A Mini Project with Seminar On

Prediction of stock with On-Go billing cart using IoT

Submitted in partial fulfillment of the requirements for the award of the

Bachelor of Technology

in

Department of Computer Science and Business System

by

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CERTIFICATE

This is to confirm that the mini project titled **"STOCK PREDICTION WITH ONGOING BILLING CART USING IoT"** has been submitted by **G. Bhanu (21241A3231), N. Shirisha (21241A3239), and M. Vaishnavi (21241A3231)** as part of the requirements for the **Bachelor of Technology degree** in Computer Science and Business Systems for the academic year 2023-2024.

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DECLARATION

We hereby declare that the mini project titled **"PREDICTION OF STOCK WITH ON-GO BILLING CART USING IoT"** The above-undertaken project spans the timeframe from **September 1, 2023, to January 4, 2024.** It is presented as a partial fulfillment of the prerequisites for conferring the degree of Bachelor of Technology in Computer Science and Business Systems from Gokaraju Rangaraju Institute of Engineering and Technology, which operates autonomously under Jawaharlal Nehru Technology University, Hyderabad. The findings encapsulated in this project have not been presented for the attainment of any degree or diploma from any other university or institution.

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ABSTRACT

Modern technology has significantly improved the quality of life for humans. However, with the increase in technology usage, there has been a rise in the number of people visiting shopping malls. As a result, the billing process has become more time-consuming, and customers often have to wait in long queues to get their goods billed. To address this issue, we propose the development of a smart shopping cart system that uses RFID and Arduino to keep track of purchased products and generate bills automatically. The main objective of this project is to reduce the time consumed in the billing process. Our On-go billing Cart with an Automatic Billing System will use an EM-18 RFID Module and Arduino. Each product in the store will have an RFID tag, and every cart will have an RFID Reader. When a product is scanned, the price will automatically be added to the billing system. The LCD Display will show the item name and its price. This system will help reduce the wait time for customers, making their shopping experience more comfortable and convenient.

The primary objective of this project is to minimize the amount of human effort required during shopping and enhance customer productivity by reducing billing queues. Additionally, it assists in managing and monitoring the budget while shopping, as well as providing valuable insights into customer preferences. From a business perspective, it aids in maintaining stock levels by avoiding overstocking and understocking.

KEYWORDS: RFID tags, EM-18 Reader, Arduino, LCD display, On-go billing , Stock prediction, IoT.

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CHAPTER 1

INTRODUCTION

The Internet of Things (IoT) refers to devices that have sensors, processing ability, software, and other technologies that enable them to connect and exchange data with other devices and systems over the Internet or other communication networks. IoT is an interdisciplinary field that encompasses electronics, communication, and computer science engineering. It is worth noting that the term "Internet of Things" is somewhat misleading as devices do not necessarily need to be connected to the public internet. Rather, they simply need to be connected to a network and have an individual address.

The Internet of Things (IoT) is a rapidly evolving field that has been made possible by the convergence of multiple technologies, such as ubiquitous computing, commodity sensors, powerful embedded systems, and machine learning. Various fields like embedded systems, wireless sensor networks, control systems, and automation, including home and building automation, have contributed to the development of IoT. In the consumer market, IoT technology is primarily associated with smart home products, such as lighting fixtures, thermostats, home security systems, cameras, and other home appliances, that support one or more common ecosystems. These devices can be controlled through devices associated with that ecosystem, such as smartphones and smart speakers.

The Internet of Things (IoT) revolutionized the way we interact with everyday objects. By adding sensors and processors, everyday objects can be integrated with the internet. Initially, progress was slow due to bulky chips. However, the development of RFID tags and smaller, faster chips facilitated the connection of billions of devices to the Internet. IoT allows everyday objects to collect data and adjust their performance. The goal is to create self-reporting devices that communicate in real-time. IoT has brought new possibilities to healthcare, industrial automation, and other fields.

In conclusion, IoT has become an indispensable tool for connecting people with technology and making everyday life more efficient and convenient. Its impact is felt in various spheres, and its importance cannot be overstated. The continued development of this technology is crucial in enhancing its effectiveness and expanding its applications in various fields.

Figure 1.1. Internet of Things(Courtesy: Source[1.1])

1.1 HISTORY

The idea of a network of intelligent devices was first discussed in 1982. A Coca-Cola vending machine at Carnegie Mellon University was modified to become the first appliance connected to ARPANET. It could report its inventory and whether newly loaded drinks were cold or not. Mark Weiser's paper on ubiquitous computing in 1991, "The Computer of the 21st Century", as well as academic venues such as UbiComp and PerCom, produced the modern vision of the Internet of Things. In 1994, Reza Raji described the concept in IEEE Spectrum as "moving small packets of data to a large set of nodes, to integrate and automate everything from home appliances to entire factories".This is the history of IoT displayed in the below timeline chart.

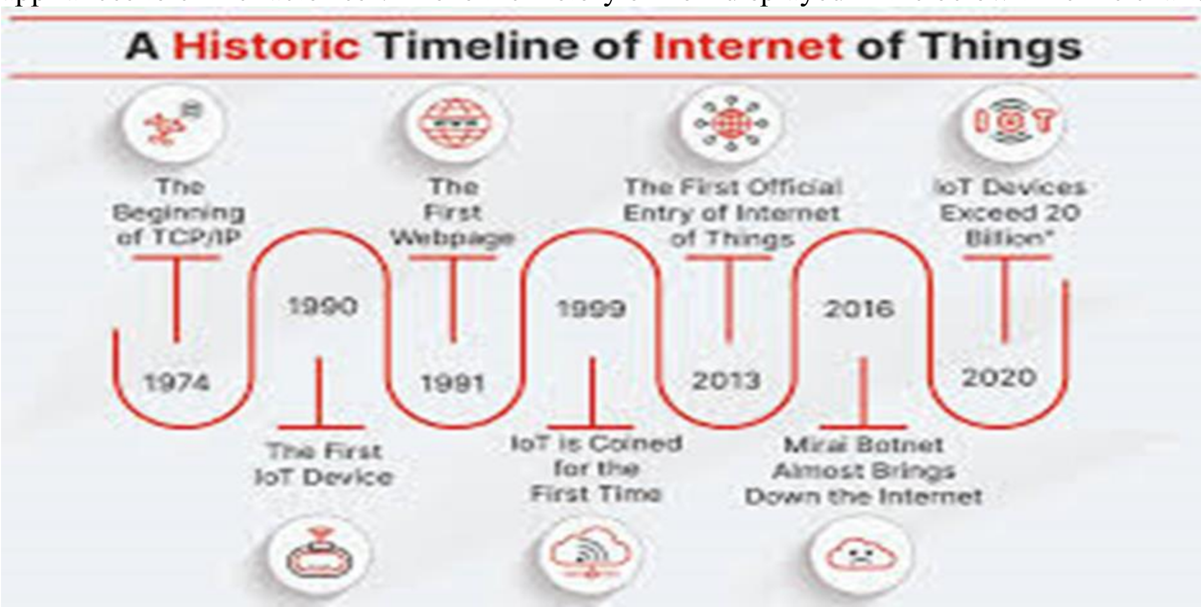

Figure 1.2. History of IoT(Courtesy:Source [1.2])`

1.2 WORKING PRINCIPLE

Massive Analog Data:

Analog data is all around us and represents the natural and physical world. This type of data encompasses a wide range of things, including light, sound, temperature, voltage, radio signals, moisture, vibration, velocity, wind, motion, video, acceleration, particulates, magnetism, current, pressure, time, and location. Analog data is the oldest, fastest, and largest form of big data, but it can present a challenge for IT professionals because it can have more than two values, unlike digital data.

Continous Connectivity:

The Internet of Things (IoT) is a network of interconnected devices that are always connected and always on. This "Perpetual Connectivity" offers three key benefits:

1. Monitor: Continuous monitoring provides ongoing and real-time information about the condition and usage of a product or user in a market or industrial setting.

2. Maintain: Due to continual monitoring, upgrades, fixes, patches, and management can be pushed as needed.

3. Motivate: Constant and ongoing connection to consumers or workers gives organizations a way to compel or motivate others to take some action, purchase a product, and more.

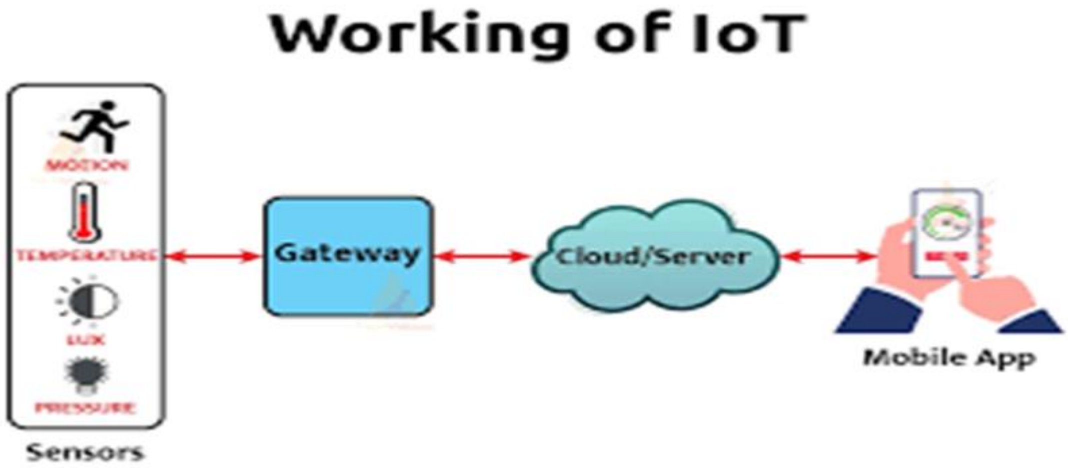

Figure 1.3. Connectivity(Courtesy: Source[1.3])

Real-Time:

The interpretation of the term "real-time" can vary greatly, especially between those who have a deep understanding of IoT and those who don't. In the context of IoT, real-time refers to the exact moment when data is gathered by the sensor, as opposed to when it reaches a network switch or computer system. This is because data that has reached those later stages is already considered outdated and unreliable. In scenarios where time is of the essence, such as detecting a fire or preventing a crime, receiving real-time alerts is critically important. In such situations, receiving alerts even a few seconds later can have a significant impact on the outcome. Therefore, an alarm must be triggered in real-time, even before the data reaches the cloud or data center. Real-time data collection and analysis is especially vital in the context of

IoT because of the enormous amounts of data that are generated. With real-time data collection, it's possible to detect anomalies as soon as they occur, allowing for swift remedial action.

The Scope of understanding:

The "Spectrum of Insight" that comes from IoT data can be categorized into five phases of data flow: real-time, in motion, early life, at rest, and archive. Real-time refers to the data that is collected at the sensor or point of acquisition. In order to determine the immediate response of a control system and adjust accordingly, such as in military applications or precision robotics, analytics are needed.

Timely overview vs In-depth analysis:

Today's conventional computer and IoT solutions usually require a choice between speed and depth of analysis. In other words, quick insights can be obtained on basic analytics, such as temperature comparisons or fast Fourier transforms to detect potential life-threatening accidents caused by rotating wheels on a tram. Immediate Time-to-Insight is essential in such situations.

1.3DISTINCT APPLICARIONS OF IoT

Figure 1.4. Applications of IoT(Courtesy: Source[1.4])

1.Traffic management:

Over the past decade, roadway infrastructure has become more connected, similar to the vehicles that travel on it. Cameras, sensors, traffic light controls, parking meters, and even smartphone traffic apps are now transmitting data to help prevent traffic jams, accidents, and ensure smooth travel.

Cameras play a crucial role in detecting and transmitting data about traffic volume to central management groups. These groups analyze the information to decide whether, when, and what mitigation steps need to be taken. Additionally, sensors on traffic signals can detect varying levels of light in the sky and adjust the brightness of the signals. This helps ensure that the signals are always visible to drivers.

Connected devices have the potential to identify available parking spaces and share that information with kiosks or apps, thereby alerting drivers. Moreover, monitors installed on bridges can collect and transmit data for analysis regarding their structural health. This data helps authorities to identify maintenance requirements before any kind of issue or failure occurs.

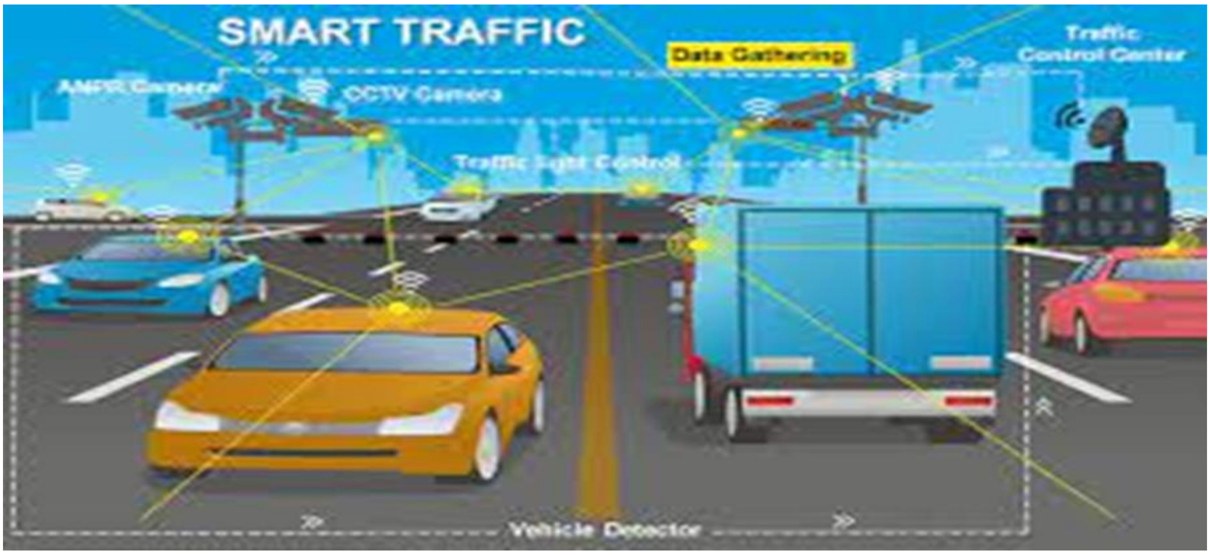

Figure 1.5. Traffic management using IoT(Courtesy: Source[1.5])

2. Environmental Monitoring and management:

With the advent of IoT technology, connected devices have become capable of collecting vast amounts of data that can provide us with a deeper understanding of the health and quality of our environment. This data includes a range of information, such as air quality, water quality, soil conditions, weather patterns, and other natural habitats. By accessing this real-time data, organizations across a variety of industries can gain valuable insights into the state of the environment and how it is changing over time. For instance, government agencies can use this information to better monitor and predict natural disasters like tornadoes while managing and protecting land and wildlife populations. Similarly, companies can leverage this data to reduce their carbon footprint, ensure compliance with environmental regulations, and plan around weather conditions that impact their business. In short, IoT technology has the potential to revolutionize the way we protect and manage our environment, making it more sustainable for future generations. In this way, government can manage cities or villages well.

Figure 1.6. Environmental monitoring using IoT(Courtesy: Source[1.6])

3. Agricultural, commercial, industrial, and retail management operations:

IoT, or the Internet of Things, has extensive applications in almost all sectors, ranging from agriculture to space exploration. For instance, in manufacturing, IoT is utilized to monitor the factory's production and predict equipment maintenance. Machine-to-machine connected devices are used to more accurately map workloads, and a factory can track wear and tear on equipment to schedule maintenance at the best time. Companies can use RFID chips embedded in employee badges or wearable devices to manage and control physical access to their facilities.

Farmers can opt for location technologies integrated with environmental monitors and their field equipment to automate and maximize seed allocations. Transportation and logistics companies, including international shipping companies, use IoT technologies to track their fleets and the goods they transport. Some also track the conditions in which goods are stored. For example, a transportation company can monitor the temperature in a refrigerated truck to ensure it's kept within an optimal temperature range for the items being transported.

Retailers are using IoT systems to support automation and robotics capabilities in their warehouses. They're also using IoT for inventory control and, increasingly, for personalized in-store customer experiences. One of the most promising agricultural advancements is the use of agricultural drones in smart farming. Drones are better equipped than airplanes and satellites to collect agricultural data. Also known as precision agriculture, precision farming is all about efficiency and making accurate data-driven decisions.

Figure 1.7. Agriculture automation using IoT(Courtesy:Source[1.7])

4. Health and Wellness monitoring:

The healthcare industry and the consumer health and wellness market both have numerous examples of IoT in action.

Numerous medical institutions employ connected devices to facilitate the monitoring of patient vital signs and health conditions. These devices are specifically designed to record and transmit a patient's heart rate, glucose levels, or blood pressure, with some capable of determining whether readings are within an established acceptable range. If readings exceed this range, healthcare providers or patients can be alerted accordingly. In today's market, consumers have a plethora of options when it comes to tracking their wellness. Among these options are smartwatches and other wearables, which have become increasingly popular in recent years. These devices are equipped with advanced sensors that can monitor and analyze a wide range of health indicators, including steps taken, distance traveled, calories burned, and sleep quality. Some devices can even track heart rate, blood pressure, and blood oxygen levels. Additionally, many of these devices come with accompanying apps that allow users to view their health data, set goals, and receive personalized recommendations for improving their overall well-being. With so many options available, consumers can choose the device that best fits their needs and preferences, making it easier than ever to take control of their health and wellness.

Figure 1.8: Healthcare using IoT(Courtesy: Source[1.8])

5. Smart cities:

Smart cities integrate various systems, which include connected traffic management and smart buildings, including private ones. They can also connect to smart grids and use environmental monitoring to create a broader IoT ecosystem that provides real-time views of various elements that affect life in their municipalities. The Internet of Things (IoT) has been widely adopted in smart cities. It helps to improve efficiency, reduce costs and enhance the quality of life for residents. IoT-powered devices such as connected Bluetooth sensors, RFID tags, and meters are used to collect real-time data for future analysis. Municipalities can use this data to improve infrastructure, services, public utilities, and more. Traffic operators can analyze and identify patterns of public transport usage by using data from sensors embedded in multiple sources. Such public access data can reveal usage patterns.

Figure 1.9. Smart-cites using IoT (Courtesy : Source[1.9])

6. Connected buildings and building security system:

Property owners are leveraging the power of IoT to make their buildings smarter, more energy-efficient, comfortable, convenient, healthier, and even safer.

An IoT ecosystem in a commercial building can consist of real-time data monitoring and automation technology that constantly measures and adjusts the temperature for optimum energy efficiency and comfort. Additionally, cameras using AI can improve crowd management to ensure a smooth flow of foot traffic and maintain public safety at large-scale events such as sold-out concerts. On the home front, consumers can install smart technologies such as door locks, appliances, thermostats, and smoke detectors, which help them with their everyday needs, for instance, coordinating temperature controls to the owners' schedules.

IoT technology enables advanced security systems in both commercial and residential buildings. Connected cameras and sensors can detect and record movement or activity, such as a doorbell ringing. This information is then transmitted to other systems which can analyze the data and take specific actions based on it. Alternatively, the data can be sent to humans, such as homeowners, who can decide what course of action to take based on the information received.

The IoT market segment is experiencing significant growth, with the global smart building market reaching $72.8 billion in 2022. It is predicted to increase to $304.3 billion by 2032, with a compound annual growth rate of 15.8% over the 10-year period. To ensure safety in public spaces, IoT-enabled cameras and sensors can be installed to monitor for potential security threats, such as suspicious activity or unattended bags. These solutions come with integrated analytics, real-time tracking, and decision-making capabilities. By analyzing data generated from CCTV cameras, acoustic sensors embedded throughout the city, and social media feeds, it is possible to predict potential crime incidents.

Figure 10. Connected buildings(Courtesy: Source[10])

7. Logistics and fleet management:

Companies are utilizing various technologies such as sensors, telematics, GPS, and analytics to track the location of their vehicles in real-time and estimate their arrival time at the desired destination.

This helps them to assess whether any external conditions require updating the route or arrival time. With the use of predictive maintenance, driver training, and route optimization, this technology ecosystem assists companies in identifying areas for improvement in their operations.

Figure 1.11. fleet management using IoT(Courtsey :Source[1.11])

8. Self-driving and connected vehicles:

Autonomous vehicles are a prime illustration of the Internet of Things (IoT) in action. Long-established automotive companies such as BMW Group, Ford Motor Company, and General Motors, along with more recent entrants such as Tesla, are all engaged in the development of self-driving vehicles. Self-driving cars and trucks use various connected devices to navigate roadways safely, even in challenging traffic and weather conditions. The technologies employed include AI-enabled cameras, motion sensors, and onboard computers.

Figure 12. self driving car using IoT(Courtsey : Source[12])

Connected devices are installed by manufacturers on conventional vehicles for performance monitoring and computerized systems management. Meanwhile, IoT connections also exist on these vehicles.

1.4 SIGNIFICANCE OF IoT

1. Monitors business processes, improves customer experience and saves time and money.
2. Our solution confidently enhances employee productivity and empowers better business decisions.
3. It allows for seamless access to information from any location, at any time, and on any device. This capability ensures that our users can stay connected to important information, regardless of their physical location or the device they are using.
4. Facilitates seamless communication between interlinked electronic devices, thereby improving their ability to exchange information efficiently.
5. This technology allows healthcare patients to receive continuous and more

efficient care.

6. IoT simplifies everyday tasks by automating, providing remote control, and streamlining activities.

1.5 CHALLENGES IN BUILDING IoT-BASED SYSTEMS

1. Security

IoT devices can be vulnerable to cyber attacks due to the sensitive data they collect and transmit. Ensuring their security is a major challenge.

2. Interoperability

One of the main goals of loT is to have devices from different manufacturers be able to communicate and work together seamlessly. However, this can be difficult to achieve due to the variety of protocols and standards used by different manufacturers.

3. Scalability

As the number of lol devICes grows, it can be challenging to manage and maintain the network. especially in terms of data storage and processing Integrating loT devices with existing systems can be challenging for organizations that already have systems in place.

4. Power and connectivity

Ensuring that loT devices have a reliable power source and can connect to the network can be a challenge, especially in remote or hard-to-reach locations.

5. loT botnets target cryptocurrencies

loT bot network workers can manipulate privacy and pose a significant risk to the open crypto market. Malicious hackers compromise the exact value and creation of cryptocurrency codes. Blockchain companies are looking to tighten security.

1.6 DRAWBACKS OF loT-BASED SYSTEMS

1. Deploying and managing IoT systems can be complex, and requires expertise in areas such as data analytics, network infrastructure, device management, and cybersecurity. Technical challenges, including scalability and reliability issues, can also arise, making it even more difficult.

2. IoT raises ethical and legal considerations regarding data ownership, consent, and privacy. The collection, use, and sharing of personal data without proper consent and transparency can lead to ethical dilemmas and legal implications. Therefore, it is important to consider the ethical and legal implications before deploying IoT.

3. Due to the production of intelligent devices and robots, activities that were once done by humans can now be replaced, leading to increased unemployment.

4. IoT cannot function effectively without the Internet, making it highly dependent on it. This means that any disruption to the Internet can also affect the performance of IoT.

5. IoT devices are interconnected and prone to various network attacks, making them vulnerable to security breaches. Therefore, it is important to ensure that IoT devices are secure from cyber threats.

6. Due to the overuse of technology, people may lose control of their lives, as technology starts to lead them instead of the other way around. It is important to use technology in moderation and ensure that it does not harm our lives.

CHAPTER 2

LITERATURE SURVEY

Throughout history, people have always created technology to make their lives easier and more efficient. One task that has always taken up a lot of time is shopping, and over time, technology has been developed to make this task easier. In the past, people used manual billing with pen and paper, then barcodes were introduced. However, barcodes had their own issues, such as line-of-sight problems and long queues at checkout counters. To address these issues, the concept of smart shopping with RFID technology was proposed.

In supermarkets, customers come to purchase various products and pay for them. Supermarkets generate a bill for the customer, and after bill generation, customers have to stand in long lines to pay for their purchases. To save customers valuable time, we are developing a Smart Trolley that can generate bills, and customers can pay the bill with the help of a swapping machine in the smart trolley.

Nowadays, the use of embedded systems, inexpensive sensors, and wireless sensor networks has led to the growth of the Industrial Internet of Things (IoT). IoT refers to the integration of complicated devices and objects with high-end applications, software, networked devices, and sensors. The IoT enables businesses to collect and aggregate data from sensors embedded in devices and analyze their value. It maximizes the efficiency of machines and entire operations.

Applications of IoT include predictive maintenance, smart grid, motion control, big data analytics, smart medicine, and M2M. M2M communication allows machines and devices to exchange data or sensor values with each other. Key components in M2M are devices attached to sensors or actuators, RFID technology, wireless networks, and autonomic computing systems programmed to service networked devices to interpret data and make decisions.

To attract customers and employees in supermarkets, an M2M system can be implemented. Supermarkets provide daily necessities such as groceries, food, products, electrical appliances, clothing, etc. Customers often face problems such as incomplete information about product discounts, long queues, and slow billing systems. Combining RFID technology with the M2M system can create a flexible and efficient system for shopping malls that improves the customer experience. RFID technology can provide a solution to long queues and save customers and cashiers valuable time. Several techniques have been proposed to generate redundant item sets to mine association rules efficiently.

RFID technology uses radio waves to automatically identify people or items. The most widely used form of this technology is RFID tags and readers. RFID tags support more unique IDs and additional information than barcodes. This technology can create a smart system by eliminating most of the human assistance, particularly the need for checkout counters in supermarkets.

2.1 Existing Approaches:

[1] Automated Shopping Trolley Follower for Super Market Billing System by Poorvitha H R, Pavithra T N

The project report presents a new smart trolley for Object Recognition and Following image-based procedure and is also user-friendly. The trolley was used to diminish the HUMAN effort by evolving an image-based robotic machine creation for object ensuing concept. It's very time-consuming for bill generation to wait in a queue for the customer and to remove the products while taking count of products when the customer has a shortage of amount. It is difficult to push the cart while shopping. We conclude that the paper is developed with low cost, and low power consumption so customers can enjoy shopping without pushing shopping trolleys themselves. We are using a Pi camera and IR sensors on the trolley which can detect and track the customer/human and follow the human at some limited distance, it will stop when the customer stops and also there is an add-on feature barcode scanner fixed on the trolley to scan the product to generate total bills amount of the purchased product automatically.

[2] Smart Supermarket Billing System Using Python by Mrudul Padole, Apurva Gupta, Ayush Kumar

The advent of unmanned retail stores has led to a significant transformation in conventional shopping practices. Unmanned retail containers have played a pivotal role in this shift. However, traditional weighing sensors-based methods have certain limitations when it comes to detecting customer purchases. To address this issue, a novel, image-processing-based unstaffed retail shop scheme has been proposed in this paper. The project primarily aims to design an electronic smart cart device that encompasses an OLED display, an Arduino Mega 2560 board, a specially designed PCB, a Wi-Fi module, a 13.56 MHz HF RFID reader, a power supply, and a shopping cart. The device has been developed to enhance the overall shopping experience of customers in unmanned retail stores.

[3] Object detection System for Self-Checkout Cashier System by Michael Ariyanto, Prima Dewi Purnamasari

This research aims to propose an alternative to the use of barcodes in the form of object detection based on deep learning. This approach reads the overall features of an object, thus eliminating the possibility of defects or irregularly shaped products hindering the reading of the product during the processing of purchases. The study tests the performance of two deep learning-based object detection models, Faster Regional Convolutional Neural Network (Faster R-CNN) and You Only Look Once 9000 (YOLO9000), in both the training phase and real-time implementation.

The results of the training phase testing indicate that the Faster R-CNN model is more accurate and efficient, with an mAP of 88.2%, a training time of 1175.6 seconds/epoch, and memory usage of 1.611 GB. In contrast, the real-time testing of the model reveals that Faster R-CNN has a high accuracy of 67.1%, while YOLO9000 has a faster prediction speed of 0.023 seconds/frame. In simulation testing, YOLO9000 demonstrates an ability to read products at a speed of 67.40 seconds, comparable to the speed of a barcode scanner-based cash register that can read products at a speed of 65.77 seconds. Overall, the findings suggest that the proposed object detection approach offers a viable alternative to barcodes, with the Faster R-CNN model proving to be the more effective of the two models tested.

[4] Smart Shopping Carts Based on Mobile Computing and Deep Learning Cloud Services by Muhammad Atif Sarwar, Yousef-Awwad Daraghmi, Kuan-Wen Liu

Self-checkout systems are designed to help retailers reduce costs and enable customers to process their purchases quickly without waiting in queues. However, these systems often have large hardware requirements, including cameras, sensors, RFID, and other IoT technologies, which can increase their cost. To provide a better customer experience and overcome these problems, we propose a smart shopping cart with self-checkout, called ICart.

ICart uses mobile cloud computing and deep learning cloud services. When a customer checks out, a video is captured and sent to the cloud server for classification and segmentation. The Linux-based cloud server contains the yolov2 deep learning network, which identifies and adds items to the shopping list. ICart is a lightweight system made of low-cost solutions, which makes it suitable for small-scale retail stores. With ICart, customers can enjoy a seamless checkout experience and just walk out of the store without waiting in queues.

[5] Designing a Self-Payment Cashier For Bakeries Using YOLO V4

This paper presents an automation project for bakery stores that utilizes the YOLOv4 object detector. The project involves the development of a self-checkout cashier, where the customer places a tray of products under a webcam and the system returns the total price of the purchase. The main goal of this project is to create a low-cost, high-accuracy, fast-response, and easy-to-use application. To achieve this, the project includes the development of various processes and protocols, a user interface, a segmentation algorithm, and a server to integrate everything. The menu for this research includes 10 items - coke, guaraná, coxinha, banana, apple, ice tea, choux cream, eclair, cheese bread, and bread - and the mAP obtained for our test set is 91.52% and 96.25% when all requirements were met. Despite the high precision obtained, two important problems were encountered during the validation process: the system has difficulty recognizing products when they are too close and when an unknown object is placed on the tray. Throughout the text, it is explained how this project was developed, the system requirements, and the operating protocols.

[6] Design of Smart Unstaffed Retail Shop Based on Iot and Artificial Intelligence

Unstaffed retail shops have emerged recently, changing the way we shop. The design of vending machines is crucial to the user shopping experience in these shops. Traditional designs use weighing sensors that cannot detect what the customer is taking. To improve the user shopping experience, a smart unstaffed retail shop scheme has been proposed using artificial intelligence and the internet of things. The SSD (300x300) algorithm is used to analyze multiple features of commodities, and the recognition accuracy is enhanced further by adding sub-prediction structures. An 18,000-image dataset in different practical scenarios containing 20 different types of stock keeping units is used to compare experimental results. The proposed SSD (300x300) model outperforms the original SSD (300x300) in goods detection. The mean average precision of the developed method reaches 96.1% on the test dataset, indicating that the system can make up for the deficiency of the conventional unmanned container. The practical test shows that the system can meet the requirements of new retail, greatly increasing customer flow and transaction volume.

[7] Super shop Billing System – A Survey

The "Billing System in Supermarket" project is designed to automate the supermarket sales process and increase efficiency for salespersons. The software automates customer record management, which streamlines processes, saves time and reduces the energy spent on manual efforts. As customer numbers grow, managing individual information becomes increasingly difficult in the existing manual system. This project addresses the inefficiencies in manual systems, particularly in information retrieval and overall performance reporting. The automation aims to eliminate these challenges, offering a reliable, fast, and informative solution. The system targets salespersons' needs, providing an efficient and effective means of managing supermarket operations. It ensures reliability, ease of use, speed, and enhanced information accessibility.

[8] IoT BASED SMART CART BILLING SYSTEM

In this project, we employ Radio Frequency Identification (RFID) technology to develop a Smart Shopping Cart system. The system consists of RFID cards, RFID readers, and NodeMCU microcontroller board. Each RFID card is assigned to a particular product, and an RFID reader is placed in the cart to read the product details such as price and description. NodeMCU receives the data from the RFID reader, processes the available items, and calculates the total value of the products in the cart. The information is then sent to a web server, which displays the data on a webpage and an LCD display.

Web servers are widely used to monitor and control various sensor values via web browsers. In this regard, we have employed diverse microcontroller boards such as Arduino, NodeMCU, ESP32, Raspberry Pi, and so forth, to create web servers for different applications. With the Smart Shopping Cart system, users can monitor their shopping carts' contents and total value remotely via any web browser from anywhere in the world.

[9] Smart Shopping Trolley with Automated Billing using Arduino

This project aims to revolutionize the shopping experience with an automated billing system integrated into shopping trolleys. The system uses RFID technology controlled by Arduino to instantly register products placed in the trolley, displaying the item details and prices on an LCD. Shoppers can easily add or remove items, with the total cost dynamically updating. Upon completion, a button press consolidates the purchases, providing the shopper with the total amount. Shopkeepers can verify purchases using a mastercard at the exit, reducing manpower and optimizing the shopping process, making it more efficient and enjoyable for customers, especially in busy places like supermarkets.

[10] Arduino-Based Smart Billing System Using RFID

Our project aims to create an automated billing system for supermarkets and malls by using

Arduino and RFID technology. We have implemented automation for RFID scanning with a billing system, which eliminates waiting time for billing and the need for more workers in the billing section. Our system is faster at scanning compared to the traditional handheld method.

We use radio frequency identification (RFID) and wireless technology to provide on-the-spot billing in supermarkets. Our system uses an RFID-based application on the shopping conveyor and an RFID card as a security access for the product. The computer system is fixed to the conveyor, displaying the product name, cost, and the total cost of all purchased products. The bill is transmitted to the server end through Zigbee technology.

Our system promotes quick shopping and immediate payment without any queuing process, reducing labor efforts, and increasing efficiency by minimizing errors.

2.2 DESCRIPTION OF GISMO-VI BOARD AND VARIOUS SENSORS

Gismo-VI

The ESP32 is an affordable microcontroller that comes with built-in capabilities for Wi-Fi and Bluetooth, including support for Bluetooth Low Energy. It boasts of dual processors and has a wide range of input/output peripherals, such as touch sensing, ADCs, DAC, UART, SPI, 12C, and PWM. It is compatible with the Arduino programming language and can be programmed using MicroPython firmware, which is a version of Python 3 optimized for microcontrollers. The ESP32 is an ideal choice for Internet of Things (IoT) and home automation projects due to its Wi-Fi and Bluetooth capabilities and its ability to connect to and create its own Wi-Fi networks.

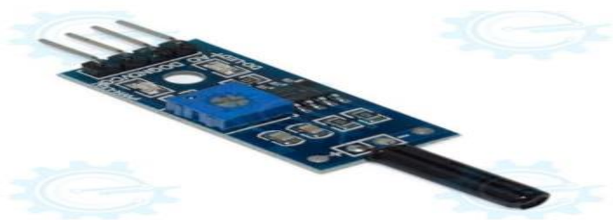

Figure 2.13. Gismo-VI (Courtesy: Source [2.13])

SENSORS

Sensors are instruments or devices designed to detect and measure physical properties or changes in the environment. They convert this information into signals or data that can be interpreted and used for various purposes. Sensors are crucial in a wide range of applications, including industrial and scientific settings, as well as everyday consumer electronics. There are types of sensors available, each with its unique features and uses.

Types of sensors

Temperature Sensor

Proximity Sensor

Magnetic Sensor

PIR Sensor

Ultrasonic sensor

Soil Moisture sensor

IR Receiver IR Generic Remote

Temperature sensor

Temperature sensors are a crucial component in many industrial and scientific applications. They are available in two types, namely analog and digital. Analog temperature sensors are designed to measure temperature changes through variations in physical properties such as resistance or voltage. One of the most widely used analog temperature sensors is LM35, which is known for its high accuracy and stability. The LM35 sensor is capable of measuring temperature in the range of -55°C to +150°C with an accuracy of ±0.5°C. Its linear output makes it a preferred choice for a wide range of temperature-sensing applications.

It is worth noting that analog temperature sensors have some limitations, including low resolution and susceptibility to noise and interference. Digital temperature sensors, on the other hand, are more immune to noise and provide higher resolution and accuracy. However, they are more complex and expensive compared to their analog counterparts. The choice of temperature sensor for a given application depends on various factors such as accuracy, resolution, response time, and cost. Therefore, it is essential to carefully evaluate the requirements of the application before selecting a temperature sensor.

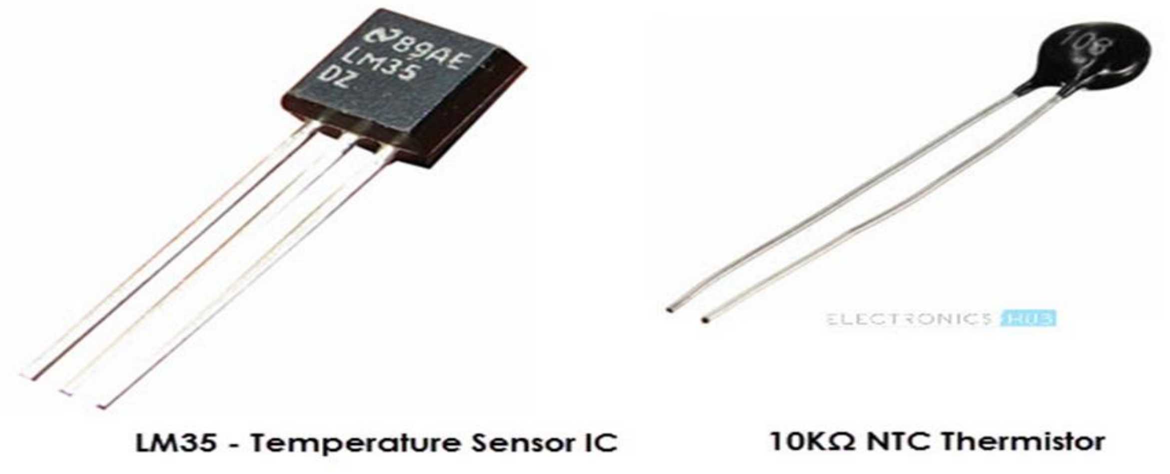

Figure 2.14. Temperature sensor (Courtesy: Source [2.14])

Proximity Sensor

A Proximity Sensor is a sensor that detects the presence of an object without making any physical contact. Different techniques can be used to implement Proximity Sensors, such as Optical (like Infrared or Laser), Sound (Ultrasonic), Magnetic (Hall Effect), Capacitive, etc. Proximity Sensors are used in various applications such as Mobile Phones, Cars (Parking Sensors), industries (object alignment), Ground Proximity in aircraft, etc.

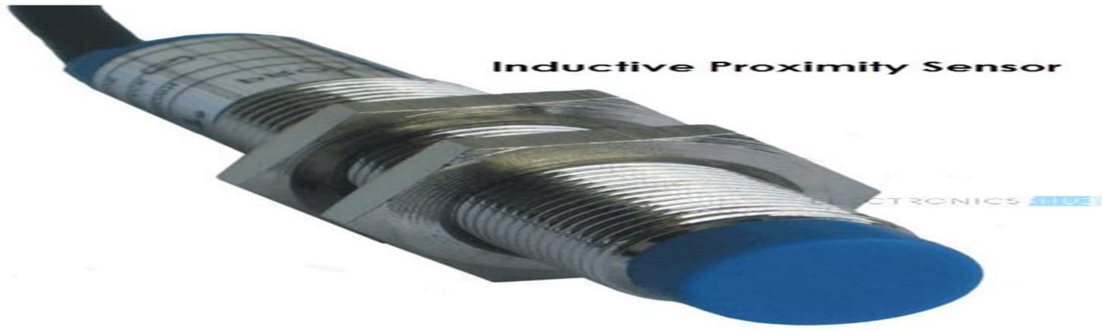

Figure 2.15. Proximity Sensor (Courtesy: Source [2.15])

Magnetic Sensor

Magnetic sensors are solid-state devices used to detect distance, speed, rotation, angle, and position by converting magnetic information into electrical signals. The electrical signals are then processed by circuits.

Figure 2.16. Magnetic Sensor (Courtesy: Source [2.16])

PIR Sensor

A passive infrared sensor is an electronic device that detects infrared light emitted by objects. These sensors are commonly used in motion detectors, as well as security alarms and automatic lighting systems. The pin configuration of a PIR sensor is relatively simple and easy to understand, as shown in the image below.

Figure 2.17. PIR Sensor (Courtesy: Source [2.17])

Ultrasonic Sensor

An ultrasonic sensor is an electronic device that facilitates the measurement of the distance of a target object through the emission and reception of ultrasonic sound waves. The sensor comprises two key components, namely the transmitter and the receiver. The former emits sound waves, utilizing piezoelectric crystals, while the latter receives the reflected sound waves after they have traveled to and from the target object. The velocity of ultrasonic waves is greater than that of audible sound waves, which are typically perceptible to human hearing. Upon reception of the reflected sound waves, the ultrasonic sensor converts the resultant signal into an electrical format.

Figure 2.18. Ultrasonic Sensor (Courtesy: Source [2.18])

2.3 RFID TAGS, TYPES, AND USES

Radio Frequency Identification (RFID) is a wireless communication technology that employs either electromagnetic or electrostatic coupling in the radio frequency segment of the electromagnetic spectrum to uniquely identify an object, animal, or person. An RFID system comprises three essential components namely, a scanning antenna, a transceiver, and a transponder. Collectively, the scanning antenna and transceiver are referred to as an RFID reader or interrogator. These readers can either be fixed or mobile, and they are network-connected devices that utilize radio waves to transmit signals that activate the tag. Once the tag is activated, it emits a wave back to the antenna, where the data is translated.

An RFID tag is a small device that consists of a transponder, which is the component that enables the identification of an object, animal, or person. The transponder is composed of an antenna and a microchip that stores data. When an RFID reader emits radio waves, they are received by the antenna of the RFID tag, which powers the microchip, allowing it to send back the stored data.

The read range of RFID tags is not fixed and varies based on multiple factors. For instance, the type of tag and reader used, the frequency of the RFID system, and the surrounding environment can all impact the read range of the tag. For example, if the RFID frequency is higher, the tag will have a shorter read range. Similarly, if there are other RFID tags or readers nearby, they can create interference, reducing the read range of the tag. Conversely, tags with a stronger power source typically have a longer read range. In conclusion, the read range of RFID tags is a complex subject that depends on many factors.

Understanding these factors can help you optimize the performance of your RFID system.

TYPES:

1. Active RFID Tags:

Active tags are a type of RFID tag that operates without an external power source. They consist of an integrated circuit (IC) that includes a battery, transmitter, and power processing unit. The battery powers the IC and transmitter, allowing the tags to communicate with the reader via radio signals without the need for an external power source.

Active tags are equipped with additional processing units that permit the establishment of connections between internal sensors and external sensors of other active tags or their surroundings. These processing units also enable the tags to carry out more complex tasks, such as data storage and processing. Active tags have a read range of 300 to 750 feet, making them ideal for applications that require longer read distances. They are commonly used in asset tracking, inventory management, and supply chain management.

However, active tags are more susceptible to radio intrusion and noise interference than passive and semi-passive tags. Their larger size, weight, and price tag also make them less practical for certain applications. Additionally, their battery life is shorter than passive and semi-passive tags, requiring them to be replaced more frequently. In summary, active tags offer a high level of functionality and are well-suited for applications that require longer read distances and more complex tasks. However, they do have some limitations, including susceptibility to radio interference, higher cost, and shorter battery life.

Figure 2.19. active RFID tag(Courtesy:Source[2.19])

2.Passive RFID Tags:

Passive RFID tags are a type of radio frequency identification (RFID) tags that operate differently from active tags. Unlike active tags, passive RFID tags do not have power sources on their integrated circuit (IC). This means that they cannot transmit signals by themselves and instead, rely on the interrogator to provide power. The interrogator sends out radio waves to power the passive tags and read the information stored on them.

Since passive tags do not have their own power source, they are limited in terms of functionality. They cannot support complex functions, such as active communication or real-time tracking. However, they are still useful for a variety of applications, such as inventory management, asset tracking, and access control.

One advantage of passive tags is that they are less susceptible to radio interference. This is because they do not have active transmitters on their board, which reduces the chance of radio intrusion. Additionally, passive tags are less expensive and more compact than active tags, making them a popular choice for many applications.Passive RFID tags operate at low, high and ultra-high frequencies. Inductive coupling is mandatory for tags operating at low and high frequencies, whereas radiative coupling is vital for tags operating above high frequencies. The read range of former tags is 2 feet only, and the read range of later one is equal and more than 20 feet.

Passive or battery-assisted Radio Frequency Identification (RFID) tags are not as cost-effective as passive tags, as they are larger in size, more expensive, and have a shorter lifespan. Additionally, they are susceptible to temperature changes, which can affect their functionality. In contrast, passive tags are more reliable and efficient in terms of cost and durability.

The accompanying figure, 2.21, displays semi-passive RFID tags, which offer a potential solution to some of the limitations posed by passive and battery-assisted tags. The figure is sourced from a credible and reliable source.On the downside, passive tags have limited storage and don't have the potential for adding additional characteristics. Due to their simple nature, they don't attach any temperature, pressure, light sensors like active tags.

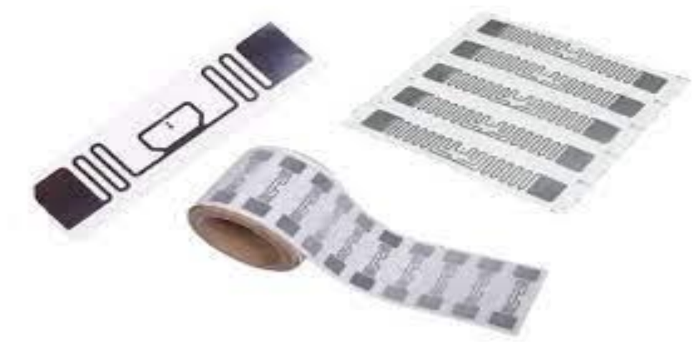

Figure 2.20. Passive RFID tag(courtesy: Source[2.20])

3. Semi-passive RFID Tags

The semi-active tags consist of an integrated circuit (IC) that contains a battery and uses the backscattering mechanism for communication with the interrogator. Similar to passive tags, their ICs do not have an active transmitter, which makes them resistant to radio interference. However, the presence of a battery allows them to include environmental sensors and offer longer read ranges of up to 100 feet, making them an advanced version of passive tags.

In contrast to passive tags, battery-assisted tags, also known as semi-passive tags or BATs, come with a few drawbacks. Firstly, they can be quite costly to implement. Secondly, they are more vulnerable to fluctuations in temperature, which can impact their performance. Additionally, they tend to be bulkier and heavier than passive tags. Lastly, they have a shorter lifespan than passive tags, meaning they need to be replaced more frequently.

Figure 2.21. semi-passive RFID tag(Courtesy :Source[2.21])

CHAPTER 3

PROPOSED METHOD

3.1 PROBLEM STATEMENT & OBJECTIVE OF THE PROJECT

3.1.1 Problem Statement

Shopping can be a time-consuming and frustrating experience, especially if you have to wait in long queues at payment counters. The traditional billing process is outdated and inefficient, leading to errors and hindering the overall shopping experience. To overcome these challenges, a smart shopping cart with an automatic billing system can be a game-changer. This solution aims to reduce waiting times, eliminate errors, and enhance customer satisfaction, providing a smooth and seamless checkout experience for shoppers in various retail environments. By leveraging AI demand forecasting, purchasing managers can optimize their inventory levels, reduce costs, and improve customer satisfaction. This technology can help retailers stay ahead of the competition by providing a more efficient and customer-friendly shopping experience.

3.1.2 Objectives

1. Reduces manpower required in the billing section.

2. Users should be able to see the final amount of the bill before making a purchase.

3. It Reduces time spent on the bill.

4. Customers can get product details at the time of shopping.

5. When products get added/removed from the cart by the customer, the amount is automatically updated. Complete offers and discounts are shown on the display of the LCD screen.

6. Minimizing Overstock and Stockouts

7. Dealing With Supplier Unpredictability

8. Workflow Automation and Data Consolidation

3.2 ARCHITECTURE DIAGRAM, MODULES CONNECTIVITY DIAGRAM, SOFTWARE AND HARDWARE REQUIREMENTS

3.2.1 ARCHITECTURE DIAGRAM

These illustrate the overall structure of a system, showcasing major components, their interactions, and the flow of data. Architectural diagrams serve as visual blueprints, fostering communication and shared understanding among project stakeholders. They guide development efforts, facilitate discussions, and provide a visual reference for informed decision-making during the software development or system implementation process.

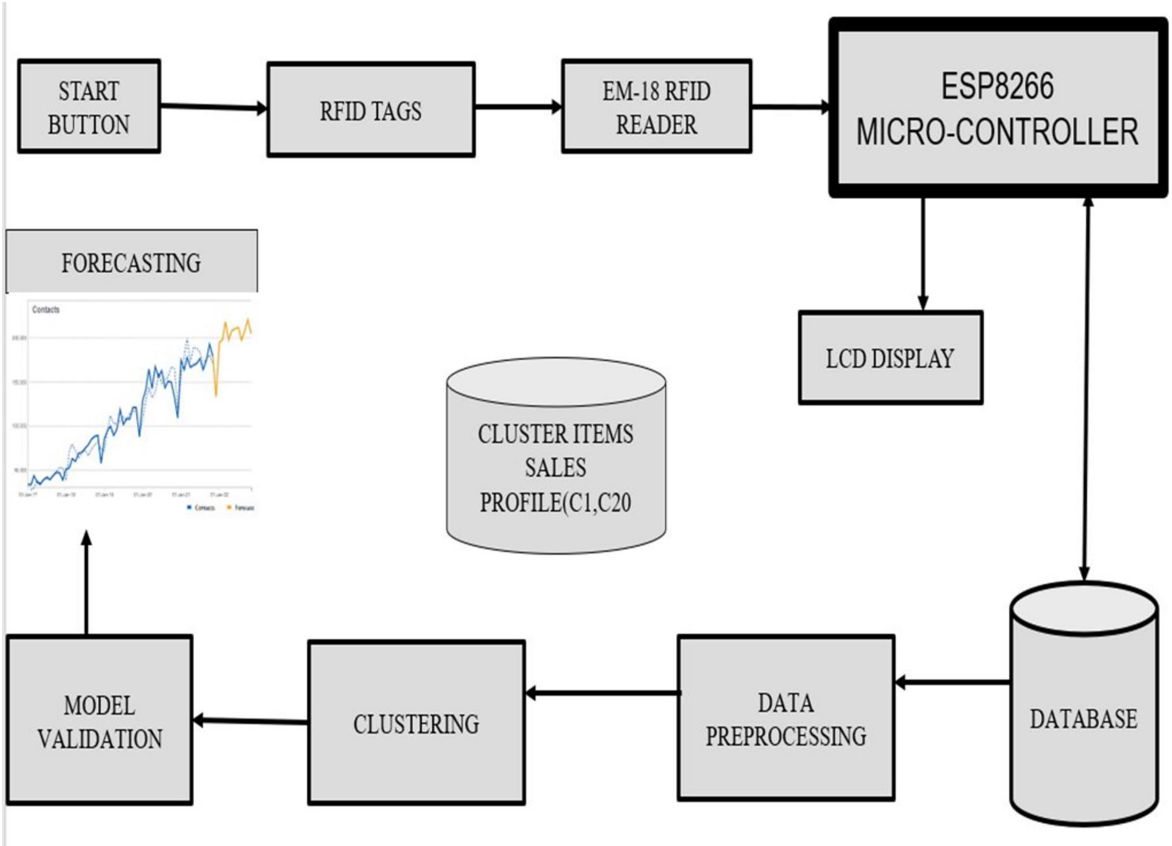

Figure 3.22. Architectural Diagram(Courtesy : Source[3.22])

Start Button: The user initiates the On-go billing by pressing the start button, signaling the beginning of their shopping journey.

Read RFID Tags: Upon activation, the system reads RFID tags attached to products. RFID (Radio-Frequency Identification) technology allows for the identification and tracking of items using distinctive tags.

User Interface (UI): The information gathered from RFID tags is seamlessly integrated into the User Interface (UI), offering users a visual representation of the products they've selected or interacted with.

EM-18 RFID-Reader: Users actively participate in the shopping experience by scanning RFID tags, allowing them to retrieve detailed information about a product, such as pricing, reviews, or additional recommendations.

LCD display: An LCD (Liquid Crystal Display) is utilized to showcase items in a shopping mall and the total count of items added, Offering a visual depiction of the shopping journey.

Data Preprocessing: Simultaneously, the Recommendation Engine comes into play, leveraging advanced algorithms to analyze user preferences, historical data, and real-time interactions with RFID-tagged items. This results in tailored product suggestions displayed on the UI.

Data Security Check: Before displaying any sensitive information, a thorough data security check is implemented to safeguard user privacy and ensure the integrity of the information presented on the UI.

Transaction and Checkout: As users proceed with their shopping, the system facilitates a smooth transaction and checkout process, allowing them to seamlessly purchase the selected items.

End Process: The smart shopping experience concludes as users complete their transactions, marking the end of their interaction with the system.

This systematic flow ensures a user-friendly and technologically advanced shopping journey, seamlessly integrating RFID technology, personalized recommendations, and interactive features.

3.2.2 Modules-Connectivity diagram

It presents the prototype experimental model

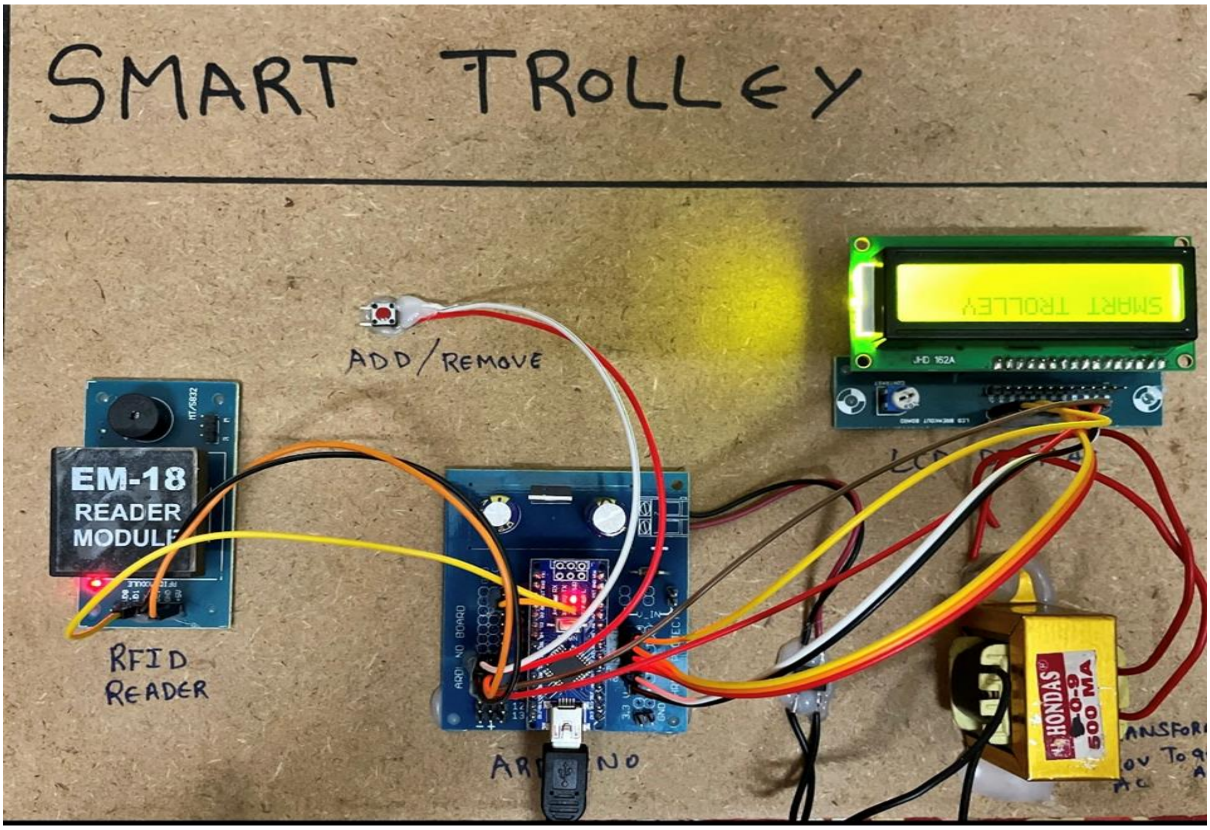

Figure 3.23. Connectivity Diagram(smart trolley)(Courtesy : Source[3.23])

3.2.3 Software Requirements

1. Arduino IDE

The Arduino IDE (Integrated Development Environment) is a software platform crafted for programming Arduino microcontrollers. It presents a user-friendly interface equipped with a built-in code editor, compiler, and uploader to facilitate seamless development. Compatible with various Arduino boards, the IDE simplifies the coding process by providing syntax highlighting and convenient access to libraries and examples. The Serial Monitor aids in debugging and communication, while the Library and Board Managers streamline the incorporation of additional code libraries and board support packages. With a comprehensive set of features, the Arduino IDE acts as a central hub for the creation, compilation, and uploading of code, catering to both novice and experienced developers engaged in a variety of electronic projects.

2.DBMS software

Database Management System (DBMS) software is a vital tool for efficiently organizing, storing, and managing large volumes of data. It provides a structured framework for data retrieval, storage, and manipulation, ensuring data integrity and security. Popular DBMS software includes Oracle, MySQL, and Microsoft SQL Server, each offering unique features to meet diverse business needs. Utilizing a DBMS enhances data organization, accessibility, and supports applications in various domains, from business and finance to healthcare and education.

3.ESP8266 webserver

The ESP8266 is a versatile microcontroller with built-in Wi-Fi capabilities, often utilized to create web servers in IoT projects. As a web server, the ESP8266 can handle HTTP requests, enabling it to serve web pages, receive data, and interact with connected devices. Developers commonly use the Arduino IDE or other platforms to program the ESP8266 for web server applications, making it a popular choice for projects requiring remote monitoring, control, or data exchange over a local network or the internet.

4. Unsupervised learning

Unsupervised learning, within the realm of machine learning, involves algorithms acquiring patterns and structures from data without specific guidance or labeled examples. Rather than receiving explicit instructions on what to discern, the system autonomously identifies inherent relationships and structures within the data. This approach allows the computer to explore and uncover insights independently, rendering unsupervised learning valuable for tasks such as clustering similar data points, detecting anomalies, and revealing concealed patterns in extensive datasets.

3.2.4 Hardware Requirements

1. ESP8266 Node MCU

The NodeMCU, short for Node Micro Controller Unit, constitutes an open-source development environment encompassing both software and hardware components. This ecosystem is centered around a cost-effective System-on-a-Chip (SoC) known as the ESP8266. Developed and produced by Espressif Systems, the ESP8266 integrates essential components of a computer, including a CPU, RAM, Wi-Fi networking capabilities, and a contemporary operating system with a Software Development Kit (SDK). This comprehensive feature set positions it as a highly suitable option for a diverse range of Internet of Things (IoT) projects, offering versatility and robust capabilities in IoT applications.

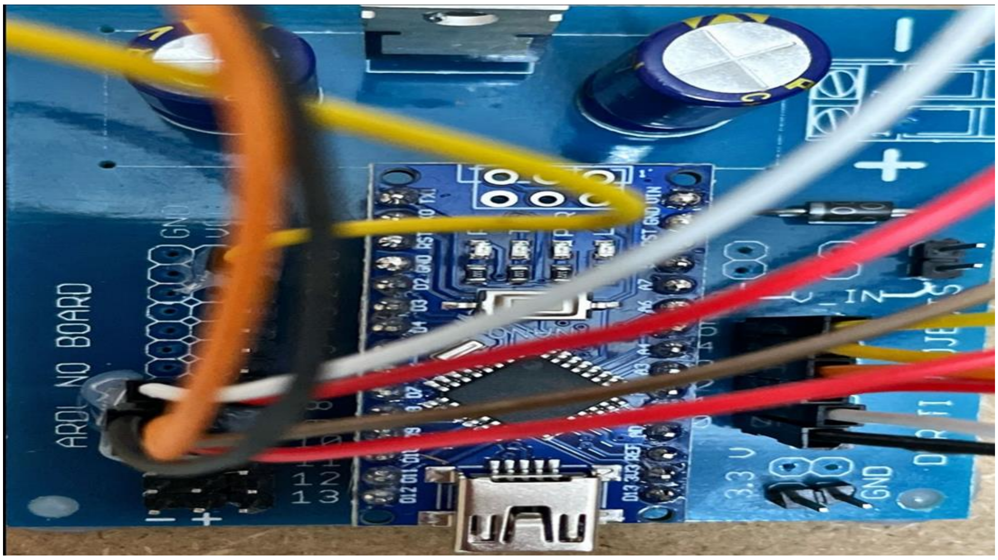

Figure 3.24.ESP8266 Node MCU (Courtesy : Source[3.24])

2. EM18 RFID Reader

EM18 is an RFID reader that is used to read RFID tags of frequency 125 kHz. After reading tags, it transmits unique ID serially to the PC or microcontroller using UART communication or Wiegand format on respective pins.EM18 RFID reader reads the data from RFID tags which contain a stored ID which is of 12 bytes.EM18 RFID reader doesn't require line-of-sight. Also, it has a short identification range i.e. in a few centimeters.

Figure 3.25. EM18 RFID Reader(Courtesy : Source[3.25])

3. LCD DISPLAY

LCD (Liquid Crystal Display) is a type of flat panel display that uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors, and instrument panels. LCDs were a big leap in terms of the technology they replaced, which included light-emitting diodes (LED) and gas-plasma displays.

Figure 3.26. LCD Display(Courtesy : Source[3.26])

4. RFID TAGS

RFID tags serve as a tracking system employing radio frequency for the searching, identification, tracking, and communication with both items and individuals. Essentially acting as intelligent labels, RFID tags have the capability to store diverse information, ranging from serial numbers and concise descriptions to extensive data pages. Certain RFID tags incorporate cryptographic security features, providing a heightened level of verification and authentication. These tags are typically categorized based on their radio frequencies, which include low frequency (LF), high frequency (HF), and ultra-high frequency (UHF).

Figure 3.27. RFID Tags(Courtesy : Source[3.27])

3.3 MODULES AND ITS DESCRIPTION

1. Detecting Phase Module
2. Alerting Phase

Module 1: Detecting Phase

1. Attach RFID Tags to Products:

Affix RFID tags to each product or item that the smart trolley will carry. Ensure that each RFID tag is unique, enabling individual identification.

2. RFID Reader on the On-go billing Cart:

Install an RFID reader on the On-go billing Cart. This reader can be a handheld device or integrated into the trolley structure. Connect the RFID reader to the Cart's central processing unit or microcontroller.

3. Read RFID Tags: As items are placed in or removed from the trolley, the EM18 RFID reader scans the RFID tags. Capture the unique identification information from each RFID tag.

4. Database or Cloud Integration:

Maintain a database or cloud-based system that associates each RFID tag with specific products.Update the database in real-time as items are added or removed.

5. Phase Detection Algorithm:

Implement a phase detection algorithm in the trolley's software.Analyze the RFID data to determine the current phase, such as empty, partially filled, or fully loaded.

Module 2: Alerting Phase

1. Install Proximity Sensors:

Equip the smart trolley with proximity sensors or infrared sensors.These sensors can detect the presence or absence of objects in certain compartments of the trolley.

2. Connectivity:

Establish a communication system on the smart trolley, such as Wi-Fi, Bluetooth, or a dedicated IoT (Internet of Things) platform.Ensure the trolley can connect to a central server or mobile devices.

3. Sensor Integration:

Integrate the output from the proximity sensors with the trolley's central processing unit or microcontroller.Program the microcontroller to interpret sensor data.

4.User Interaction:

Design an interface for users to acknowledge or address alerts.This could involve buttons, touchscreens, or other input methods

CHAPTER 4

RESULTS AND DISCUSSION

4.1 ALGORITHM:

Step 1: Begin by resetting the cart to its initial state.

Step 2: Proceed to read the RFID TAG using the EM18 reader. If the tag is read an odd number of times, the corresponding item is added to the cart.

Step 3: Conversely, if the RFID TAG is read an even number of times, the item is subtracted from the cart.

Step 4: Upon pressing the reset button once more, the LCD screen displays the total billing amount.

Step 5: Utilize the pre-charged cart to debit the specified amount.

Step 6: Upon completion of the final billing, transmit the information via the HC-12 transmitter for observation at the billing section by the designated personnel.

4.2.1 Cart Initial State:

During the initial phase of the shopping cart, any information from the previous transaction, such as details about items, quantities, and billing, is wiped clean. This means the cart is reset to start a new transaction without any leftover data from the previous purchase

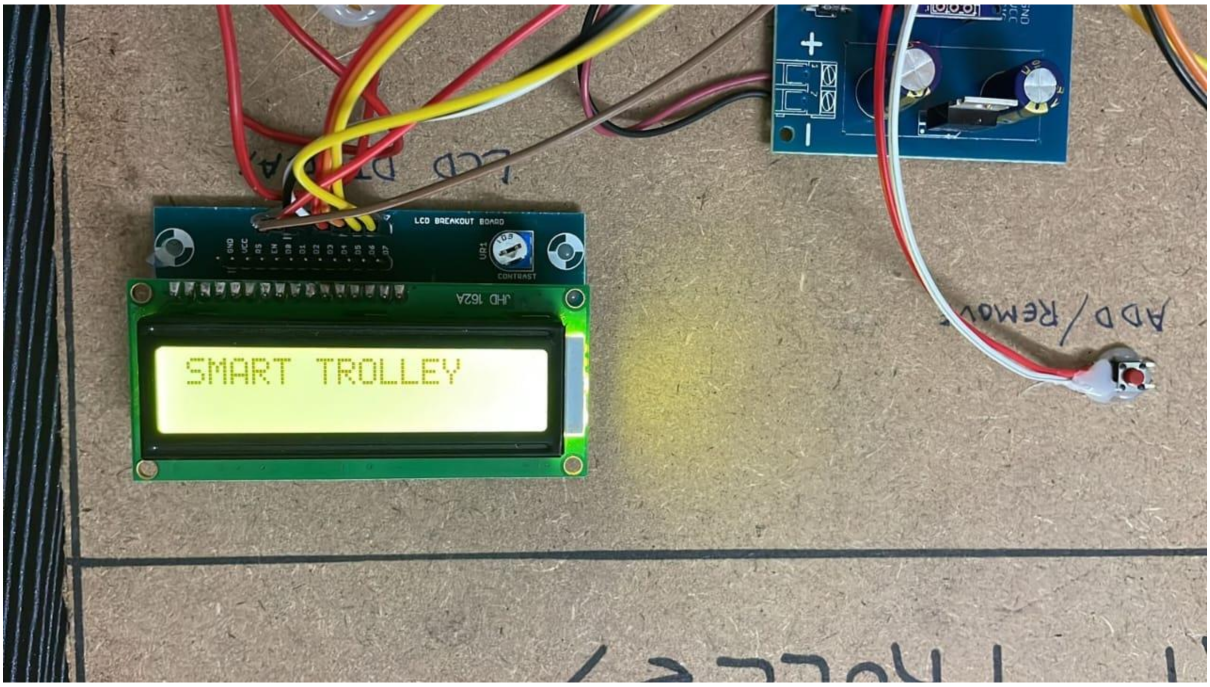

Figure 4.28. Initial state(Courtesy :Source[4.28])

4.2.2 RFID TAG Reading

The **EM18 RFID reader** is a device that employs radio frequency signals to establish communication with RFID tags. Every item within the store is equipped with a distinct RFID tag. As the RFID tag enters the vicinity of the RFID reader, the reader captures the unique identifier from the tag. Subsequently, this information undergoes processing to ascertain whether the tag has been read an odd or even number of times.

When a customer chooses a milk product and brings it close to the RFID reader for the first time, the RFID tag gets scanned. If the count is odd (like 1), the system takes this as a signal to add the milk product to the shopping cart.

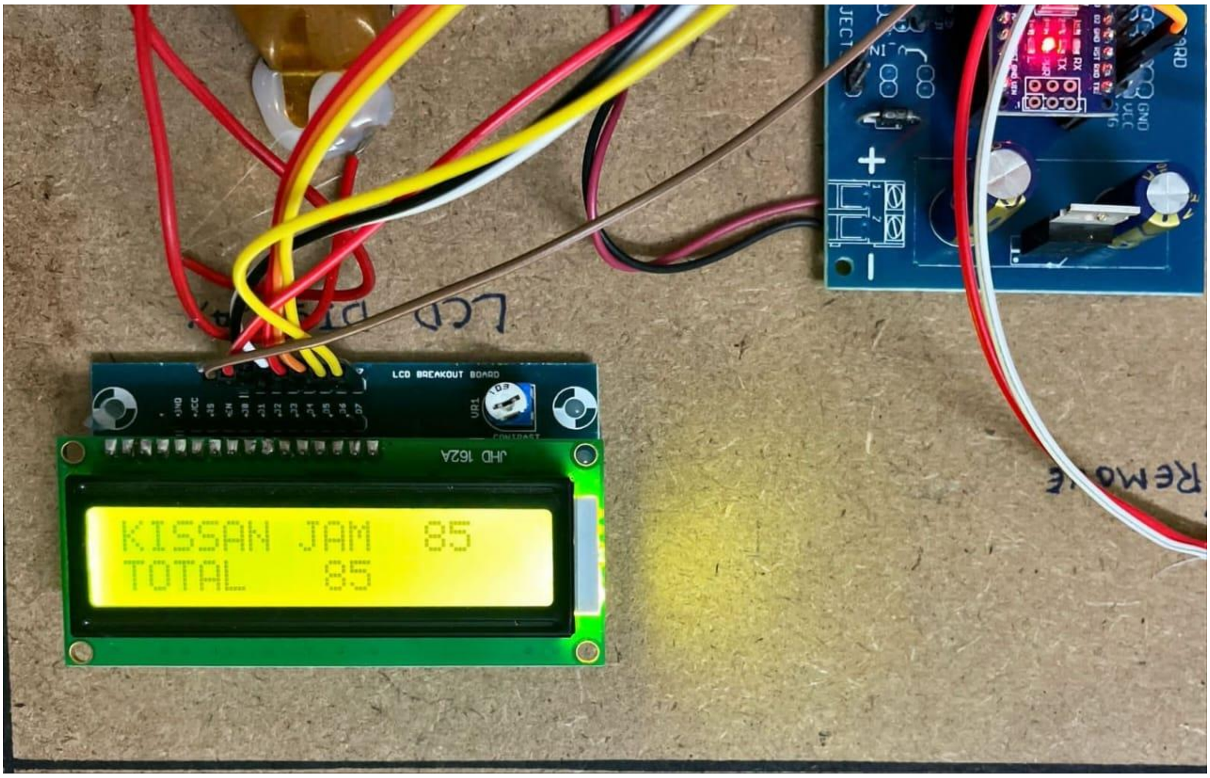

Figure 4.29. RFID tag reading(Courtesy :Source[4.29])

4.2.3 Adding Items:

During the course of adding items to the cart, let's envision a situation where a customer opts for a Clinic Plus shampoo. Initially, the RFID tag affixed to the shampoo packaging remains unscanned by the RFID reader. As the customer brings the shampoo in close proximity to the RFID reader for the first time, the tag is successfully scanned, leading to an increment in the count, reaching an odd value (e.g., 1). The system interprets this odd count as a command to incorporate the shampoo into the shopping cart.

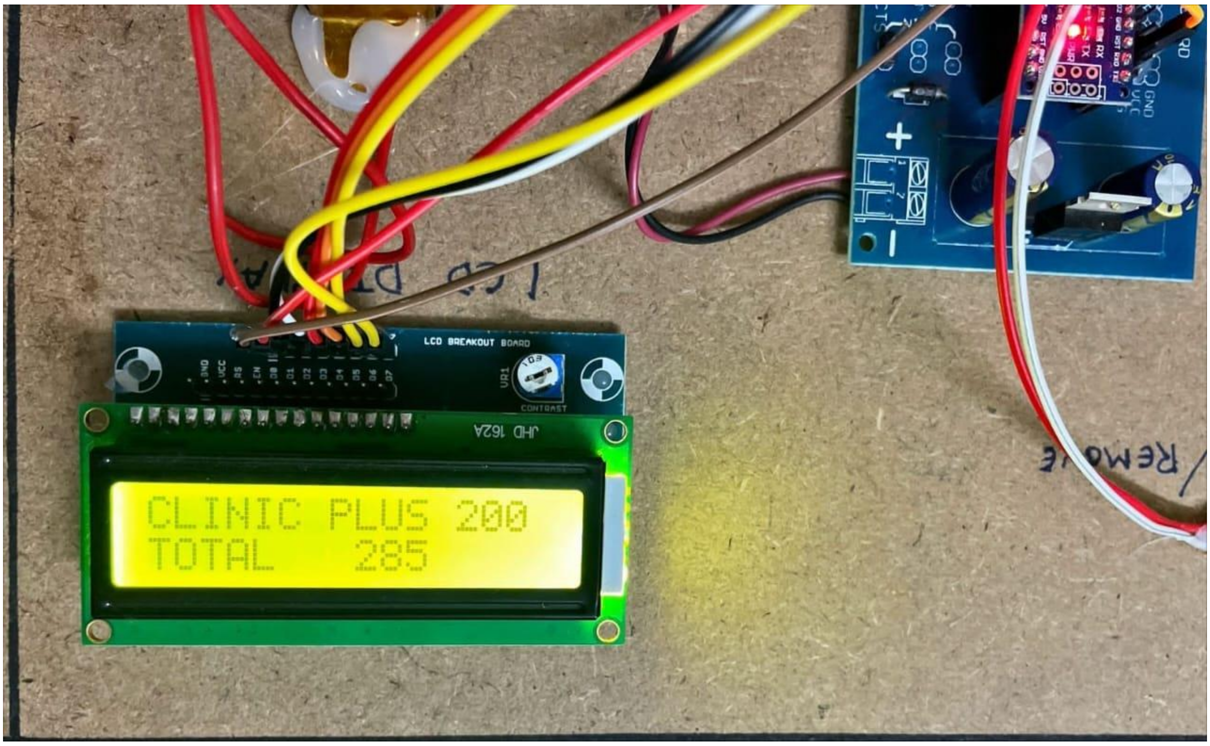

Figure 4.30. Adding Items(Courtesy :Source[4.30])

4.2.4 Multiple Items:

Imagine a situation where a customer is grocery shopping and selects various items equipped with RFID tags. If the RFID tag of an item is read an odd number of times, it is included in the cart. Conversely, if the same item is picked up once more and its RFID tag is read an even number of times, it is then removed from the cart.

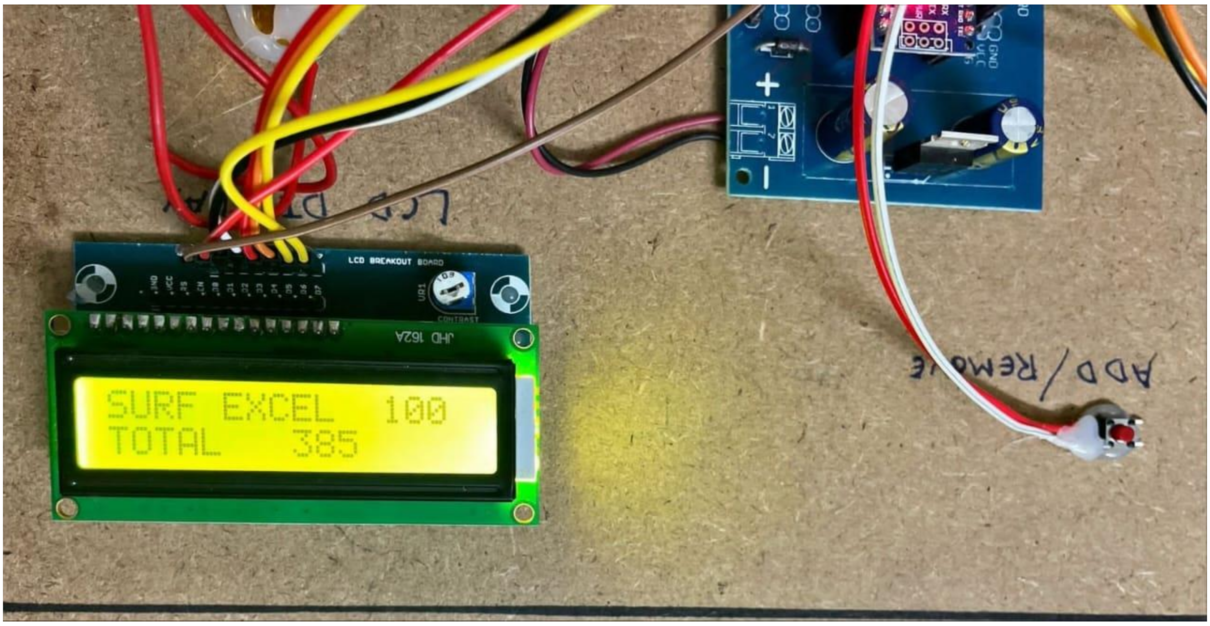

Figure 4.31. Multiple items1 (Courtesy : Source[4.31])

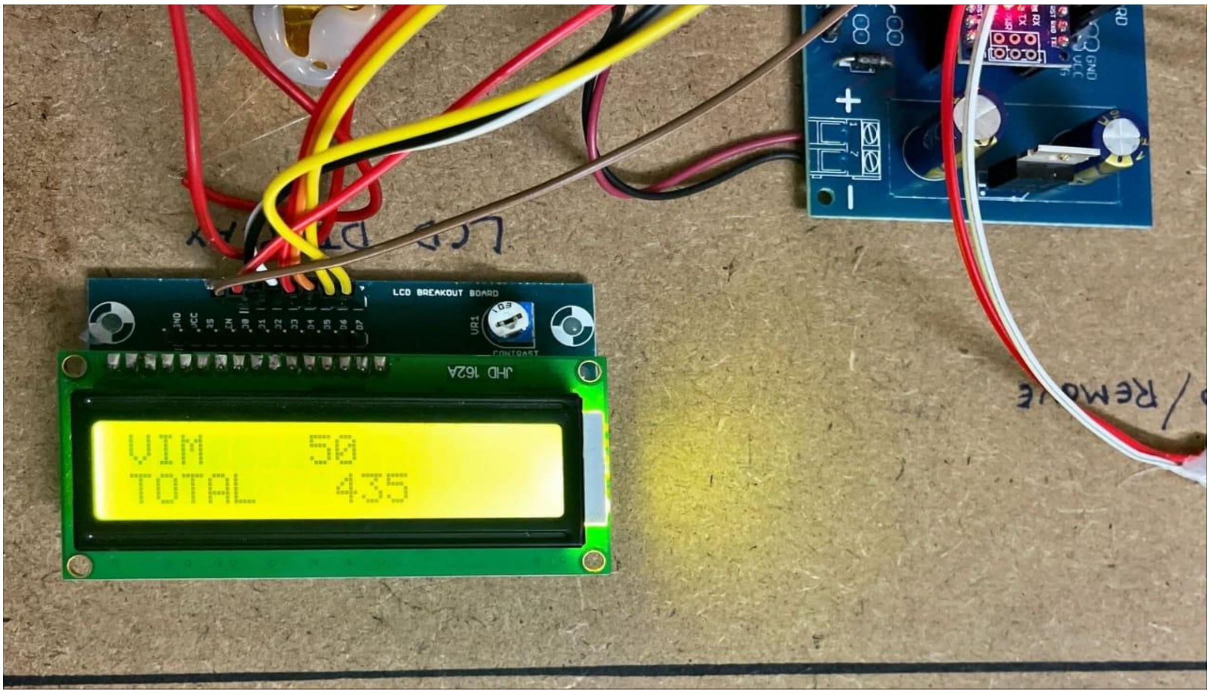

Figure 4.32.Multiple items2 (Courtesy :Source[4.32])

4.2.5 Subtracting Items:

Now, let's say the customer changes their mind and puts the vim back on the shelf.When the RFID tag is read again, the count becomes even (2).The system interprets this even count as an instruction to subtract the vim from the cart since the customer decided not to purchase it.

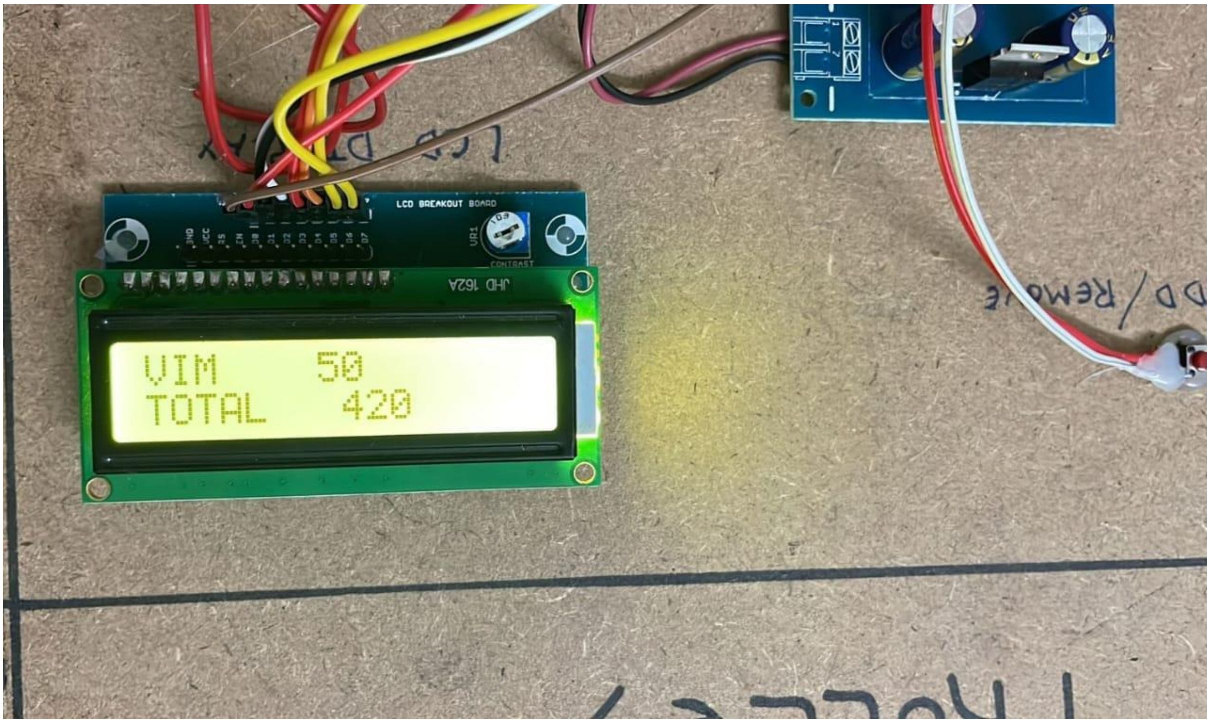

Figure 4.33. Subtracting items (Courtesy :Source[4.33])

Upon completing their shopping or desiring to review the total, the user presses the reset button. Subsequently, the system engages in the computation of the total billing amount, taking into account the prices corresponding to each item added to the cart. The outcome of this calculation is presented on an LCD screen, providing the user with a detailed overview of the total expenses before concluding the purchase.

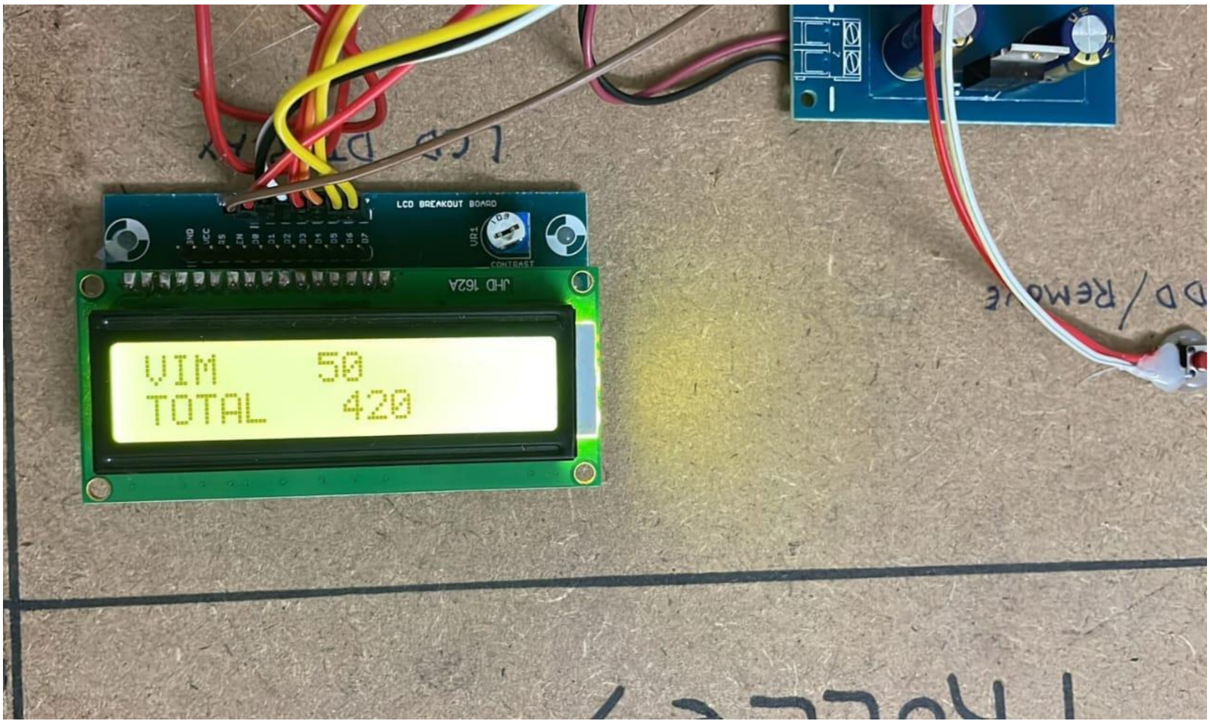

Figure 4.34.Total items and Payment (Courtesy :Source[4.34])

The odd/even mechanism ensures that the cart maintains an accurate representation of the items the user intends to purchase. It relies on the assumption that a change in the user's decision (adding or removing an item) will result in a change in the RFID tag read count, distinguishing between adding and subtracting actions. The system's design and programming would need to consider these scenarios to provide a seamless and reliable shopping experience.

4.3 MACHINE LEARNING ALGORITHM

The Walmart dataset employed for the smart shopping application encompasses a rich repository of meticulously organized information, specifically tailored to facilitate the operational dynamics of an intelligent shopping cart system within Walmart stores. This dataset encapsulates diverse facets integral to the functioning of the smart shopping experience.
Granular records pertaining to Radio-Frequency Identification (RFID) tags affixed to each product. This dataset captures tag IDs, temporal information, and proximity data, essential for monitoring customer interactions with the RFID readers.

4.3.1 Dataset

	Unit price	Quantity	Tax 5%	Total	cogs	gross margin percentage	gross income	Rating
Unit price	1.000000	0.010778	0.633962	0.633962	0.633962	NaN	0.633962	-0.008778
Quantity	0.010778	1.000000	0.705510	0.705510	0.705510	NaN	0.705510	-0.015815
Tax 5%	0.633962	0.705510	1.000000	1.000000	1.000000	NaN	1.000000	-0.036442
Total	0.633962	0.705510	1.000000	1.000000	1.000000	NaN	1.000000	-0.036442
cogs	0.633962	0.705510	1.000000	1.000000	1.000000	NaN	1.000000	-0.036442
gross margin percentage	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
gross income	0.633962	0.705510	1.000000	1.000000	1.000000	NaN	1.000000	-0.036442
Rating	-0.008778	-0.015815	-0.036442	-0.036442	-0.036442	NaN	-0.036442	1.000000

Figure 4.35 Wallmart Dataset(Courtesy :Source[4.35])

4.3.2 Data Preprocessing

Data processing serves as a foundational prerequisite for deriving insightful outcomes. This crucial phase encompasses the methodical manipulation, refinement, and extraction of relevant information from raw datasets, aiming to elevate the quality and pertinence of input data destined for subsequent model training or analysis. The overarching goal is to optimize the dataset, ensuring it is conducive to fostering robust and meaningful machine learning models.

```
data = data.dropna()
fig = px.scatter(data, x="Quantity", y="Total",size='Quantity')
fig.show()
print(data.corr())
correlations = data.corr(method='pearson')
plt.figure(figsize=(15, 12))
sns.heatmap(correlations, cmap="coolwarm", annot=True)
plt.show()
x = data[["Total", "Unit Price"]]
y = data["Quantity"]
xtrain, xtest, ytrain, ytest = train_test_split(x, y,
                                                test_size=0.2,
                                                random_state=42)
from sklearn.tree import DecisionTreeRegressor
model = DecisionTreeRegressor()
model.fit(xtrain, ytrain)
features = np.array([[133.00, 140.00]])
model.predict(features)
```

Figure 4.36 Data preprocessing(Courtesy :Source[4.36])

4.3.3 Correlated Data

Correlation analysis is vital for comprehending how changes in one variable may correspond to changes in another, thereby aiding in feature selection and enhancing the model's predictive capabilities.Identifying correlated data involves recognizing patterns of interdependence or mutual influence between different variables within the dataset.

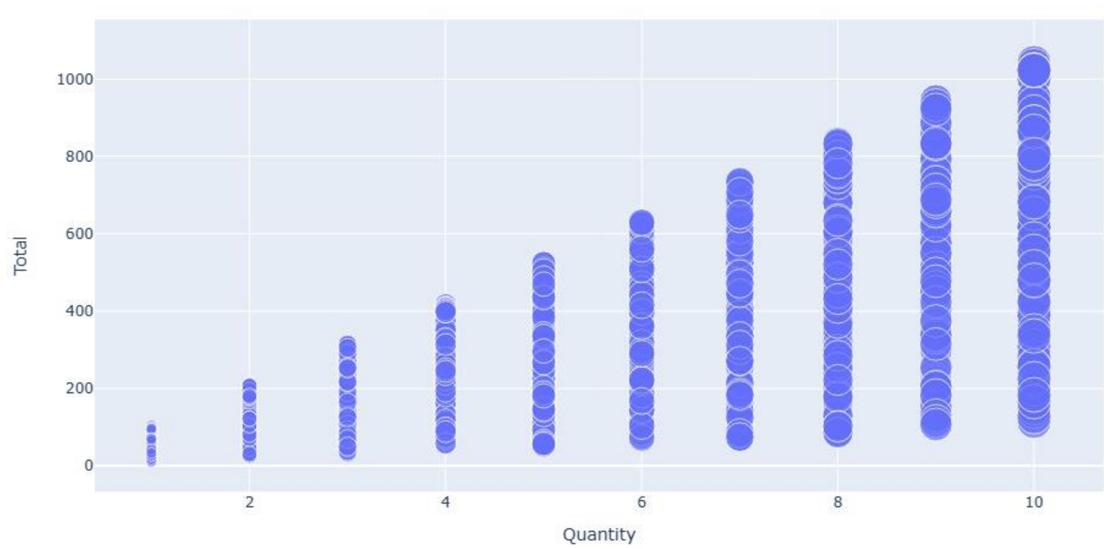

Figure 4.37.Corelated Data(Courtesy :Source[4.37])

4.3.4 Forecasting

In the realm of forecasting, sophisticated algorithms play a pivotal role in leveraging historical data patterns to predict future trends or outcomes. As illustrated in the aforementioned example, where meticulous data processing serves as a crucial initial phase, the overarching goal of forecasting is not only to analyze patterns but also to extract valuable insights from the refined dataset. This process involves identifying correlations, discerning emerging trends, and ultimately using the processed information to make comprehensive and well-informed predictions or projections about future scenarios. The iterative nature of forecasting often involves continuous refinement of models to enhance accuracy and adaptability in response to changing data dynamics.

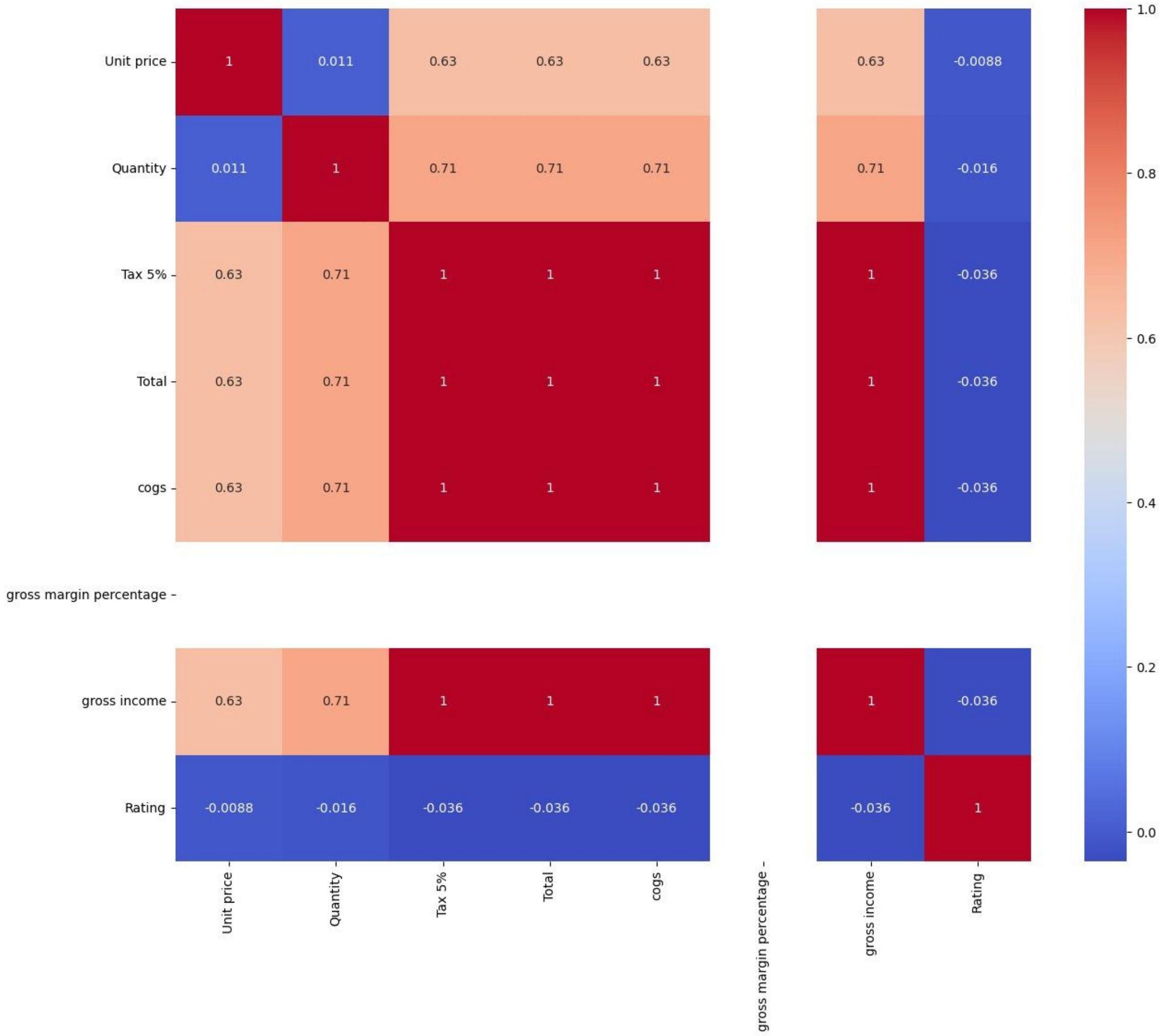

Figure 4.38. Forecasting(Courtesy :Source[4.38])

CHAPTER 5

5.1 CONCLUSION

The project utilized RFID technology, an EM-18 reader, and Arduino to streamline the billing process, aiming to reduce wait times in long queues and enhance inventory management efficiency. The primary objective is to provide customers with a quicker and more convenient billing experience while simplifying inventory control. This system is particularly applicable in crowded shopping malls where large volumes of customers can experience delays. In the realm of automation, this automatic billing system represents a significant technological advancement. It is poised to replace the existing barcode system, offering a more efficient and time-saving alternative. The implementation of this technology not only contributes to the ease of daily life but also plays a crucial role in advancing technology.

Furthermore, the system enhances the overall shopping experience by promptly displaying the total cost of selected products to the customer. In case a product is removed from the cart, the corresponding adjustment is reflected in the bill, ensuring accuracy. Additionally, the technology paves the way for online transaction procedures during the billing process. Overall, this innovative approach is designed to make life easier, save time, and contribute to the seamless integration of technology in various aspects of daily living. The ongoing trend of online shopping, which reduces the hassle of shopping offline at stores, and introducing smart carts may not only be able to eliminate the surge but contribute to the reduction of the usage of paper bills making them environmentally friendly, & saving time wasted in standing in long queues. This also makes it more economically viable for the owner to manage fewer staff. The envisioned enhancements for the smart shopping system represent a quantum leap in the realm of user-centric retail experiences. By leveraging advanced recommendation algorithms, the system is poised to decode user preferences with unparalleled accuracy, ensuring a personalized and gratifying shopping journey.

The integration of Natural Language Processing (NLP) further elevates user interaction, creating a more intuitive and responsive interface. This synthesis of cutting-edge technologies not only promises efficiency but also underscores a commitment to adaptability and continuous learning, ensuring the system remains attuned to evolving consumer behaviors and preferences. As we navigate towards the future, the fusion of innovation and user-centric design principles paves the way for a seamlessly intelligent shopping ecosystem, where convenience, personalization, and technological sophistication converge for an unparalleled retail experience.

5.2 FUTURE ENHANCEMENTS

1. Implementing sophisticated recommendation algorithms that rely on user preferences, behavior, and historical data, coupled with the integration of natural language processing (NLP) to augment the system's capacity to comprehend and address user inquiries.

2. Enhancing the user profiles to include more detailed preferences and demographics and provide personalized promotions, discounts, and product suggestions based on individual preferences.

3. Allowing users to virtually try on clothing, and accessories, or visualize furniture in their living spaces using AR and implement AR features for in-store navigation, helping users locate products more efficiently.

4. Integrate voice-activated shopping capabilities to enable users to make purchases and navigate the system through voice commands.

5. Implementation of frictionless checkout processes, including contactless payment options and automated billing.

6. Connecting IoT devices to the shopping system for inventory tracking and automatic replenishment of goods and enabling smart home devices to interact with the shopping system, such as adding items to a shopping list through voice commands.

CHAPTER 6

APPENDICES

5.3.1 Code Explanation:

LiquidCrystal I2C library:

This library provides a mechanism for the regulation of I2C displays, utilizing functions that closely parallel those found in the LiquidCrystal library. It enables an Arduino board to govern LiquidCrystal displays (LCDs) employing the Hitachi HD44780 chipset or a compatible counterpart, which is prevalent in the majority of text-based LCDs. To use the LiquidCrystal I2C library, you typically need to include the library in your Arduino sketch and initialize an instance of the LiquidCrystal_I2C class. You also specify the I2C address of your particular LCD module. After initialization, you can use standard LiquidCrystal library functions to control the display.

5.3.2 Code:

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sketch_dec20a

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(A0,A1,A2,A3,A4,A5);
#define sw 7
String IncomingData;
int surf=0;
int jam=0;
int shampoo=0;
int brush=0;
int paste=0;
int vim = 0;
int count=0;
int a=0,b=0,c=0,d=0,e=0,f=0;
int balance =1400;
void setup() {
  pinMode(sw,INPUT_PULLUP);
  lcd.begin(16, 2);
  lcd.setCursor(0,0);  lcd.print("SMART TROLLEY");
  Serial.begin(9600);
  pinMode(13, OUTPUT);
  delay(5000);
}

void loop() {
  if(Serial.available()){
    IncomingData = Serial.readString();
    Serial.println(IncomingData.substring(0,11));
```

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```
    IncomingData = Serial.readString();
    Serial.println(IncomingData.substring(0,11));
    if(IncomingData.substring(0,11) == "1E00CBA5D8A"){ //DONE
      surf = 1;
      Serial.println("SURF EXCEL");
      lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("SURF EXCEL");
      lcd.setCursor(12,0);
      lcd.print("100");
      if(digitalRead(sw)==LOW){
        a=a-1;
        count = count-100;
        lcd.setCursor(0,1);
        lcd.print("TOTAL ");
        lcd.setCursor(8,1);
        lcd.print(count);
        }
       else{
           a=a+1;
           count = count+100;
           lcd.setCursor(0,1);
           lcd.print("TOTAL ");
           lcd.setCursor(8,1);
           lcd.print(count);
        }
```

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```
           lcd.print(count);
        }
    }

    if(IncomingData.substring(0,11) == "1000D24EC44"){  //DONE
      vim = 1;
      Serial.println("VIM");
      lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("VIM");
      lcd.setCursor(7,0);
      lcd.print("50");
      if(digitalRead(sw)==LOW){
        b=b-1;
        count = count-50;
        lcd.setCursor(0,1);
        lcd.print("TOTAL ");
        lcd.setCursor(8,1);
        lcd.print(count);
        }
       else{
           b=b+1;
           count = count+50;
           lcd.setCursor(0,1);
           lcd.print("TOTAL ");
           lcd.setCursor(8,1);
```

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```
        }
      }

    if(IncomingData.substring(0,11) == "0800ABF6F4A"){   //DONE
      Serial.println("COLGATE PASTE");
      paste = 1;
      lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("COLGATE PASTE");
      lcd.setCursor(14,0);
      lcd.print("35");
      if(digitalRead(sw)==LOW){
        f=f-1;
        count = count-35;
        lcd.setCursor(0,1);
        lcd.print("TOTAL  ");
        lcd.setCursor(8,1);
        lcd.print(count);
        }
       else{
           f=f+1;
           count = count+35;
           lcd.setCursor(0,1);
           lcd.print("TOTAL  ");
           lcd.setCursor(8,1);
           lcd.print(count);
```

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```
      }

    if(IncomingData.substring(0,11) == "0800A93028B"){   //DONE
      Serial.println("CLINIC PLUS");
      shampoo = 1;
      lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("CLINIC PLUS");
      lcd.setCursor(12,0);
      lcd.print("200");
      if(digitalRead(sw)==LOW){
        d=d-1;
        count = count-200;
        lcd.setCursor(0,1);
        lcd.print("TOTAL  ");
        lcd.setCursor(8,1);
        lcd.print(count);
        }
       else{
        d = d+1;
           count = count+200;
           lcd.setCursor(0,1);
           lcd.print("TOTAL  ");
           lcd.setCursor(8,1);
           lcd.print(count);
        }
```

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```
  if(IncomingData.substring(0,11) == "1E006F64445"){ //DONE
    Serial.println("KISSAN JAM");
    jam = 1;
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("KISSAN JAM");
    lcd.setCursor(12,0);
    lcd.print("85");
    if(digitalRead(sw)==LOW){
      e=e-1;
      count = count-85;
      lcd.setCursor(0,1);
      lcd.print("TOTAL ");
      lcd.setCursor(8,1);
      lcd.print(count);
      }
     else{
      e=e+1;
         count = count+85;
         lcd.setCursor(0,1);
         lcd.print("TOTAL ");
         lcd.setCursor(8,1);
         lcd.print(count);
      }
    }
```

```
      }
    }

    if(IncomingData.substring(0,11) == "1E006EC5C77"){
      Serial.println("MONEY CARD");
      lcd.clear();
      lcd.setCursor(0,0); lcd.print("MONEY CARD");
      balance = (balance-count);
      lcd.setCursor(0,1); lcd.print("AVL BAL");
      lcd.setCursor(9,1); lcd.print(balance);
    }
    //----------------------------------------------------//
  }
}
```

Machine learning code:

```
import pandas as pd
import numpy as np
import plotly.express as px
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeRegressor

data = pd.read_csv("C:/Users/HP/OneDrive/Documents/bhanu.csv")
data.head()
```

```
data.isnull().sum()
```

```
data = data.dropna()
fig = px.scatter(data, x="Quantity", y="Total",size='Quantity')
fig.show()
print(data.corr())
correlations = data.corr(method='pearson')
plt.figure(figsize=(15, 12))
sns.heatmap(correlations, cmap="coolwarm", annot=True)
plt.show()
x = data[["Total", "Unit price"]]
y = data["Quantity"]
xtrain, xtest, ytrain, ytest = train_test_split(x, y,
                                                test_size=0.2,
                                                random_state=42)
from sklearn.tree import DecisionTreeRegressor
model = DecisionTreeRegressor()
model.fit(xtrain, ytrain)
features = np.array([[133.00, 140.00]])
model.predict(features)
```

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