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Smart-Cart : Shopping with IoT-Enabled Trolley

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Abstract : In the era of digital transformation, our project introduces an innovative solution, the "Smart Cart Shopping with IoT-Enabled Trolley," designed to enhance the traditional shopping experience by seamlessly integrating Internet of Things (IoT) technologies. Our system incorporates cutting-edge devices such as RFID (Radio-Frequency Identification), Node MCU, and an LCD (liquid crystal display), creating a dynamic and intelligent shopping cart.

The foundation of our smart cart lies in the RFID technology, which enables automatic item identification and tracking within the cart. Each product is affixed with an RFID tag, and as items are added or removed, the Node MCU microcontroller processes the data in real-time. The LCD display mounted on the cart provides a convenient interface for customers to view their selected items, ensuring a transparent and accurate shopping experience.

Furthermore, our system introduces an innovative payment mechanism through a seamlessly integrated web page accessible on the cart. By leveraging QR code technology, customers can effortlessly make payments for their selected items. The QR code, generated dynamically based on the RFID data, can be scanned using a mobile device, directing the customer to a secure payment gateway on the web page. This not only streamlines the checkout process but also eliminates the need for traditional point-of-sale terminals, enhancing the overall efficiency of the shopping journey.

To further enhance the transparency and convenience of the shopping experience, our Smart Cart Shopping system incorporates a real-time data pricing feature. As customers navigate the aisles and add items to their carts, the system dynamically updates the prices of each item based on the latest market rates. The LCD display on the cart provides customers with a comprehensive and up-to-the-minute overview of their current bill, allowing them to make informed decisions about their purchases. This real-time data pricing not only ensures accuracy in the billing process but also empowers customers to manage their budgets effectively. The integration of this feature exemplifies our commitment to leveraging technology to provide a holistic and customer-centric approach to the retail experience.

In conclusion, our Smart Cart Shopping with IoT-Enabled Trolley represents a significant leap forward in the evolution of retail technology. By leveraging RFID, Node MCU, and QR code integration, we aim to provide consumers with a seamless, secure, and efficient shopping experience. The project not only showcases the potential of IoT in transforming traditional retail processes but also lays the groundwork for future innovations in the realm of connected devices and smart retail solutions.

Keywords - Smart Cart Shopping, RFID Technology, Node MCU, Real-Time Data Pricing, Seamless Checkout, Web-based Interface, User-Friendly Technology, Shopping Efficiency.

I. INTRODUCTION

As the technology is developing and seeing new inventions in various fields including machine learning, artificial intelligence, and Internet of Things (IoT) and so on, there is an increase in the expectations in the consumer point of view. With the fast-moving lives, the consumers absolutely have no time to stand in long queues in order to get their work done. So our project is “a smart shopping trolley system using Radio Frequency Identification (RFID) technology for streamlined shopping and billing [1]. The trolleys in the shopping malls are protocoled so as to automatically bill the products put into them and the final bill is sent to a web application.

The system which is used nowadays in the shopping mall is a barcode system which addresses long queues at billing counters. In this system, the barcode readers are used to detect barcode label which is attached to every product [2]. An electronic device is associated with the barcode reader to read written barcodes.in that, we used a sensor that converts light into an electrical signal. Data sent by a sensor is decoded by the barcode reader and then the barcode image is analyzed and this analyzed information is sent to the scanner’s output port. when any customers brought any product and put that product in the shopping trolley and go to the cashier section the cashier used this barcode system which is a slow method therefore in this way billing method becomes slow resulting in the long queue at the cashier section.

Smart-Cart is a revolutionary innovation that has transformed the traditional shopping experience by integrating cutting-edge technology into everyday grocery trolleys. This IoT- enabled trolley represents a significant leap in the world of retail, offering customers a seamless and efficient way to navigate the aisles while also enhancing the overall shopping experience. Equipped with a range of sensors, cameras, and RFID technology, smart cart introduces an innovative feature of real-time price tracking on the Liquid Crystal Display (LCD), allowing users to dynamically view and monitor the accumulated cost of scanned items as they shop, enhancing the transparency and convenience of the billing process in our project [3]. Smart-Cart allows customers to easily track and manage their purchases in real-time, ensuring they never forget an item or exceed their budget. technology, is to enhance the shopping experience for consumers, improve operational efficiency for retailers, and gather valuable data for various purposes. Here are some of the key benefits of using IoT-enabled trolleys like Smart-Cart:

- Enhanced Shopping Experience: Our offer a seamless and efficient shopping experience, reducing the time customers spend at billing counters.
- Time Efficiency: Our project streamlines the billing process, minimizing the time customers need to spend at the checkout counter, thereby enhancing overall time efficiency [4].
- Real-time Price Tracking: Our project incorporates a feature for real-time tracking of prices on the LCD display, allowing users to monitor their expenses as they shop, contributing to better financial management [5].
- Contactless and Convenient Payments: Our project facilitates contactless billing and payment through a webpage, enhancing the safety and convenience of the shopping process.
- IoT Integration for Global Accessibility: Our project utilizes IoT technology to enable global accessibility, allowing customers and administrators to interact with the system from anywhere in the world for enhanced control and management.

II. PROBLEM STATEMENT

Smart-Cart is a cutting-edge shopping solution that revolutionizes the traditional grocery shopping experience through the integration of IoT technology into the shopping trolley. This innovative approach addresses several key issues in the shopping process and offers a more convenient and efficient way for consumers to shop.

The primary problem observed is challenge of long queues and time-consuming billing processes at supermarkets during peak hours is a common concern addressed. This issue not only affects customer satisfaction but also leads to inefficient use of time, hindering the overall shopping experience. Recognizing this problem, our project aims to streamline the billing process and eliminate the need for customers to endure extended waiting times at checkout counters, aligning with the goal of enhancing customer convenience and satisfaction [6].

Existing shopping systems often rely on paper receipts, contributing to environmental concerns and inconvenience for customers. To mitigate this issue, our smart cart project incorporates QR code scanning technology for direct payment on the project's webpage. By promoting a paperless and eco-friendly approach, our system enhances the overall shopping experience and aligns with contemporary environmental sustainability goals [7].

Current shopping carts often lack integration with modern technologies, resulting in a gap between the physical shopping experience and the digital world. This disconnect limits the overall shopping experience and fails to leverage the potential benefits of IoT and other advanced technologies.

During COVID-19 pandemic has exacerbated the challenges faced by customers in shopping, particularly in maintaining social distancing and avoiding crowded billing counters. In response to this concern, our project aligns with the goal of ensuring a safer shopping environment. By introducing a smart trolley with IoT-enabled features, we aim to minimize physical contact and queuing at billing counters, contributing to a more secure and socially distanced shopping experience.

In summary, the problem statement of Smart-Cart revolves around the inconvenience, inefficiency, and environmental sustainability issues inherent in traditional shopping cart systems. By leveraging IoT technology, this innovative solution seeks to transform the shopping experience, making it more convenient, sustainable, and secure for consumers and retailers a like.

III. OBJECTIVE

Primary objective of this thesis is to design, develop, and integrate a sophisticated smart cart shopping system utilizing IoT-enabled trolleys. The project focuses on seamlessly incorporating key IoT connectivity devices, such as RFID for item tracking, Node MCU microcontrollers for real-time data processing, and LCD displays for an interactive user interface. The aim is to create a holistic system that enhances the shopping experience by leveraging IoT technologies and ensuring the smooth integration of various components for optimal functionality [8].

One of the central objectives is to establish an efficient and transparent payment mechanism accessible directly through the web page of the IoT-enabled trolley. By implementing a QR code payment system, customers can make payments seamlessly by

scanning the dynamically generated QR code. This objective addresses the need for a secure and convenient payment solution, aligning with modern retail trends and contributing to a more streamlined checkout process [9].

The thesis aims to implement real-time data pricing functionality within the IoT-enabled trolley, allowing customers to view the updated prices of their selected items on the LCD display as they shop. This enhances transparency and empowers customers to make informed decisions about their purchases. The interactive user interface fosters customer engagement, providing a dynamic and personalized shopping experience that goes beyond the traditional static pricing model.

An integral objective is to assess the user experience of customers interacting with the Smart Cart Shopping system. Through surveys, interviews, and observational studies, the study seeks to understand user satisfaction, ease of use, and overall acceptance of the technology. Insights from this objective contribute valuable information on how the system performs in a real-world retail setting, guiding potential improvements for a more user-friendly and customer-centric experience.

The final objective is to contribute to the broader knowledge base in the field of IoT-enabled retail systems. By documenting the development process, implementation challenges, and user feedback, the thesis aims to provide insights for industry practitioners, researchers, and stakeholders. This contribution extends beyond the immediate project, laying the groundwork for future research and innovations in the application of IoT technologies in the retail sector, with a focus on enhancing customer interaction, transparency, and overall shopping efficiency [10].

IV. LITERATURE SURVEY

The concept of "Smart-Cart: Shopping with IoT-Enabled Trolley" is an innovative application of IoT technology in the context of shopping and retail. This technology aims to enhance the traditional shopping experience by incorporating IoT features into shopping carts or trolleys. The literature on this subject reveals several key insights and findings.

One of the primary benefits of the Smart-Cart concept is its potential to streamline and optimize the shopping process. Traditional shopping often involves pushing a cart through the aisles, manually selecting items, and keeping track of the shopping list. IoT-enabled trolleys can automate many of these tasks. For instance, they can provide real-time inventory information, helping customers locate products efficiently. They can also offer personalized shopping recommendations based on a customer's preferences and past purchase history, enhancing the overall shopping experience.

The literature also highlights the potential for IoT-enabled trolleys to collect valuable data for retailers. These smart carts can track customer behavior, such as the products customers interact with, the time spent in different store sections, and purchase patterns. This data can be analyzed to gain insights into customer preferences, optimize store layouts, and improve inventory management.

While the concept of Smart-Cart with IoT-Enabled Trolleys holds significant promise, the literature also highlights some challenges and considerations. Privacy and security concerns are paramount, as the collection of customer data and personalization features raise questions about data protection and consent. Furthermore, the cost of implementing such technology and ensuring seamless connectivity can be a barrier for some retailers.

In conclusion, the literature on Smart-Cart: Shopping with IoT-Enabled Trolleys reveals a fascinating intersection of technology and retail. The concept offers numerous advantages, such as improved shopping experiences, data-driven insights for retailers, and the potential for contactless transactions. However, it also brings to the forefront issues related to privacy, security, and affordability that require careful consideration in the development and adoption of this innovative shopping solution. Further research and real-world implementations are essential to fully explore and address these opportunities and challenges.

This technology is aimed at enhancing the shopping experience, improving efficiency, and providing various services to customers. Below are some key points and summaries of research papers related to this topic:

- The research paper "A Smart Trolley for Smart Shopping" suggests valuable findings for our project on smart cart automatic billing with RFID technology and Node MCU. The paper proposes a system that integrates RFID technology for efficient item tracking and introduces an automatic billing process. Key components include an Arduino board, RFID reader, RFID tag, LCD display, ESP8266 Wi-Fi module, and a database manager. The system allows customers to receive e-bills via email and view purchase details on the shop's website. With global IoT-based accessibility, administrators can manage data from anywhere.

- The research paper on "Automated Smart Trolley System using RFID Technology" suggests findings relevant to our project on smart cart automatic billing with RFID technology and Node MCU. The study highlights the time constraints faced by customers and introduces an innovative solution. The proposed smart trolley, utilizing Node MCU and RFID tags, efficiently scans and displays product information on an OLED screen, allowing customers to track their purchases and costs in real-time. This approach not only enhances the shopping experience but also significantly reduces the time spent at the billing counter. These findings inspire our project, indicating that integrating RFID technology and Node MCU could lead to a more efficient and customer-friendly smart cart system.

- The paper on "The IoT-Based Smart Shopping Trolley System" proposes an IoT-integrated smart cart to elevate the supermarket shopping experience. The system, equipped with sensors and microcontrollers, interacts with a cloud-based server and a mobile app. It features item detection, displaying the total cost on an LCD screen, and enables customers to manage their purchases through a mobile application. The cloud server provides real-time analytics for store managers, offering insights into popular

products and inventory levels

.

- The paper on "Smart Trolley Using Automated Billing Interface" proposes an innovative design incorporating RFID technology and Arduino for shopping trolleys. This design empowers customers to independently scan products, while also providing a web interface for bill generation and an automated payment interface. The integration of the ESP8266 module enhances connectivity, aiming to reduce billing time, alleviate queue pressure at counters, and enhance the overall shopping experience [11].

- The "Smart Trolley" research paper introduces a practical solution to address long queues at billing counters during peak times in markets and shopping malls. By incorporating a barcode reader and an LCD screen into the shopping trolley, the system automates the billing process. As items are placed in the trolley, the barcode reader detects product barcodes, and the LCD screen displays relevant details, effectively adding the item cost to the bill. This innovation eliminates the need for traditional counter-based billing, offering a streamlined approach to the checkout process and mitigating the issue of extended queues.
- The paper on "Smart Shopping Trolley Using IoT" suggests an innovative solution to tackle time-consuming billing processes during busy periods in supermarkets. By integrating a Raspberry Pi device with a barcode scanner and an LCD display, the proposed automatic shopping trolley empowers customers to self-scan products and generate bills. This approach aims to eliminate long queues at billing counters, especially during sales and holidays.

V. BLOCK DIAGRAM

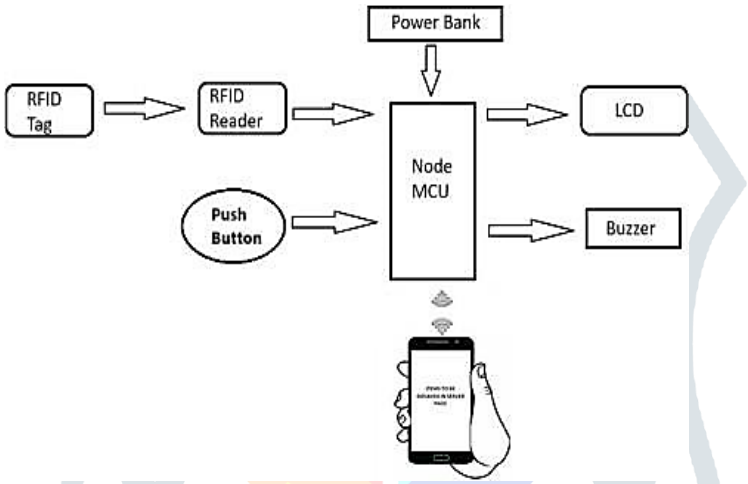

fig. 1 block diagram

1. Node MCU (ESP8266) Microcontroller:
- A microcontroller board based on the ESP8266 chip, used for wireless communication and control in smart trolleys.
- Typically operates at around 5V and consumes varying amounts of power depending on usage (usually in the range of a few hundred milliwatts).

2. RFID Module - Radio-Frequency Identification
- A device for reading RFID tags to identify items in the smart trolley.
- Generally operates at 3.3V or 5V,with power consumption varying based on the model and mode of operation (typically less than 200mA).

3. LCD Display - Liquid Crystal Display
- A visual interface for displaying information and feedback on the smart trolley's status.
- Commonly operates at 5V, consuming power depending on the display size and backlight intensity (typically between 100mA to 300mA)

4. Push Button - Input Component
- The input button on the trolley facilitates users in instantly sending data, like scanned items, to the cloud, ensuring real-time updates for a seamless and accurate shopping experience.

5. Power Bank - Portable Power Source
- A portable battery source used to supply power to the smart trolley's components.
- Lithium-ion cell Generally operates at 3.7 V and battery capacity of 2200 mAh.

6. Buzzer- Sound Device
- An electric signaling device that makes a buzzing sound
- Commonly operates at 5V.

VI. CIRCUIT DIAGRAM

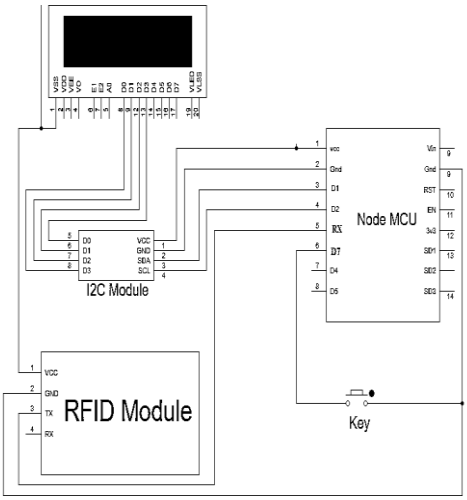

fig. 2 circuit diagram

Using a Wireless network for shopping is demonstratedsuccessfully by this project. Hence we can conclude that this is one of the efficient ways we can use. By using the RFID technique we are making billing process happen fast. The proposed systemis highly genuine dependable, reliable, equitable and time- effective due to passive mechanism the system is energy constraint .the adding and reducing item. mechanism in the trolley is also very simple hence there is no complexity if user don't want to purchase any item which he/she earlier put in the trolley hence the mechanism of trolley is flexible and hence it makes implementation simpleand also help to reduce long queue during billing section.

The Smart-Cart, a cutting-edge shopping solution incorporating IoT-enabled technology in a traditionalshopping trolley, holds immense promise for revolutionizingthe retail experience. By seamlessly integrating IoT sensorsand connectivity, this innovative cart not only enhances convenience but also provides retailers with valuable insights into consumer behavior. In conclusion, the Smart- Cart offers a range of benefits for both shoppers and retailers.

For shoppers, it delivers a more streamlined and efficientshopping experience. The IoT-enabled trolley is equipped with sensors that automatically detect and add items to thevirtual cart, reducing the need for manual scanning orcheckouts. This saves time and minimizes the chances offorgetting items. Additionally, the Smart-Cart can providereal-time product information, including pricing,promotions, and product reviews, helping consumers makeinformed purchasing decisions.

For retailers, the Smart-Cart serves as a powerful tool for data collection and analysis. It gathers data on shoppingpatterns, popular products, and peak shopping hours. This information can be leveraged to optimize store layouts, inventory management, and marketing strategies. Retailers can also offer personalized recommendations and promotions to customers based on their shopping history. This data-driven approach can lead to increased customer satisfaction and higher sales.
In summary, the Smart-Cart is a game-changer in the retail industry, enhancing the shopping experience for consumersand providing retailers with valuable data-driven insights.

VII. INTERFACE OF WEBPAGE

1. **Home page of Smart Cart:** The first interface of a project model webpage for a smart cart is commonly referred to as the "home page." The home page is the initial web page that users encounter when they visit a website. It serves as the entry point to the project, providing essential information, billing and payment options for the user.

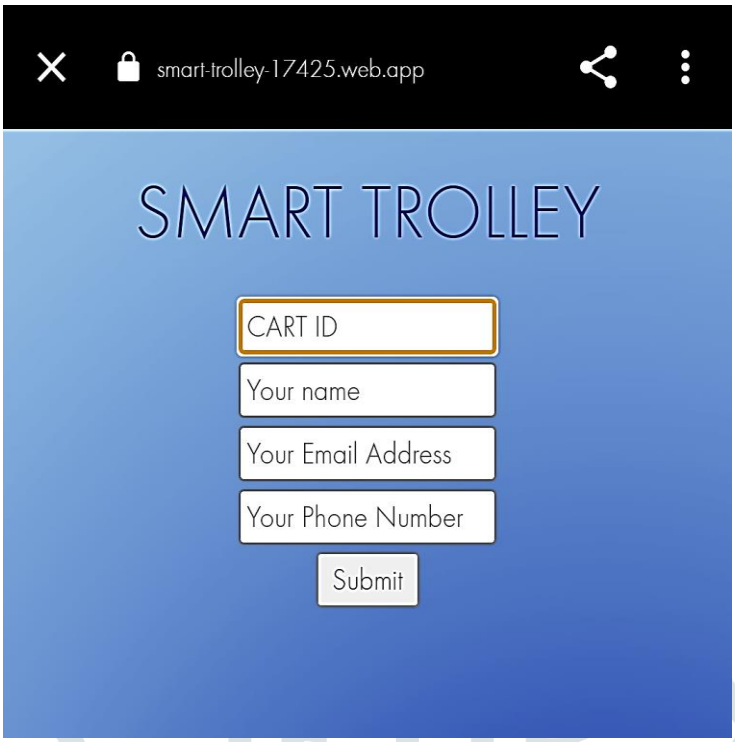

fig. 3 home page of smart cart

2. Checkout page of Smart cart: The second interface of a project model webpage for a smart cart, specifically for bill and payment functionalities, is commonly referred to as the "checkout page". This is the section of the website or application where users review the items in their cart, confirm their purchases, and proceed to make payments.
Key elements on the checkout page may include:

- Item Summary: A list of items in the cart, along with quantities and prices.
- Total Amount: The total cost of the items in the cart.
- Trolley ID: A unique identifier for the smart cart being used.
- Billing Information: Fields for users to input their billing details.

fig. 4 checkout page of smart cart

3. Webpage QR for Smart Trolly Web Site: To streamline the payment process for smart trolley users, a QR code has been generated for the website. This QR code, created using a QR code generator, contains a dynamic payment link reflecting the total amount and transaction details. Users can scan the QR code using their mobile devices, directing them to the payment page on the smart trolley website. The QR code is integrated into the checkout or payment section, providing a quick and convenient way for

users to complete their transactions. It is recommended to test the QR code for functionality and security before making it publicly available, and clear instructions should be provided to guide users through the payment process.

fig. 5 webpage qr for smart trolly web site

VIII. WORKING PRINCIPLE

The Smart Cart Shopping system operates on a sophisticated integration of IoT-enabled devices to revolutionize the shopping experience. In this innovative approach, RFID tags are affixed to each product, storing specific information about the item. While the details within the RFID tags may vary among malls, essential information like the product name and cost is standardized across all establishments. The comprehensive database of the main server stores all information about the products available in the supermarket or mall.

When a customer wishes to purchase a product, they engage with the Smart Cart by scanning the RFID tag attached to the item using the integrated RFID reader. Instantaneously, the RFID reader identifies the product and retrieves its information from the central database. Subsequently, the LCD display on the shopping cart dynamically presents the product name and cost, allowing customers to make informed decisions as they shop.

The unique feature of the system lies in its real-time processing capability. As additional products are scanned, the RFID reader deducts the corresponding amounts from the total displayed on the LCD, ensuring an accurate and continually updated view of the total purchase amount. Once the shopping is complete, the customer presses a designated key on the shopping trolley, signalling the end of the shopping session.

To obtain the final bill, the customer proceeds to the billing counter, where they provide their information. The shopping trolley number, coupled with the customer details, is then transmitted to the webserver of the mall. The webserver is updated with the total price of the products present in the customer's shopping trolley, and a bill is promptly generated. This bill reflects the items purchased and their respective costs. The customer can then choose to make their payment, either in cash or through a cashless method, at the counter. This seamless integration of RFID, Node MCU, LCD display, and QR code payment system redefines the traditional shopping experience, providing efficiency, transparency, and convenience for both customers and retailers alike.

IX. RESULT & DISCUSSION

Result:

Here are some potential outcomes and advantages of using IoT-enabled shopping trolleys:

1. Enhanced Shopping Experience: Smart-Carts can provide customers with a more convenient and interactive shopping experience. They can access product information, find discounts, and even receive personalized recommendations through a smartphone app or the cart's built-in display.
2. Inventory Management: Retailers can use IoT data from Smart-Carts to monitor inventory levels in real-time. This can help optimize stock levels, reduce out-of-stock situations, and improve the overall supply chain.
3. Smart Checkout: Smart-Carts can enable a seamless and automated checkout process. Items are automatically added to the digital cart as they are placed in the physical cart, and customers can complete the purchase without the need for traditional checkout lines.
4. Product Information: Customers can access detailed product information, including ingredients, nutritional facts, and user reviews by scanning barcodes or using RFID technology. This helps them make informed choices.
5. Reduced Theft: Smart-Carts can incorporate security features like RFID-based anti-theft systems, which can deter shoplifting and improve store security.
6. Sustainability: IoT-enabled trolleys can help reduce paper usage through digital receipts and encourage customers to make more sustainable choices by providing information on eco-friendly products.
7. Customer Loyalty: By providing a more convenient and personalized shopping experience, Smart-Carts can enhance customer satisfaction and loyalty, leading to repeat business.

Overall, the result of using IoT-enabled shopping trolleys is to create a more efficient, engaging, and data-driven shopping experience for customers while helping retailers streamline their operations and increase sales.

Discussion:

Smart-Cart, a revolutionary concept in the world of shopping, brings together the power of IoT and traditional grocery trolleys to create a seamless and efficient shopping experience. This innovative shopping solution is designed to enhance convenience, efficiency, and overall customer satisfaction. Smart-Cart is equipped with various sensors and connected tothe internet, allowing it to offer a wide range of features and benefits to both customers and retailers.

Smart-Cart, a revolutionary concept in the world of shopping, brings together the power of IoT and traditional grocery trolleys to create a seamless and efficient shopping experience. This innovative shopping solution is designed to enhance convenience, efficiency, and overall customer satisfaction. Smart-Cart is equipped with various sensors and connected tothe internet, allowing it to offer a wide range of features and benefits to both customers and retailers.
One of the primary advantages of Smart-Cart is its ability to assist customers throughout their shopping journey. With built-in sensors, it can automatically scan and add items to the cart as they are placed in it, eliminating the need for manual item scanning or checkout lines. This not only saves time for customers but also reduces the chances of human error during the checkout process.

Additionally, Smart-Cart can provide customers with real-time information about product availability, prices, and discounts. It can also suggest relevant products or promotions based ona customer's preferences and previous purchases, creating a personalized shopping experience. This level of customization can lead to increased sales for retailers and a more satisfying shopping experience for customers.

Furthermore, Smart-Cart can help retailers with inventory management. By tracking product movement and stock levels, it enables stores to optimize their restocking processes, reducing waste and ensuring that popular items are always in stock. This not only benefits the retailer butalso contributes to a more efficient supply chain and reduced environmental impact.
The IoT technology in Smart-Cart also opens up opportunities for retailers to engage with customers through their smartphones. For example, a retailer can send notifications to a customer'ssmartphone regarding ongoing sales, special offers, or product recommendations based on their cart contents. This direct communication enhances the shopping experience and encourages customers to make informed purchasing decisions.

In conclusion, Smart-Cart is a significant step forward in the evolution of the shopping experience. By seamlessly integrating IoT technology with traditional shopping carts, it streamlines the entire process for both customers and retailers.

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ONLINE RESOURCES AND TUTORIALS:

1. Instructables (https://www.instructables.com/) - Search for IoT and smart cart projects.
2. Hackster.io (https://www.hackster.io/) - Browse through IoT and electronics projects.
3. Arduino Project Hub (https://create.arduino.cc/projecthub) - Explore various IoT projectsusing Arduino, including smart cart applications.

BOOKS:

1. "Internet of Things: Principles and Paradigms" by Rajkumar Buyya, Amir Vahid Dastjerdi,and Samar Al-Masalmeh
2. "Building Arduino Projects for the Internet of Things: Experiments with Real-WorldApplications" by Adeel Javed
3. "IoT Solutions in Microsoft's Azure IoT Suite: Data Acquisition and Analysis in the RealWorld" by Scott Klein and Manfred Helber
4. "Internet of Things with Raspberry Pi 3" by Maneesh Rao