observable by window shoppers.

As customers select products, the database identifies the product information, and customers verify their identity through a scanner. Scanning the products using the camera within the Raspberry Pi setup in the shopping basket transmits product details and content information to the database through Raspberry Pi via serial communication drivers. Raspberry Pi retrieves necessary product details and displays them on the basket's screen.

Upon scanning an authorized card, the lock on the rack containing the products opens, allowing customers to take the selected items. Customers need to showcase the taken products before the

camera, with the details sent to the database via the connected Raspberry Pi and camera. After confirming their bill, customers can review product details, complete the transaction process, and make the necessary online payment before leaving the store swiftly.

This innovative approach ensures a quick and hassle-free experience for customers in the electronic shopping store.[4]

Technology Used in the Proposed System

A. Image processing

To facilitate object identification in this project, the authors have employed image processing alongside machine learning. The camera within the Raspberry Pi can efficiently scan products presented in front of it. The Raspberry Pi utilizes the database information of the shopping complex or mart to recognize product details. A significant tool in image processing, particularly for object detection, is the cascading classifier available in OpenCV. The authors have implemented object detection using this feature based on cascading classification. This machine-learning-based approach involves training a cascading function from numerous positive and negative images in the database, enabling effective object detection. Initially the algorithm requires a substantial set of positive and negative images to train the OpenCV classifier. The Raspberry Pi then extracts features at each stage of the classification, labeling regions as either positive or negative based on the current location of the sliding window. A positive label indicates the presence of the object, while a

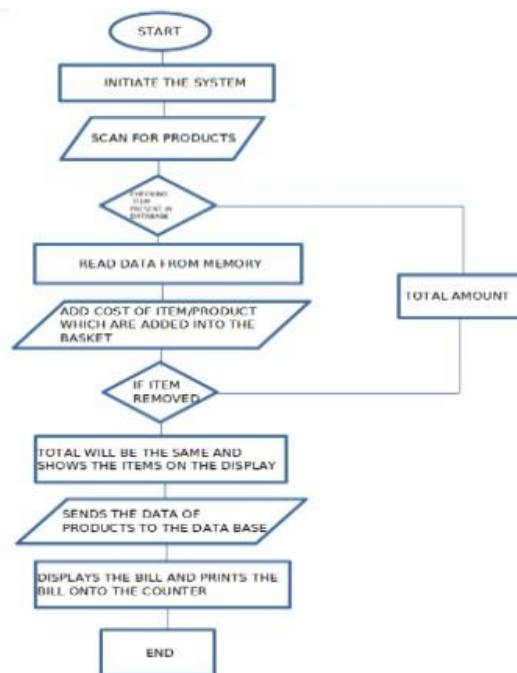


Figure 2:- Flow chart

negative label suggests its absence. In case of negative, and the classification for that region is complete, the

detector slides to the next location in the database. If the label is positive, the classifier advances the region to the next stage, reporting that the object is found. The designed stages aim to swiftly reject negative samples, assuming that most windows do not contain the object of interest.

While true positive product hits are rare, it is essential to invest time in verifying and consolidating the database with high-definition images. A true positive appears when sample is correctly classified using image detection, whereas a false positive happens when a negative sample is classified as positive, indicating the product is taken. Conversely, a false negative occurs when a positive sample is erroneously classified as negative, implying the product is already taken or bought. Object identification or detection stands out as a critical component of the proposed system, as it directly influences the billing process by dealing with the products consumers intend to purchase

IV. HARDWARE REQUIREMENTS

A. Web Camera

A digital camera device designed to connect to and function with a Raspberry Pi microcomputer. These webcams are typically USB-powered and can be easily integrated into the Raspberry Pi's USB ports. They serve as an essential component for various projects and applications that involve image or video capture, such as surveillance systems, home automation, video streaming, and more.



Figure 3:- Web Camera

B. Raspberry Pi

It is a versatile, credit-card-sized computer developed by a non-profit organization. The Raspberry Pi has evolved into a popular platform

for hobbyists, makers, and professionals working on various projects. The device is made affordable, accessible, and easily programmable, making it an ideal tool for learning about computing and electronics.



Figure 4:- Raspberry Pi

C. Shopping Cart

A shopping trolley in certain regions, is a specially designed wheeled vehicle created to enhance the shopping experience in retail environments. It serves as a practical and indispensable tool for customers, offering assistance in transporting selected items conveniently throughout a store. The primary purpose of this carts is to facilitate the gathering of goods as customers navigate through aisles and make their product selections.



Figure 5:- Shopping Cart

V. SOFTWARE REQUIREMENTS

A. Python programming language will be used for Raspberry pi configuration.

Python is a widely-used language for its readability, simplicity, and extensive support for various applications. When it comes to configuring and programming the Raspberry Pi, Python stands

out as a preferred language due to its ease of use and the Raspberry Pi's native support for Python.

B. HTML Language for designing the website.

HTML is the standard markup language used to create and structure content on the World Wide Web. It is essential for designing and organizing the various elements that users interact with when browsing websites. HTML provides a systematic way to define and present content, ensuring consistency and compatibility across different browsers.

C. PHP Language to maintain the database.

PHP is used for web development. While HTML focuses the client side (i.e., in the user's browser), PHP is employed on the server side to generate dynamic content, interact with databases, and perform various server-related tasks. One of the significant applications of PHP is in managing databases, where it seamlessly integrates with database systems to retrieve, manipulate, and store data.

D. Database Required SQLITE

SQLite is an embedded, and self-contained database management system (RDBMS) that does not require a separate server process and allows for a hassle-free integration within applications. It is a popular choice for mobile apps, embedded systems, and small to medium-scale web applications.

VI. RESULT

The Raspberry Pi offers several advantages over standardized RFID or NFC tags, which are prone to tampering due to factors such as temperature, water exposure, physical wear and tear, and other environmental causes. The Raspberry Pi ensures the secure storage of product information, and the communication gateway in shopping trolleys or carts remains inactive until an item or product is scanned, and its information is accurately read by the R camera.

This approach enhances security and prevents unauthorized access or tampering. Unlike traditional RFID or NFC tags, the Raspberry Pi's robust design mitigates the risks associated with environmental factors, ensuring the reliability of stored information.

The information of items placed inside the trolley is crucial for preventing theft or the removal of items that have not been properly scanned and charged to the customer. Attempting to remove an item

triggers the same procedure, and the Raspberry Pi, serving as a database, stores this information locally on the database server previously set up for the Raspberry Pi.

By leveraging the Raspberry Pi's capabilities, the system effectively addresses security concerns and prevents unauthorized removal or manipulation of items. The implementation of a local database server ensures that transaction data is stored securely, providing a reliable and tamper-resistant solution. The overall result demonstrates working model in real-world shopping scenarios.

This innovative approach using the Raspberry Pi not only improves security but also offers a more robust and reliable solution compared to traditional RFID or NFC tags, especially in challenging environmental conditions.

VII. CONCLUSION

From the customer's perspective, the presented project has revolutionized the traditional method of purchasing products. The Raspberry Pi demonstrates significant advantages over scanner tags like RFID or NFC, primarily owing to its precision and rapid response facilitated AI&ML process. The features embedded within the Raspberry Pi contribute to an enhanced shopping experience, offering improved efficiency that can be easily navigated by any regular individual accustomed to buying products.

Looking ahead, the utilization of enhanced Raspberry Pi models tailored to specific products, operating with a high degree of accuracy. This advancement allows consumers to seamlessly access information about the products simultaneously. Furthermore, IoT (Internet of Things) can be leveraged for automating stock management, leading to efficient and real-time updates on product information. This contributes to the automation of stock administration.

Based on a comprehensive literature survey and an exploration of various shopping systems worldwide, the authors conclude that the proposed system is reliable and, importantly, cost-effective. In comparison to the highly technical Amazon Go store and its associated shopping carts or trolleys, the presented model stands out as a feasible and economical solution for modernizing and innovating the shopping experience.

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