



GESTURE CONTROLLED SMART SHOPPING TROLLEY

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Abstract: The smart shopping cart project aims to revolutionize the traditional shopping experience by incorporating cutting-edge technologies to enhance efficiency and customer satisfaction. The primary objectives include streamlining the checkout process through automation, utilizing RFID technology for accurate product tracking, and implementing real-time inventory management. The project seeks to provide a personalized shopping journey by offering tailored product recommendations based on customer preferences. Integration with mobile devices allows customers to interact seamlessly with the cart, view their shopping lists, and make payments through mobile apps. The smart shopping cart is designed to adapt to various store layouts, promote sustainability, and contribute to cost efficiency with a positive return on investment. Real-time analytics offer insights into customer behavior and store performance, while features supporting promotions, discounts, and loyalty programs enhance the overall shopping experience.

Index Terms – IoT, Arduino, Smart Shopping, Sustainability, Smart assistance, Voice control.

I. INTRODUCTION

In this era of multiplexes and malls, normally we face huge rushes and crowds while we go shopping. The purpose of this innovation is to improve upon the conventional method of shopping by making it simple and fast. People generally spend much of their time in shopping. So we need to make this process of shopping simpler and more efficient. A shopping complex is a place where we can find everything from household groceries to the heavy machinery and so on. Nowadays, everyone is busy. People don't want to waste their precious time queuing behind the billing counters instead they want to utilize this time on some other important works. While shopping, trolley plays an important role in carrying all the items. After selecting all the items, we go to the billing counter and have to wait in the long queue for our turn. Shopping nowadays can be done in 2 ways: online shopping & offline shopping.

Online shopping does not require us to go to the shopping complex. We just tap 2 or 3 buttons on our mobile and it is done. In offline shopping, we have to go to a shopping complex and collect all the items of need. At shopping complexes, we see a huge crowd at the counter and it is one of the reasons why people prefer online shopping more. To reduce or to eliminate this problem we need a smart trolley which is similar to the regular trolley but with a more advance function embedded in it. With the help of RFID technology and LCD, we can get shopping bills easily without being involved in any type of queue. This will save us time and hard work. With this trolley, we save time and money. This is also an opportunity that helps the customer by displaying the product catalog and its relevant costs. This approach assists the management unit of innovation by improving the purchase of individual products.

II. LITERATURE SURVEY

According to [1] in 2014, the combination of RFID and Zigbee technology is used to create a prototype of an efficient, automated central bill system for supermarkets and malls. The data transfer between microcontroller and EEPROM is made through I2C serial protocol. Since AT24C02 is two line serial I2C enabled IC. In this research using PID, customers no need to wait near cash counters for their bill payment.

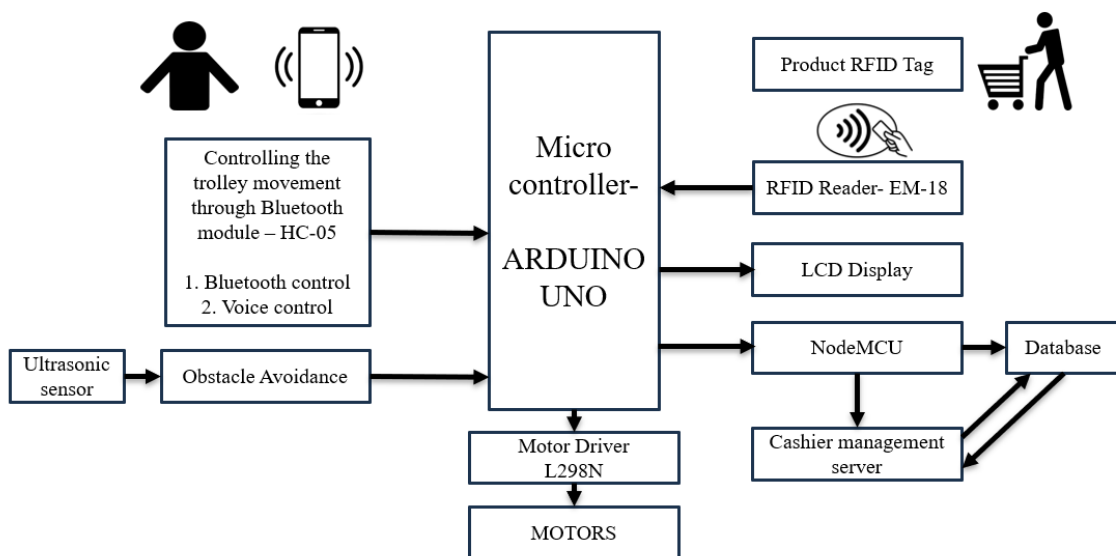
According to [2] in 2020, An initiative for complete automated customer following trolley was taken which calculates the total sum of grocery items inside the trolley to be purchased by the customer. In the current research, the use of RFID and Raspberry pi are vital. The proposed model uses the concept of color tagging system, which is less expensive in terms of computation complexity, and image processing hence reduce the power conception, which is vital in the case of a trolley as frequent charging of moving trolley is not acceptable to business environment.

According to [3] in 2021, The problem of standing in a long line at the shopping complex counter was identified, which resulted in total wastage of time for people. This research was mainly for the middle class people who go for shopping from their busy schedule and waste time at the billing counter. The implementation of this system included the use of Barcode scanner, Raspberry pi and touch screen module that displays the purchase details. They made an attempt to create a prototype suitable for a shopping environment and to avoid the crowd.

III. PROPOSED SYSTEM

The smart shopping trolley project represents a holistic approach to modernizing the shopping experience by incorporating advanced technological features. Central to its functionality is the utilization of RFID (Radio Frequency Identification) technology, which enables the trolley to automatically identify and record items placed inside it. This RFID system is managed by a NodeMCU microcontroller, a versatile device based on the ESP8266 Wi-Fi module, which facilitates seamless communication with the store's server. Through this connection, the trolley is able to provide customers with real-time updates on their total bill as they shop, ensuring transparency and convenience. Moreover, the integration of Telegram's API allows for the transmission of bill details directly to customers' Telegram accounts, providing an accessible and user-friendly means of tracking purchases.

Beyond its billing capabilities, the smart shopping trolley also features an innovative robotic mechanism that enables autonomous movement within the store environment. Controlled via Bluetooth, customers can interact with the trolley using either voice commands or arrow keys through a smartphone app. This intuitive control system enhances the overall shopping experience by offering flexibility and ease of use.



To ensure the safety and efficiency of its movement, the trolley is equipped with an obstacle avoidance system. Utilizing sensors such as ultrasonic or infrared sensors, the trolley can detect obstacles in its path and promptly adjust its trajectory to avoid collisions. In the event of an obstacle detection, a buzzer alerts the user while the trolley navigates around the obstruction, ensuring uninterrupted progress through the store.

The integration of these components and functionalities is executed seamlessly, with a dedicated smartphone app serving as the central interface for users. In addition to providing control over the trolley's movement, the app displays the current bill and notifies users of any updates or alerts. Robust security measures, including data encryption and user authentication, are implemented to safeguard sensitive information and protect user privacy throughout the shopping experience.

Through rigorous testing and continuous feedback from users, the project aims to refine and optimize the smart shopping trolley to meet the evolving needs and expectations of both customers and store operators. By combining technological innovation with user-centric design principles, the project seeks to redefine the shopping experience and set new standards for convenience, efficiency, and customer satisfaction.

3.1.HARDWARE COMPONENTS

1) Arduino UNO

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

Specifications:

- Serial Pins 0 (Rx) and 1 (Tx): Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
- External Interrupt Pins 2 and 3: These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- PWM Pins 3, 5, 6, 9 and 11: These pins provide an 8-bit PWM output by using analogWrite () function.
- SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK): These pins are used for SPI communication.
- In-built LED Pin 13: This pin is connected with an built-in LED, when pin 13 is HIGH – LED is on and when pin 13 is LOW, its off.



2) Motor Driver : L298N H Bridge

This dual bidirectional motor driver is based on the very popular L298 Dual H-Bridge Motor Driver IC. This module will allow you to easily and independently control two motors of up to 2A each in both directions. It is ideal for robotic applications and well suited for connection to a microcontroller requiring just a couple of control lines per motor. Two motors on each side was made to rotate as one by shorting and connecting them parallelly to each output ports of the Motor Driver circuit.

Specifications:

- Logical voltage: 5V
- Drive voltage: 5V-35V.
- Logical current: 0-36mA
- Drive current: 2A (MAX single bridge)



3) Bluetooth module – HC05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module shown in Fig. 4.3, it is used in a Master or Slave configuration, making it a great solution for wireless communication. The Bluetooth module HC-05 is

a MASTER/SLAVE module. By default, the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by ATCOMMANDS. The slave modules cannot initiate a connection to another Bluetooth device but can accept connections. The master module can initiate a connection to other devices.

Specifications:

- Serial Bluetooth module for Arduino and other microcontrollers
- Operating Voltage: 4V to 6V (Typically +5V)
- Operating Current: 30mA
- Range:<100



4) *NodeMCU*:

The NodeMCU (*Node Microcontroller Unit*) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

Specifications:

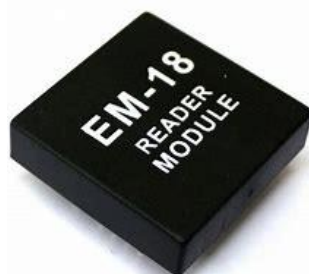
- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- RAM: 128Kb
- Flash memory: 4 MB
- Maximum clock speed: 160MHz (80 -160)
- Operating current: 80mA (average)
- Wi-Fi: 2.4GHz 802.11b/g/n with on-board antenna which supports WPA/WPA2
- GPIO: 17, 11 are usable (6 are used for communication with the onboard flash memory chip) and some of them support PWM



5) *RFID tags and readers*:

The EM-18 RFID Reader module operates at 125kHz is an inexpensive solution for your RFID based application. The Reader module comes with an on-chip antenna and can be powered up with a 5V power supply. Power-up the module and connect the transmit pin of the module to receive the pin of your microcontroller. Show your card within the reading distance and the card number is thrown at the output. Optionally the module can be configured for also a Wiegand output.

RFID TAGS are mainly divided in to two types - PASSIVE RFID TAGS and ACTIVE RFID TAGS. Passive RFID Tags are the Tags with no internal power source. And Active RFID Tags are Tags with their own power source. In Passive RFID Tags, have generally two main components. One is ANTENNA COIL and



another is MICROCHIP, there is no battery or any other active power here.

3.2. NECESSITY FOR IMPLEMENTING THE SYSTEM

The traditional shopping trolley is upgraded with smart technology. This includes features such as sensors and connectivity modules (Bluetooth) to enable communication with other devices. Users can navigate the

smart shopping trolley using their voice commands or by controlling it via arrows on their smartphone app. Voice control offers hands-free operation, while arrow control provides precise directionality.

The smart shopping trolley is equipped with RFID (Radio-Frequency Identification) technology. Each product in the store is tagged with an RFID tag containing product information and pricing. As items are placed into the trolley, RFID readers located within the trolley scan the RFID tags on the products. The system automatically adds the scanned items to the user's virtual shopping cart. When the user has finished shopping, they can proceed to a designated checkout area. The RFID system calculates the total cost of the items in the virtual cart based on the scanned RFID tags. Users can pay for their purchases directly through UPI payment or they can opt for traditional payment methods at the billing counters.

This innovative system offers several benefits, including convenience for shoppers, reduced checkout times, improved inventory management for retailers, and potential cost savings by minimizing the need for manual labor at checkout counters.

Overall, the integration of voice and arrow control for navigation, coupled with automatic billing using RFID technology, transforms the traditional shopping experience into a more streamlined and efficient process.

3.3. FUTURE SCOPE

The future scope for the smart shopping trolley project holds immense potential for further advancements and innovations in the realm of retail technology. One avenue for development lies in the integration of advanced artificial intelligence (AI) algorithms to analyze customer behavior and preferences, allowing the trolley to offer personalized recommendations and tailored shopping experiences. Additionally, there is room for enhancing the trolley's autonomy through autonomous navigation and mapping capabilities, enabling it to navigate seamlessly within the store environment while avoiding obstacles and optimizing its path. Augmented reality (AR) technology could also be incorporated to provide customers with interactive shopping assistance, allowing for immersive product experiences and virtual information displays. Furthermore, integrating the trolley with smart home systems could enable customers to manage their shopping lists and preferences from home, facilitating convenient pickup or delivery options. Biometric authentication features and expanded language support can enhance security and accessibility, respectively, catering to diverse customer needs. Leveraging data analytics and predictive insights can offer valuable insights into customer behavior and market trends, empowering retailers to make informed decisions and optimize their operations. Collaborations with retailers and manufacturers could unlock opportunities for exclusive promotions and customized experiences, fostering brand loyalty and customer engagement. Lastly, sustainability initiatives could be integrated to promote eco-friendly shopping practices and raise awareness of environmental impacts, aligning with growing consumer preferences for ethical and sustainable consumption. Through continued innovation and collaboration, the smart shopping trolley project can continue to redefine the shopping experience and meet the evolving needs of customers and retailers in the digital age.

IV. METHODOLOGY

Implementing the smart shopping trolley project begins with careful selection and integration of appropriate technologies. This involves choosing components such as RFID readers, NodeMCU boards, Bluetooth modules, motors, and sensors, ensuring compatibility and interoperability between them. The hardware components are then assembled into a functional prototype, taking into account factors like size, weight, power consumption, and durability. Concurrently, software development is undertaken to create firmware for the NodeMCU microcontroller, smartphone applications for user control and interface, and algorithms for obstacle detection and avoidance. This step requires meticulous attention to detail to ensure that the software seamlessly interacts with the hardware components.

Integration with external systems is another critical aspect of the implementation process. Communication protocols and APIs are established to connect the smart shopping trolley with the store's server, inventory management software, and payment gateways. Compatibility with existing systems is ensured to enable smooth data exchange and functionality. Rigorous testing of both hardware and software components follows, with a focus on functionality, reliability, and performance. The RFID system is tested for accurate product

identification and billing, while the Bluetooth control mechanism and obstacle avoidance system are evaluated for responsiveness and effectiveness.

User training and support are essential elements of successful implementation. Training materials such as user manuals, tutorials, and troubleshooting guides are developed to assist store staff and customers in effectively interacting with the smart shopping trolley. Pilot deployment in select stores or test facilities allows for real-world evaluation and feedback gathering. This feedback is then used to identify areas for improvement and iteration, such as user interface enhancements, performance optimizations, and additional features. The iterative improvement process ensures that the smart shopping trolley continuously evolves to better meet the needs of users and stakeholders, ultimately delivering an enhanced shopping experience and improved operational efficiency.

V. RESULTS AND DISCUSSIONS

The implementation of the smart shopping trolley project has yielded promising results and sparked insightful discussions regarding its functionality and potential impact. Through rigorous testing and validation, it was observed that the RFID-based billing system accurately identifies and logs products in real-time, providing customers with transparent and convenient billing experiences. The integration of Bluetooth-controlled robotic movement and obstacle avoidance mechanisms further enhances the usability and safety of the trolley within store environments. Additionally, the implementation of Telegram integration for bill notifications received positive feedback from users, highlighting its effectiveness in providing seamless communication and updates. Discussions surrounding future enhancements and optimizations focused on areas such as AI integration for personalized recommendations, advanced navigation algorithms for autonomous movement, and sustainability initiatives to promote eco-friendly shopping practices.

VI. CONCLUSION

The smart shopping trolley project represents a significant advancement in retail technology, offering a comprehensive solution to enhance the shopping experience for customers while improving operational efficiency for retailers. Through the seamless integration of RFID technology, Bluetooth-controlled robotic movement, and obstacle avoidance systems, the smart shopping trolley provides customers with a convenient and interactive shopping experience. The project's successful implementation and positive feedback from users demonstrate its potential to redefine the future of retail. Looking ahead, further advancements in AI integration, autonomous navigation, and sustainability initiatives hold promise for continued innovation and improvement in the smart shopping trolley's capabilities. Overall, the project serves as a testament to the power of technology to transform traditional retail practices and deliver enhanced value to both customers and retailers alike.

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References:

- [1] "Smart Shopping Cart with Automatic Billing System through RFID and ZigBee" by Mr. P. Chandrasekar and Ms. T. Sangeetha in the year of 2014.
- [2] "Human Friendly Smart Trolley With Automatic Billing System" by Hanooja T, Raji C.G and Sreelekha M in the year of 2020.
- [3] "Smart Trolley" by Shailesh, Pragati Shrivastava Deb, Rajan Chauhan. Vaibhav Tyagi in 2021.