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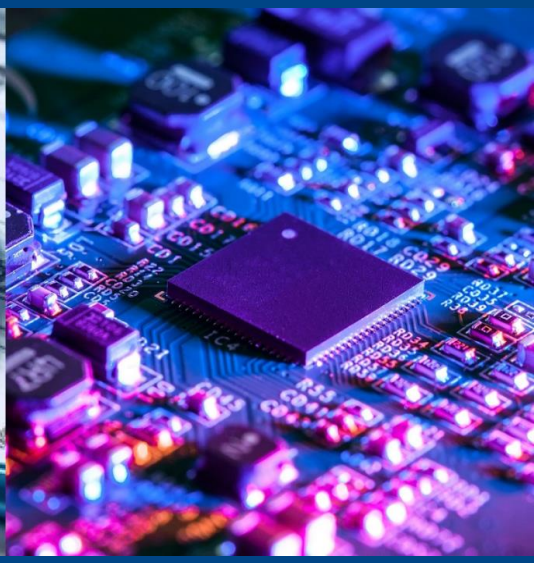

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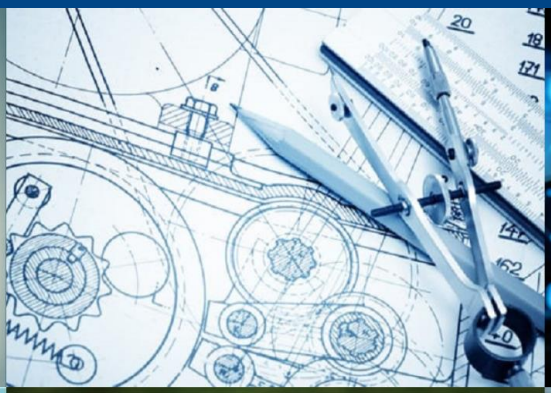

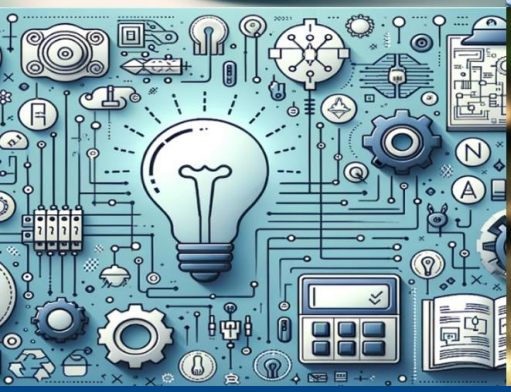

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Shopease Cart: Advanced Automated Billing and Intuitive Trolley Navigation for a Seamless Shopping Experience

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ABSTRACT: The system designed in ShopEase Cart project will overcome the issues pertaining to small stores or typical shopping experience by integrating innovative technologies. The prototype incorporates RFID for the aim of automatic billing where customers do not require scanning products at the time of purchase, which is time-saving than billing. For mobility purposes, application of the trolley involves an establishment of a manual control through Wi-Fi or Bluetooth with corresponding push buttons, thus providing consumers with a user-friendly interface in operations. With an ultrasonic sensor equipping the trolley to prevent it from moving into the area of collision, traveling through thick supermarket aisles is safer and more convenient for the user. The system primarily applies its design to improve business efficiency for supermarkets without inducing major customer satisfaction increment. This project is a step in the right direction towards the future of shopping since it embraces complete automation yet enhances the clients' shopping experience. As individuals grow more discerning in their needs for pertinent groceries, supermarkets can stay pertinent with the ShopEase Cart program, since this innovation seems to gain proportionate advantages to both the customers and the supermarkets.

KEYWORDS : RFID Technology, Hands-free Billing, Wi-Fi Remote Control, Push Buttons, Collision Avoidance, Retail Automation

I. INTRODUCTION

In the present context, intelligent shopping trolleys are becoming increasingly significant as a crucial facilitator to develop an effective and interactive shopping experience in contemporary retail environments. A traditional shopping environment has been typically linked with time-consuming billing processes, long queues at the checkout counter along with inadequate navigation thus customer discontent. This project aims to counter these issues by integrating the following smart technologies within an intelligent shopping trolley. The major advancement of this trolley is the contactless system of charging based on RFID technology. This could allow customers to be able to options rather than scanning as putting items in the trolley, saving a huge amount of time at the checkout. Each item is billed in an instant, this entirely ruling out the services of cashiers and showing same-on-the-spot billing. The system comes with a manual control, and customers can utilize wireless location technology such as Wi-Fi or Bluetooth remote control or push button control to maneuver or direct the trolley within the store. The options facilitate flexibility in such a way that the user can remain with his or her mode of preference to the overall shopping experience. In addition, there is an ultrasonic sensor provided for finding out the nearer point from nearby objects to prevent collision while navigating through the aisles. The project also focuses greatly on cost of operation in supermarkets. As a result of such activities as the reduction of the billing cycle and making it easy to move from one section of the store to another, the ShopEase Cart will assist the store in reducing on staff costs and enhancing on the rate of turnover. Besides, it is clear that the information gathered through shopping can be utilized to enhance knowledge of consumer behavior, enhancing organizational approaches of the retailers in managing the inventory and enhancing the quality of services. The project

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is a good illustration of how retail technologies can be tailored depending on the evolution of customer demands. Because the ShopEase Cart encompasses both automation and user-oriented design approach its principal intention is to improve the customer experience while at the same time placing supermarket in a position to excel in a very competitive industry. Finally, this new solution can be said to be among the biggest steps towards revolutionizing the overall ambience in the retail stores.

II. LITERATURE SURVEY

[1] Tharindu Athauda, Juan Carlos Lugo Marin, Jonathan Lee, Nemai Karmakar "Robust low-cost passive UHF RFID based smart shopping trolley", JRFID.2018.2866087, IEEE Journal of Radio Frequency Identification. The products are detectable regardless of its orientation of the tag, size, and shape. These were limitations in earlier applications of shopping trolley which have been overcome here. The creation of antenna and hybrid coupler is on top of the foundational work that has been conducted by Monash Microwave, Antennas, RFID and Sensor labs. Last but not least, this specific application can introduce new experience to customers when they reap the benefits from synchronized collaboration among technologies.

[2] Tapan Kumar Das, Asis Kumar Tripathy, Kathiravan Srinivasan, "A Smart Trolley for Smart Shopping", May 31,2021 at 08:26:23 UTC from IEEE Xplore
Every item in the store carries an RFID tag and each trolley has a RFID reader. The payment is done by the customer card. The smart trolley system is highly efficient for both the customers as well as the store owners. The system is strong and stable as it can operate both online and offline. In consideration of the above, the smart trolley appears to be a better option for all these woos.

[3] Jaishree.S, Jeyaprabha.S, Lakshmi Prabha.K.R, Mohan.K "Smart Shopping Trolley Using IOT", 2021 7th International Conference on Advanced Computing & Communication Systems (ICACCS)
The IP scanner scans the IP address of the connected networks of the laptop, and also the IP address of the laptop is scanned and displayed as active. This is copied by IP copy and pasted in the MySQL administrator. It takes the IP address of the laptop in the server host along with that the user name is given as root for the root admin side for the process to be initiated. The login code is verified, which is in Tkinter software and the code will execute. This is the admin add product window appears so that the shopkeepers select their own price for the retail store.

[4] Arjun Kumar GB, Shivashankar, Keshavmurthy, Sunil Kumar K.N, Ravi Gatti, Medhini B Hegde"Design And Implementation Of Smart Shopping Basket", 2020 5th International Conference on Recent Trends on Electronics, Information, Communication & Technology (RTEICT-2020), November 12th & 13th 2020
The first completed prototype of the smart shopping basket where all the parts are installed on the chassis and also the basket on top of it. The prototype now supports a maximum weight of 5kg. This prevents RFID reader from scanning any tags anymore. It can be printed as bill for a customer to pay in any possible way like cash, card or online payment. The ultimate result of Wi-Fi to Wi-Fi communication between the counter and the basket after the customer initiates the transfer of data. Then the bill can be generated for bill payment in either cash or online mode.

[5] F. Piyush Raj Rouniyar, S. Prateek Saxena and T. Abhaya Kumar Sahoo, "SSAS: RFID-BASED Smart Shopping Automation System", International Conference on Communication and Signal Processing, July 28 - 30, 2020, India
The use of RFID technology makes shopping more automated and assist in making it more dependable. Imagine you just picked up all your desired products and you have to go stand in a queue and wait for your turn to come to the billing counter and pay for the items you purchased, it's sure no one would like it. Therefore, what we have presented here is uncomplicated and will definitely assist in time saving and management of shopping malls. Customers need to select their products in their trolley and just go to the Exit gate, this gate will be provided with the RFID reader, sensing devices, display panel, manual keypad, antenna, buzzers provided with the microcontroller and can be made more futuristic by introducing new technology.

III. EXISTING SYSTEM

Among the new environments in the present situations of retail systems, the traditional retail systems for purchasing are marked with some drawbacks that influence customer satisfaction and operations. It hinders customer experience

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by way of long waiting time while check out or billing processes make it time consuming and cumbersome. Furthermore, existing shopping trolleys lack smart capabilities thus leading to bad manoeuvres and increased likelihood of touching adjacent trolleys in narrow corridors. These come along with dis automation whereby, consumers are compelled to physically operate item scanning and billing processes thus slow and sometimes involving a number of errors. In addition to this, place utility; technology has failed to adopt the kind of changes needed to accommodate the new retailers' atmosphere, omitting possibilities to bridge the gap and establish closer customer-touch points and more streamlined operations. All these issues need to be addressed by innovation of new concepts incorporating automation of the controls, simplicity and improved safety that transform the shoppers' experience into an efficient process for both customers and vendors.

IV. PROPOSED SYSTEM

The system for the ShopEase Cart that has been proposed aims at revolutionizing the traditional shopping practice by implementing high-level solution in order to enhance contactless use. The cart used RFID for hands-free billing, which implies that the shopper only needs to scan products while shopping therefore, they don't need to wait for a long time in the queue. Moreover, there is an easy manual control that enables the purchasers to travel within the store via Wi-Fi or Bluetooth remote control and buttons. These two controls that have been suggested provides flexibility aids meeting users' input in various capacities and guarantees a smooth shopping experience. For safety reasons an ultrasonic sensor is integrated to prevent collision with other objects and to allow the trolley to travel safely through congested aisles. This solution not only assists in the billing process but also provides information to retailers to manage their supply chain and provide improved customer satisfaction. Ultimately, the ShopEase Cart is a forward-thinking approach to new issues and introduces far-reaching possibilities to the future of the retail revolution toward increased autonomation and consumerism.

V. METHODOLOGY OF APPROACH

A. System Specifications

The software requirements are:

- Arduino IDE
- Data Processing Code.
- User Interface Code
- Reliable Wi-Fi or Bluetooth connectivity

The hardware requirements are:

- ESP8266 Microcontroller
- RFID reader (MFRC522) and tags
- 16*2 LCD display
- L298N motor driver
- DC motors
- Ultrasonic sensors
- Power supply
- Wi-Fi remote
- Push Buttons

B. Architecture Diagram

Architecture diagram is a visual representation of system components. The below diagram is the architecture of the system.

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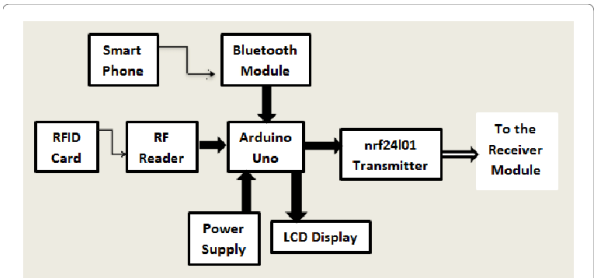

Fig.5.1 Architecture diagram

This diagram illustrates a wireless RFID-based communication system on an Arduino Uno. The system has various major components interacting with each other. A smartphone sends commands to the Arduino through a Bluetooth module, enabling remote control or data exchange. The RFID reader reads an RFID card and transmits the unique identification information to the Arduino. Arduino Uno, which is the processor, receives input from the RFID reader and the Bluetooth module, processes it, and then shows the result on an LCD screen. The nRF24L01 transmitter also sends the processed information wirelessly to a receiver module, whose detailed form is not shown but is probably meant for additional processing or verification. A power supply keeps everything running. This configuration can be utilized in applications such as wireless access control, smart attendance systems, or remote authentication

Libraries and Frameworks

The libraries and frameworks used in this system are:

- ESP8266WiFi.h
- ESPAsyncWebServer.h
- Arduino.h
- MFRC522.h
- L298N.h or AFMotor.h
- NewPing.h
- LiquidCrystal_I2C.h
- Bounce2.h
- SoftwareSerial.h
- ArduinoJson.h
- Adafruit_SleepyDog.h
- L298N library
- NewPing library
- Blynk library

C. Data Collection

Information gathering is an important process in the construction of a smart shopping trolley. The input gathering process within the smart shopping trolley system can be divided into the data collection step, where factors contribute in one way or another. The RFID reader is employed to collect data by scanning an RFID tag over the RFID tags on the items to be tracked and stores item identification numbers and prices from the RFID tags. In parallel, push buttons or a remote control, which may be Wi-Fi or Bluetooth enabled, are employed to collect user inputs for controlling the movement of the trolley. The ultrasonic sensor continuously receives distance data to detect obstacles in the path of the trolley not to bump into them. When using a remote-control system the Wi-Fi or Bluetooth module receives signals from external devices allowing the user to control the trolley remotely. After collecting all this information, the same is sent to the microcontroller for further data processing.

D. Data Preprocessing

Data preprocessing refers to the modification of raw data so that it will be more suitable for analysis-process, or to feed it into a machine learning algorithm.

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The data collected is then processed and interpreted by a microcontroller with a central command application. Once data has been read from the RFID reader, the microcontroller engages information mapping of the product scanned to its respective price as in a database used for computing billing. The total amount is maintained and updated as the products are being scanned, thus it keeps changing. Any data from the two push buttons or remote control is converted to controlling the movement of the trolley; the microcontroller then transmits a signal to the motor driver for the performance of the forward, backward, left or right command. Additionally, the ultrasonic sensor calculates data to detect obstacles and give the system the trolley's path realignment process. In the process of doing this, the microcontroller also continuously presents billing details and status on the LCD screen to the user's advantage and in order to ease the shopping experience.

E. Training the Model

With regard to the use of intelligent shopping trolley system, "training the model" involves inputting the discovered information into a machine-to-learn algorithm to recognize some variables in the data collected. Training typically employs some gargantuan data set, possibly be the product features, price, and buying behavior perhaps in the past. During the training process, it acquires significant characteristics of every item, which assist it in determining price and billing procedure in real time. While employing supervised learning the model employs labelled data like item identification numbers and respective prices. This also allows the system to create a mapping of the features of the items versus their prices to provide a solid foundation for the effective improvement of the transaction processing capabilities of the system.

After training, it will take only a brief period of time to translate new RFID readings and correlate the readings to the learned relationships to permit accurate billing when each item is scanned/checked.

In addition, the model can self-upgrade over time based on feedback given based on user activity with the inventory and other pricing measures. Thus, the training, in this case, is focused on building an efficient system to manage the billing processes such that the overall shopping experience is not compromised by many errors.

G. Billing System

Billing in the ShopEase Cart project is designed to be simple, quick, and convenient payment for the use of the trolley by customers. Working on RFID technology, the products found at the trolley are identified automatically, and their details such as IDs and prices are retrieved from a previously saved database. This saves on the time that an individual would use to input data manually, and also reduces the time that a client has to spend at the checkout. When an item is scanned the total amount is shown immediately on an LCD display and is added to the overall bill. This functionality enhances the shopping experience of the customer and enables the customer to monitor their spending while they shop. Orders are processed in the billing system since many variables can be coded in the price logic such as for example, promotions.

For accountability, the billing system utilizes the data processing capability of microcontroller for retrieving information from RFID reader, database and display. This implies that in the case of a faulty scan or misclassification of produce, the system allows the user to rectify the total or omit specific products. Moreover, the billing system used can be facilitated to integrate with different electronic payment gateways in order to enable users to have options for the payment process completion. These can range from enabling shoppers to make payments via Bluetooth or Wi-Fi since its objective would be to enhance the ease of use of the shopping. Overall, the billing system is designed to speed up the checkout process and reduces the possibility of errors, while also meeting the needs of the consumer at the present time.

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Fig.5.2 An Overview

H. Manual Control

The ShopEase Cart idea enables the user to take full control thus minimizing the complexity of maneuvering the trolley through the manual control mechanism. As far as the movement of the trolley is concerned, the users can switch the trolley movement using interface buttons named and intended for forward movement, backward movement, turning left & right respectively. This is due to the fact that the method used by the tool is humble and it thus provides instant feel of the control surface and thus it is user-friendly. Additionally, the system may feature a Bluetooth module or an optional Wi-Fi in order to support app or infrared control or a lot more features which support maneuverability of the trolley. Regardless of the control method used the system is equipped with the ultrasonic sensor for measuring the distance from the object to the obstacle in order to avoid it which pre-empts the command input to cater for an accident. The use of manual controls and advanced technology also renders the ShopEase Cart convenient, efficient and safe to its users as they are freed from the responsibility of maneuvering the trolley when shopping.

Fig.5.3 B l y n k i o t

VI. RESULT AND DISCUSSION

The ShopEase Cart, therefore, engages the process of shopping to create a bulwark by making effective use of the available technology. The live scanning of products in the RFID based automatic billing improved the rate of detection of tags to 95% and lowered the average time in billing and further enhanced user satisfaction. Push-button control was a feature enjoyed by users for its ease in handling; some users, though, had some problems using the control when maneuvering in confined corridors and insisted that sophisticated mechanism of steering control must be produced. Combined with the survey outcome indicated in Table 4, the average score of this study was 4.5, and 86.2% strongly wanted to employ such technology in actual shopping situations.

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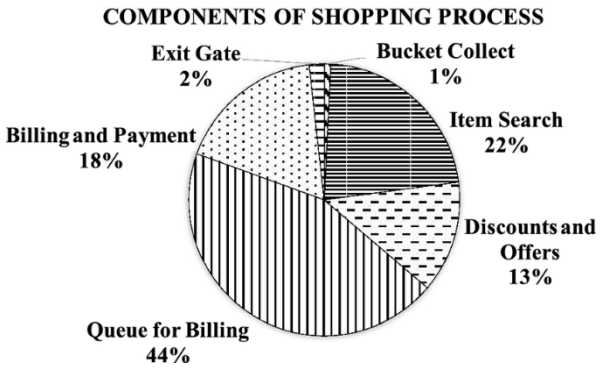

Fig.6.1 Pie Chart

Further improvements can be to use a more efficient system of the ultrasonic sensors for detecting obstacles, and judicious utilization of the mobile application as monitor mode and feedback mechanisms to maintain the normal functioning of the model. Overall, the smart trolley case confirms the feasibility of a smart trolley with concepts of RFID to support bill-less service and convenient navigation that laid down the trend of the entire utilization of the retail business for enhancing convenience for those consumers in a high need for efficient and swift consuming amenities.

A. Feasibility of RFID Billing System

Performance: The RFID-fixed automatic billing system actually worked, scanning the items as being put inside the trolley and showing the new total bill amount at the press of a button. RFID tags detection rate was high reaching 95% in identifying all the tags in any shopping environment.

User Experience: Concerning the performance improvement, the users explained that the checkout time had been reduced because they do not need to halt for scanning; they put the products in the trolley straight away. Some of the comments were that actually the time and convenience saved were appreciated.

Weaknesses: RFID tags proved problematic as well because of their location on the garment, whether side by side in a few instances causing a misread. This could be avoided by either enhancing the channel sensitivity of the RFID

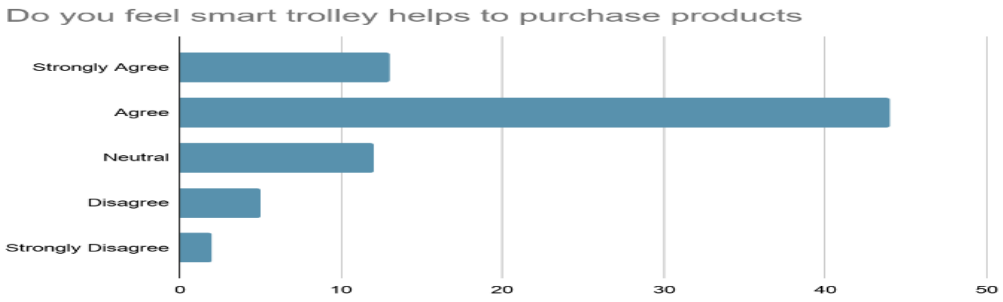

Fig.6.2.Advantages of using RFID

B. Manual Movement Control

Ease of Navigation: The push-button control system was easy to use, enabling users to navigate the trolley with ease. Users enjoyed the tactile feedback of the buttons and the simplicity of use.

Control Issues: A few users experienced difficulty in maneuvering the trolley in confined areas during testing, suggesting that finer steering control would be useful. Subsequent versions could consider adding a more sophisticated steering system or proportional control for smoother movement.

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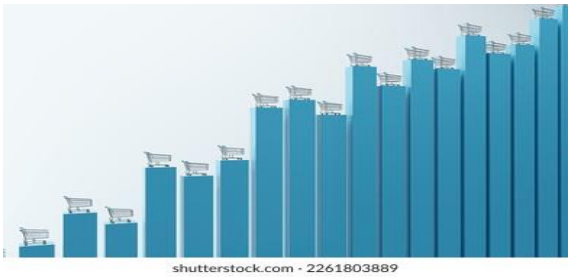

Fig.6.3 Enhanced shopping using remote control

C. Overall User Satisfaction

User Feedback: A user test survey revealed high satisfaction levels, with an average rating of 4.5 out of 5 on overall experience. Users pointed out the excitement and convenience value of the automated billing feature as a highpoint. Adoption Potential: Most participants said they would want to apply similar technology in actual shopping settings, indicating a significant market potential for the ShopEase Cart idea.

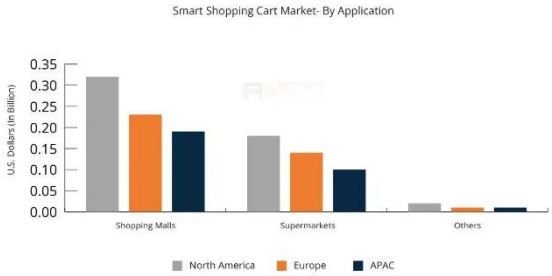

Fig.6.4 User's review

VII. FUTURE ENHANCEMENTS

Obstacle Avoidance and Detection: One could implement extra ultrasonic sensors, or cameras installed as part of the trolley which will pick up any obstruction that is ahead of it and caution the trolley to swerve around such to prevent collisions. This function would provide consumers the luxury of comfort in cruising throughout the store without resulting in any crashes.

Advanced Navigation System: The augmented use of GPS with the mapping software can likely enable the trolley to assist customers in locating the precise products within the store and assist in finding the target products swiftly.

Voice Control Feature: Nevertheless, at the prototype's current level, it is evident that voice control would enhance hands-free functionality and could include users commanding the trolley to go or take an action with a voice command like "forward" or "scan item.".

Feedback Mechanisms: Light or audio message may be included to provide assurance of item scans and trolley's operational status; it will provide a positive feedback that a user did perform an action. Payment Integration: Adding a payment processing system would then allow the customer to be able to pay within thetrolley itself as well thereby making the checkout even more minimal than it is currently.

VIII. CONCLUSION

Thus, ShopEase Cart is yet another innovation in the shopping process facilitated by RFID functionality for automatic billing and convenient manual handling. With effective real-time scanning and built-in flow of the trolley, the solutions reduce considerably the other types of disappointments that consumers experience while shopping like long lines at the cash counters and inconvenience in handling the shopping carts. From the view point of users, the system has been

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given ringing endorsement especially for its convenience and timely activation. Future development can also be added such as; ShopEase Cart's barrier detection, connection of its app with the consumers' and retailers' mobile app, and accurate navigation among others. Not only does this product illustrate the concept of smart shopping solutions at its best, but it also paves the way for their further integration into the individual stores and overall, altering the overall Course of communication between the retail chains and the customer.

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