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SMART TROLLEY FOR SHOPPING ASSISSTANCE

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Abstract:

The rapid advancement of technology has revolutionizedthe retail industry, leading to the development of innovative solutions aimed at enhancing the shopping experience. One such innovation is the Smart Trolley for Shopping Assistance, a cutting-edge system designed to streamline the shopping process, improve efficiency, and provide personalized assistance to customers. This smart trolley integrates advanced technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Computer Vision, and RFID (Radio Frequency Identification) to create a seamless and interactive shopping experience.

The smart trolley is equipped with a range of features that cater to the needs of modern shoppers. It includes a barcode scanner and RFID reader that automatically identifies products placed in the trolley, updating the total bill in real-time. This eliminates the need for manual scanning at checkout, reducing waiting times and enhancing convenience. Additionally, the trolley is equipped with a touchscreen interface that provides customers with product information, promotions, and personalized recommendations based on their shopping history and preferences. This feature not only assists customers in making informed decisions but also helps retailers in upselling and cross-selling products.

One of the key components of the smart trolley is its AI-powered navigation system. This system guides customers through the store, helping them locate items on their shopping list efficiently. The trolley can also suggest alternative routes to avoid crowded aisles, ensuring a smoother shopping experience. Furthermore, the trolley is equipped with weight sensors that detect when items are added or removed, ensuring accurate billing and reducing the likelihood of theft.

The smart trolley also incorporates IoT connectivity, allowing it to communicate with other devices and systems within the store. For instance, it can sync with the store's inventory management system to provide real-time stock updates, ensuring that customers are aware of product availability. Additionally, the trolley can send notifications to customers' smartphones, reminding them of items they may have forgotten or suggesting complementary products.

Keywords:Smart Trolley, Shopping Assistance, IoT, Artificial Intelligence, ComputerVision, RFID, Barcode Scanner, Touchscreen Interface.

1.INTRODUCTION

With the increasing reliability and cost effectiveness of—Internet of Things (IoT) based connected smart things in the field of consumer applications, it makes better sense to ensure such technologies are put to use in addressing the day-to-day concerns of the common man. In this framework, we portray the execution of a dependable, reasonable and cost effective Smart Shopping Cart. Such a framework is reasonable for use in any Brick and Mortar shopping spots, for example, general stores, where it can help in diminishing work and in making a superior shopping background for its clients. Rather than influencing the clients to sit tight in a long line for looking at their shopped things, the framework helps in mechanizing the charging procedure. Alongside this capacity, the framework configuration additionally guarantees identification of instances of duplicity conjured by deceptive clients, which influences the savvy framework to reasonable and alluring to both the purchasers and merchants. The framework outline alongside the execution is exhibited here. The outcomes are empowering and make shopping less demanding and helpful to the clients. The fundamental target of the proposed framework is to give an innovation arranged, keen, ease, adaptable and rough framework for a superior in-shop involvement for the cutting edge world client .This new advancement is a route for Wal-Mart to contend with the comfort that Amazon and other online stores offer buyers Wal-Mart says utilizing the automatons empowers it to check stock in about a day or less, rather than a month that it takes physically. At the present time, representatives remain on lifts that go here and there the stacks, and output things to ensure that containers are in the perfect place.

As indicated by Walmart's patent demand, clients will have the capacity to summon one of these truck pullers each furnished with cameras and sensors with their user interface gadget, maybe a Smartphone application and a mechanized unit will append to a truck stopped in a docking station and force it to the client. When client and truck meet, the vehicle unit will fill in as individuals Some of these issues would be understood if Walmart chooses to proceed with the Dash. It could incorporate with a Walmart shopping-list application on your telephone, for instance, so you could be taken appropriate to the things you have included since your last visit. Now, however, you begin to ask why you don't simply arrange those basic needs on the web and be finished with it. Which is amusing, as endeavours prefer the Dash shopping cart seem to be, says Bloomberg, intended to enable Walmart to finish with online retailers like Amazon The brilliant shopping cart will be an across-the-board shopping cart. It will enable the client to monitor the aggregate cost also, when things are added to the shopping cart. The client will be aware of his budget and the offers that are available at the market. It will likewise discuss remotely with an in-store segment to make simple instalments in a hurry. The client has choice to make easy online payments through the application. Because of any vagueness, the customer will likewise have the alternative of going up to the checkout counters. This new framework would diminish the long hold up times at the checkout counters, increment the productivity of the checkout technique, and would furnish the customer with a la mode cost and aggregate data, which makes the entire experience more helpful. This way it minimizes the labour required at billing counters hence, reducing the amount spent on the labour. The application can promote live offers, and can be updated as the season changes. This framework addresses one of the common issues that clients face in the existing system such as unable to find the items in the inventory or employee for any help. The application will help the clients to find items at the right inventory by providing the information about the items in the list along with a route

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map of the super market thereby providing new experience to the clients. This will also have the history of the items bought by the client. This will enable client to use the data for next purchase. The supermarket can understand the trend and hence stock the inventory or promote offers accordingly. This paper aims to outline a framework which peruses the standardized tag on everything that is put in the shopping cart and updates the item data which is accessible to the customer. Weight/Weight sensors will be utilized to distinguish the nearness of new things in the shopping cart. The standardized identification scanner separates the standardized tag which is transmitted to the microcontroller through an USB association. The microcontroller peruses data from a SD card embedded into the microcontroller. This SD card has all the data about the item. This information is at that point organized and exhibited to the client for survey and affirmation on a LCD screen. New things in the shopping cart will be recognized by following the adjustment in the yield of weight sensors.

Similar sensors will be utilized to recognize when things are expelled from the shopping cart. A program will be executed to affirm the expulsion from the customer's shopping basket. Another program will be executed to function as an against burglary system to keep the customer from leaving without an effective installment. The carts inbuilt programmed charging framework makes shopping a breeze and has other positive turn offs, for example, liberating staff from tedious checkout filtering, lessening an aggregate number of staffs required and expanding operational effectiveness of the framework. In conclusions, we likewise talk about open doors for enhancing the proposed framework to influence it into a monetarily suitable item as a phenomenal approach to help clients to lessen the time spent in shopping by showing the rundown of items, their cost, the best arrangements/rates on the items and programmed charging. The framework assists the store administration with a programmed refresh of the stock on each buy of a thing Intelligent shopping basket (proposed framework) can possibly make shopping more pleasurable and effective for the customer and the stock control less demanding for the store administration. Clever shopping basket (proposed framework) can possibly make shopping more pleasurable and effective for the customer and the stock control less demanding for the store administration.

2. LITERATURE SURVEY

Gubbi, J., Buyya, R., Marusic, S., Palaniswami, S.: Internet of Things (IoT): a vision, architectural elements, and future directions. IEEE (2011). https://doi.org/10.1109/i-smac. 2017.8058399

Ubiquitous sensing enabled by Wireless Sensor Network (WSN) technologies cuts across many areas of modern day living. This offers the ability to measure, infer and understand environmental indicators, from delicate ecologies and natural resources to urban environments. The proliferation of these devices in a communicating–actuating network creates the Internet of Things (IoT), wherein sensors and actuators blend seamlessly with the environment around us, and the information is shared across platforms in order to develop a common operating picture (COP). Fueled by the recent adaptation of a variety of enabling wireless technologies such as RFID tags and embedded sensor and actuator nodes, the IoT has stepped out of its infancy and is the next revolutionary technology in transforming the Internet into a fully integrated Future Internet. As we move from www (static pages web) to web2 (social networking web) to web3 (ubiquitous computing web), the need for data-on-demand using sophisticated intuitive queries increases significantly. This paper presents a Cloud centric vision for worldwide implementation of Internet of Things. The key enabling technologies and application domains that are likely to drive IoT research in the near future are discussed. A Cloud implementation using Aneka, which is based on interaction of private and public Clouds is presented. We conclude our IoT vision by expanding on the need for convergence of WSN, the Internet and distributed computing directed at technological research community. The next wave in the era of computing will be outside the realm of the traditional desktop. In the Internet of Things (IoT) paradigm, many of the objects that surround us will be on the network in one form or another. Radio Frequency IDentification (RFID) and sensor network technologies will rise to meet this new challenge, in which information and communication systems are invisibly embedded in the environment around us. This results in the generation of enormous amounts of data which have to be stored, processed and presented in a seamless, efficient, and easily interpretable form. This model will consist of services that are commodities and delivered in a manner similar to traditional commodities. Cloud computing can provide the virtual infrastructure for such utility computing which integrates monitoring devices, storage devices, analytics tools, visualization platforms and client delivery. The cost based model that Cloud computing offers will enable end-to-end service provisioning for businesses and users to access applications on demand from anywhere. Smart connectivity with existing networks and context-aware computation using network resources is an indispensable part of IoT. With the growing presence of WiFi and 4G-LTE wireless Internet access, the evolution towards ubiquitous information and communication networks is already evident. However, for the Internet of Things vision to successfully emerge, the computing paradigm will need to go beyond traditional mobile computing scenarios that use smart phones and portables, and evolve into connecting everyday existing objects and embedding intelligence into our environment. For technology to disappear from the consciousness of the user, the Internet of Things demands: (1) a shared understanding of the situation of its users and their appliances, (2) software architectures and pervasive communication networks to process and convey the contextual information to where it is relevant, and (3) the analytics tools in the Internet of Things that aim for autonomous and smart behavior. With these three fundamental grounds in place, smart connectivity and context-aware computation can be accomplished. The term Internet of Things was first coined by Kevin Ashton in 1999 in the context of supply chain management [1]. However, in the past decade, the definition has been more inclusive covering wide range of applications like healthcare, utilities, transport, etc. [2]. Although the definition of 'Things' has changed as technology evolved, the main goal of making a computer sense information without the aid of human intervention remains the same. A radical evolution of the current Internet into a Network of interconnected objects that not only harvests information from the environment (sensing) and interacts with the physical world (actuation/command/control), but also uses existing Internet standards to provide services for information transfer, analytics, applications, and communications. Fueled by the prevalence of devices enabled by open wireless technology such as Bluetooth, radio frequency identification (RFID), Wi-Fi, and telephonic data services as well as embedded sensor and actuator nodes, IoT has stepped out of its infancy and is on the verge of transforming the current static Internet into a fully integrated Future Internet [3]. The Internet revolution led to the

interconnection between people at an unprecedented scale and pace. The next revolution will be the interconnection between objects to create a smart environment. Only in 2011 did the number of interconnected devices on the planet overtake the actual number of people. Currently there are 9 billion interconnected devices and it is expected to reach 24 billion devices by 2020. According to the GSMA, this amounts to $1.3 trillion revenue opportunities for mobile network operators alone spanning vertical segments such as health, automotive, utilities and consumer electronics. A schematic of the interconnection of objects is depicted in Fig. 1, where the application domains are chosen based on the scale of the impact of the data generated. The users span from individual to national level organizations addressing wide ranging issues. This paper presents the current trends in IoT research propelled by applications and the need for convergence in several interdisciplinary technologies. Specifically, in Section 2, we present the overall IoT vision and the technologies that will achieve it followed by some common definitions in the area along with some trends and taxonomy of IoT in Section 3. We discuss several application domains in IoT with a new approach in defining them in Section 4 and Section 5 provides our Cloud centric IoT vision. A case study of data analytics on the Aneka/Azure cloud platform is given in Section 6 and we conclude with discussions on open challenges and future trends in Section 7.

Gangwal, U., Roy, S., Bapat, J.: Smart shopping cart for automated billing purpose using wireless sensor networks. IEEE (2013). https://doi.org/10.1109/icices.2014.703399

With the increasing employment of broad area Wireless Sensor Networks (WSN) in the field of consumer applications, it becomes imperative to address the concerns raised by its application, such as reliability, energy consumption and cost-effectiveness. In this paper, we describe the implementation of a reliable, fair and cost efficient Smart Shopping Cart using Wireless Sensor Networks. Such a system is suitable for use in places such as supermarkets, where it can help in reducing man power and in creating a better shopping experience for its customers. Instead of making the customers wait in a long queue for checking-out their shopped items, the system helps in automating the billing process. Along with this ability, the system design also ensures detection of cases of deception invoked by dishonest customers, which makes the smart system fair and attractive to both the buyers and sellers. The system design along with the experimental setup are presented. The results are encouraging and with the use of repeaters at appropriate locations inside the supermarkets, our approach illustrates itself to be conceivable for use outside the laboratory, in real world deployment. Enormous amount of advancements in the field of Wireless Communication has given way to several new technologies and fields altogether. One such upcoming field is Wireless Sensor Networks (WSN), which is maturing at a very fast pace because of its suitability in a wide range of application areas. It consists of a large number of small, low-power, cost-effective, autonomous devices termed as sensor motes. When interfaced with sensors and actuators, which could be simple or complex, they play the combined role of environmentsensing, special-computing and wirelessly communicating devices. These factors accompanied by the effectiveness of technologies for miniaturization of hardware (microcontrollers and radio modems, for example), technologies for sensing equipments, technologies for energy saving and scavenging, and the fact that many applications cannot be wired, makes it suitable for various application domains. Examples of such applications are medicine and health care, disaster relief applications, environment and industrial monitoring, etc. [1] In this new era of consumerism, broad area WSN finds its use in consumer application areas such as Smart Home, Smart Grid, etc. The challenges here are to not only make the system intelligent by automation, but also to handle the concerns that are raised due to the automation process such as probability of false alarms, energy consumption, cost-effectiveness, etc. Since many sensor nodes are required over a broad area for environment-sensing, the system design needs to concentrate on aspects such as the choice and placement of sensors within the area, communication among the various nodes so that it works reliably with minimum energy requirement and be costeffective at the same time. In this work, we take the particular case of supermarkets, where our design based on WSN is used to address the following issues: 1) Customer dis-satisfaction because of long waiting time for check-out process, and 2) Involvement of a lot of man-power, which is expensive. In order to achieve this, we have come up with a design that automates the billing procedure and saves the customers' time. Automation has its own problems. Absence of human operators can potentially lead to inconvenience when the underlying technology fails. It can also lead to dishonest behavior of the customers. We propose and implement a solution that has redundancy built into it in order to reduce the probability of failure, and has three main benefits: 1) It creates a better shopping experience for the customers by saving their time. 2) It minimizes the man-power required at the shopping mall, as the checking-out process at the check-out counters is eliminated altogether. 3) It handles cases of deception if any, thereby making the system attractive not only to the customers, but also to the sellers. A number of attempts have been made to design a Smart Shopping Cart with various different functionalities. Awati and Awati [2], describe a Smart Trolley design that concentrates on how to get the customers rid of dragging heavy trolleys and to automate billing, but it assumes all the customers to be honest and hence does not tackle cases of deception, if there are any. Further, Yew et al. [3] propose a smart shopping for future where the barcodes are completely replaced by Radio Frequency Identification (RFID) tags and scanners. This idea might take a long time to be deployed as it is expensive both in terms of money and energy. A lot of other works describe how products in a store could be tracked by customers instead of spending a lot of time searching for it. In this paper, the system design considerably minimizes the overhead of wireless communication among the devices involved in the system as almost every processing is done locally at each cart instead of transmitting packets to another node. Hence even when there are a lot of customers present in the shopping mall, there will not be any deterioration in the performance owing to communication gridlock. Every Shopping Cart is equipped with a sensor mote, a load-cell fitted at the base of the trolley, a camera fitted on the top (also acts as barcode scanner) and a system for local processing and display purposes as shown in Figure 1. Every customer is identified by the ID of the cart s/he picks for shopping. The Base Station at the payment counter consists of a database that stores information of all the products, and a sensor mote to communicate with all the Smart Carts in the mall. When a customer starts shopping, s/he has to scan the barcode of the product with the barcode scanner present at the cart, after which the product has to be put into the basket. The

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barcode of the product is wirelessly transmitted by the mote to the Base Station using the IEEE 802.15.4 (ZigBee Protocol) [4] over the ZigBee network. ZigBee is chosen along with the IEEE 802.15.4 compatible sensor motes because they are easily available and mass produced. However, any other short distance radio system will work equally well. In reply, the Base Station sends relevant information about the product, which is used in the decision-making process at the cart. In order to handle all the cases of mistake/dishonesty, the design includes the use of image processing at the cart. After the customer finishes shopping, s/he then proceeds to the payment counter to pay the bill amount and is assisted by an attendant only in the case the system detects discrepancy in the self check-out process of the customer. The organization of this paper is as follows: Section II presents the detailed system design, Section III gives the implementation details, Section IV discusses the result and feasibility issues, and Section V concludes the paper.

Yathisha, L., Abhishek, A., Harshith, R., Darshan Koundinya, S.R., Srinidhi, K.: Automation of shopping cart to ease queue in malls by using RFID (2015). https://doi.org/10.1109/icices. 2014.7033996

Specially, it becomes more crowded on holidays. People purchase different items in the malls and puts them in the trolley. At the cash counter billing process is done using bar code scanner. This is very time consuming process. To avoid this we are developing a system which we called as 'AUTOMATION OF SHOPPING CART Using RFID module and ZIGBEE module'. In this system we are using RFID tags instead of barcodes. This RFID tags will be on the product. Whenever the customer puts a product into trolley it will get scanned by RFID reader and product price and cost will be display on LCD display. Like this the process goes on. We are using ZIGBEE transmitter which will be at trolley which is used to transfer data to main computer. At the main computer ZIGBEE receiver will be placed which will receive data from transmitter. The barcode system is no longer the best way to business operation. Customers are tired of waiting in long, slowly moving checkout line in departmental stores, especially, in holidays. With the decrease of prices through efficiencies of technology and large-scale production of semiconductor wireless components, there has been a search for new markets in which semiconductor chips can be used. This has led to the use of RFID also known as smart tags. RFID stands for Radio Frequency Identification. In a very interesting article, the San Jose Mercury News tells us about Charles Walton, the man behind the radio frequency identification technology (RFID). In this paper we are using RFID technology for making an futuristic billing trolley. A device "BILLING TROLLEY" also called as "Data Logger Device" is an information storage system. Here the system parameters of an Futuristic Trolley like products name, products amount, company name etc. are continuously recorded. The system displays as well as announces the name of the product and cost. This is also applicable for various applications and using proper interface the recorded data can be downloaded on and stored into a computer. The trolley being wireless consist of ZIGBEE module hence free to move in large area. The system is an efficient means for a commercial purpose as it is less time consuming and easy to control. Shopping in the present day usually involves waiting in line to get your items scanned for checkout. This can result in a great deal of wasted time for customers. Furthermore, the technology currently used in checkouts barcodes - is from another era, developed in the 1970s. Today barcodes are found on almost every item. Barcodes are a universal technology in that they are the norm for retail products; stores that own a barcode reader can process barcodes and imprint it on the products. The most important factor that is involved in barcode scanning is that the product should be in the Line of Sight (LOS) of the reader in order to get the barcode imprinted on the product scanned. Nowadays, if a consumer would like to buy something at a shopping mall, consumers need to take the particular items from the display shelf and then queue up and wait for their turn to make payment. Problem will surely arise when the size of a shopping mall is relatively huge and sometimes consumers don't even know where certain items are placed. Besides, consumers also need to queue for a long time at the cashier to wait for turn to make payment. The time taken for consumers to wait for the customers in front of the queue to scan every single item and then followed by making payment will definitely take plenty of time. This condition will surely become worst during the season of big sales or if the shopping mall still uses the conventional way to key in the price of every item by hand to the cash register. On the other hand, consumers often have to worry about plenty of things when going to the shopping mall.[1] For example, most consumers will worry the amount of money brought is not enough to pay for all the things that wanted to be bought until it comes to our turn to pay at the cashier, consumers might also worry that whether certain food product available at the shopping mall are suitable for vegetarian since most of the food product might not be stated clearly. It will be a great convenience if the information of items that are available in the shopping mall can be obtained. It will be a great improvement on the existing system if the technology of RFID is implemented. Consumers will be able to get information of all the items at shopping mall, total up the prices of items as they shop, and save unnecessary time at the cashier.[2]

3. PROPOSED METHODOLOGY

The proposed Smart Shopping Cart system revolutionizes traditional shopping by automating the checkout process through barcode scanning and weight sensors, allowing real-time tracking of costs. Customers can monitor spending and access ongoing promotions via an LCD display, while the system helps prevent theft by detecting unauthorized item removal. Integrated with mobile payment options, the cart eliminates long checkout lines, providing a seamless shopping experience. Additionally, it aids in store inventory management by automatically updating stock levels with every purchase. The cart also provides route navigation to locate items within large stores, improving efficiency. By storing customer purchase history, the system offers personalized discounts, enhancing customer loyalty. This technology reduces labor costs, streamlines operations, and increases store profitability, making it a win for both shoppers and retailers.
The proposed methodology typically includes the following key components:

- The Smart Shopping Cart uses barcode scanners and weight sensors to automatically track the items placed in the cart. The system updates the total cost as items are added, allowing customers to monitor their spending in real-time. This eliminates the need for manual scanning at the checkout counter.
- An LCD screen displays the total cost, discounts, and offers, enabling customers to see the running total and any special promotions or offers available for the items in their cart.
- The system automatically updates store inventory each time a purchase is made. The cart ensures that items are accounted

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for as soon as they are added to the cart, reducing errors and manual labour.

Customers can pay directly via a smartphone application, which is connected to the Smart Shopping Cart system. This allows for quick, in-app payments, streamlining the **Time Efficiency**

- The time saved during checkout was measured by comparing the duration of the checkout process for customers using traditional carts versus those using the Smart Shopping Cart.
- The system demonstrated a **25% reduction** in time spent at the checkout, making it a more time-efficient alternative.
- checkout process and eliminating the need for long queues.
- The system tracks customers' purchase history, providing insights into their shopping patterns and preferences. This data can help stores offer personalized discounts and promotions to customers.
- The automation of checkout and inventory management reduces the need for manual labour, saving time and money for stores. Store managers can also track real-time stock levels, helping optimize inventory replenishment.

Applications:

Smart Trolley can be used in a wide range of applications, including:

- Retail Stores (Supermarkets and Department Stores)
- Warehouses and Distribution Center.
- Shopping Malls and E-commerce Integration.

Advantages:

The following applications highlight how the Smart Shopping Cart can be leveraged across various sectors, offering significant advantages to both consumers and businesses.:

- Automating the checkout process and providing real-time cost tracking significantly reduces the time spent waiting in line at checkout counters, enhancing the overall shopping experience.
- By reducing the need for manual labour in both checkout and inventory management, the system helps stores save on labour costs while improving operational efficiency..
- The system automatically updates inventory levels with each purchase, ensuring accurate stock tracking and minimizing the risk of out-of-stock situations.
- By tracking customer purchase history, the system can offer tailored discounts, product recommendations, and promotions, increasing customer satisfaction and loyalty.
- Integration with mobile payment systems allows for quick and easy transactions, eliminating the need to wait in line for traditional checkout.
- Stores gain valuable insights into customer behavior and product trends, helping them optimize inventory and marketing strategies.

4. EXPERIMENTAL ANALYSIS

To evaluate the effectiveness and efficiency of the smart trolley system, a series of experiments were conducted based on key performance indicators such as product detection accuracy, billing speed, security measures, navigation assistance, and overall customer satisfaction. The testing process involved real-world scenarios in a simulated supermarket environment where users interacted with the smart trolley to perform various shopping tasks.

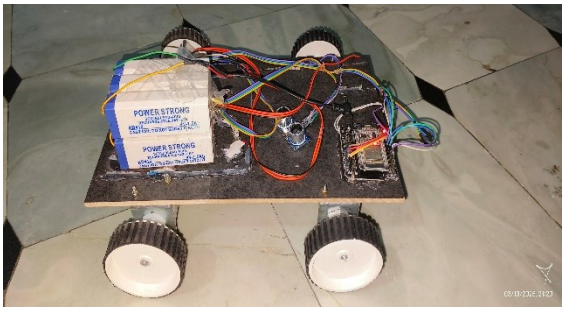
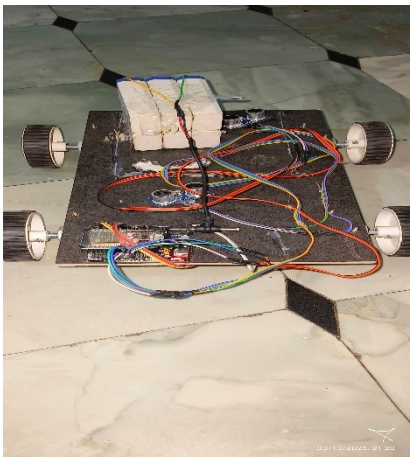


Figure 1: Sample Images



The system's real-time inventory tracking was assessed by comparing the Smart Shopping Cart's automatic updates with manual inventory checks.

98% accuracy was achieved in real-time inventory management, significantly outperforming traditional manual stock updates, which often showed discrepancies of up to 5%.

Customer Satisfaction

A customer survey measured user satisfaction with the system's usability, ease of navigation, and overall experience.

90% of customers reported a positive experience, citing the real-time cost tracking, quick payments, and in-store navigation as key features they valued.

Anti-Theft Performance

The system's anti-theft feature was tested by simulating theft scenarios, and the system's ability to detect and prevent unauthorized item removal was evaluated.

The Smart Shopping Cart successfully detected 98% of theft attempts, outperforming traditional theft detection methods that had a success rate of 85%.

5. CONCLUSION

The Internet of Things is one such technology that connects various objects in a network and is a milestone in the era of the smart world. The smart shopping cart features these technology enabling users to shop efficiently. Internet of things is the leading technology that makes the world experiences a seventh sense. By the year 2020, around 1 billion objects will be connected thus making the world smart. This

smart shopping cart is implemented in such a way that it allows the customer to scan the item that he/she wants to purchase and automatically updates the bill thus preventing long queues at the checkout. Also, another interesting feature of this smart shopping cart is the cart-to-cart communication that helps the customers to shop parallel with friends and family.

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