A PROJECT REPORT ON

Smart Shopping Cart with Automatic Pricing, Product Information and Recommendation System

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE
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FOR THE AWARD OF THE DEGREE

BACHELOR OF ENGINEERING

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PUNE – 411 018.

2023-2024

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This is to certify that the project report entitles

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are a bonafide students of this institute and the work has been carried out by them under the supervision of **Prof. Jyotsna Vilas Barpute** and it is approved for the partial fulfilment of the requirement of Savitribai Phule Pune University, for the award of the degree of **Bachelor of Engineering** (Department of Artificial Intelligence and Data Science).

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Place:

Date :

DECLARATION

We declare that this is an original report of our research, has been written by ourself and has not been submitted for any previous degree. The experimental work is almost entirely our own work; the collaborative contributions have been indicated clearly and acknowledged. Due references have been provided on all supporting works of literatures and resources.

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ABSTRACT

Individuals travel to the shopping mall to buy their daily essentials. Shopping malls have spawned a new market for bill paying convenience. Customers are occasionally frustrated standing at the long queue for the billing and payment of the items purchased at the billing counter in the shopping mall. We will develop a smart trolley with a smartphone app to overcome these issues. This project offers a user interface to help customers to purchase the product. It will also aid in automatic bill calculation and generation at the trolley itself. As the technology is developing and seeing new inventions in various fields including machine learning, artificial intelligence, internet of things and so on, there is an increase in the expectations in the consumer point of view. With the fast moving lives, the consumers absolutely have no time to stand in long queues in order to get their work done. In this paper, we are presenting a smart shopping system using ESP32 controller. The trolleys in the shopping malls are protocol so as to automatically bill the products put into them and the final bill is sent to a web application which can be accessed in any phone or any hand held device. The system is also subjected to anti-theft management where the system doesn't let any customer take non-billed items.

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CHAPTER 1

INTRODUCTION

Since the dawn of civilization, people have been inventing to suit their needs. More independence may be the underlying reason for creativity's success, and this helps to improve assignments and make them smaller and easier on a daily basis. Shopping is an important activity for people who want to burn the most calories. The shopping Center is a place where people go to acquire their daily necessities such as food, clothing, and electrical equipment. In this innovative society, shopping trolleys are used in every grocery store and supermarket to assist customers in selecting and storing the items they intend to buy. Customers often purchase the essential things, place them in their trolleys, and then wait for bill payment at the counter. Paying bills at the counter is a time- consuming and inconvenient process that increases the number of individuals at the counter. According to a poll conducted by the India Department Corporation, people spend an average of 1.4 hours each day shopping. A big number of consumers will choose to leave the line if it is too long. The clever shopping basket layout that has been suggested is intended to assist individuals save time while shopping. During the course of a typical day at the registers, to improve the nature of the customer's purchasing history, ongoing development is required. We have created a shopping basket to address the aforementioned issues and improve the current structure object's cost. This construction would save shoppers time and reduce the amount of labor required in the shopping Center. The system that we have designed is based on rfid for easy scanning and detection of objects. The bill amount will be generated automatically at the trolley It's due to the factors that we need a system that can develop a self-learning machine learning1based system. This was the basis on which set of objectives was supposed to be formulated. One thing that was predetermined was that this is going to be a real-time project. Some people preferred a good corridor, some were high or low. price with all of their demanded features, some are only weak for, notorious brands of the auto only. To elect the perfect auto is still a delicate task though some parameters like color, comfort, seating capacity, etc are known. That’s why we tried to compare some algorithms for prognosticating auto buying purposes to see which one gives better delicacy.

1.1 Problem Statement

Shopping mall is a place where most people from all walks of life will get their daily necessities ranging from food product, apparels, toiletries, gardening tools electrical appliances, and others
Since the entire process of billing is manual it increases the possibility of human error substantially and time is also increased

1.2 Objective

- Nowadays, buying and searching at huge malls is turning into a daily activity in subway cities.
- We can see large rush at malls on holidays and weekends
- The rush is even a lot of once there are special offers and discount.
- To minimize the Queue at a billing counter in a shopping complex.
- Smart Trolley does the same by displaying the total price of the product kept inside the cart.
- Recommendation of clothes will be shown on android app
- Ccollaborative filtering algorithm will be used for recommendation

1.3 Scope

The project aims at the billing automation of purchased products using Smart Shopping cart to minimize the time spent for scanning each product manually using Barcode Scanners with recommendation systems to enhance the customer's experience at supermarkets and hypermarkets.
Smart shopping cart system that will keep the track of purchased products and also online transaction for billing using RFID.

1.4 Application

1 Shopping Mall
2 Hyper Markets
3 Grocery Market

CHAPTER 2
LITERATURE REVIEW

In this chapter, we discuss various applications and methods which inspired us to build our project. We did a background survey regarding the basic ideas of our project and used those ideas for the collection of information like the technological stack, algorithms and shortcomings of our project which led us to build a better project.

[1] **Paper Name -:** Smart Cart with Automatic Billing

Author -: Chandrasekar Palanisamy, T. Sangita Publisher-: International Journal of Engineering Research & Technology, 2020.

Observation-: In this [1] paper they have made a system model where each cart will have an RFID reader and zigbee trans-receiver implemented on it. Each product in the shop or a mall will also have an RFID tag on it. A supermarket is a place where customers come to purchase their daily using products and pay for that. So there is a need to calculate how many products sold and generate the bill for the customer. When we go to a shopping mart for shopping, we have to work to select the right product. Also, after that, it is hectic to stand in line for billing all the goods. Hence, the proposed system is the smart shopping cart system that will keep track of purchased products and also online transactions for billing using RFID and ZigBee. The system will also give suggestions for products to buy based on user purchase history from a centralized system. In this system, every product in Mart will have an RFID tag, and every cart will have a RFID Reader and ZigBee attached to it. There will be a centralized system for the recommendation and online transaction. Moreover, there will also be RFID reader at the exit door for anti-theft.

[2] **Paper Name-:** Smart trolley and billing system

Author-: Dr. Subburam, Anitha R

Publisher-: Science Direct

Observation-: In this paper the smart trolley is proposed which will audit the purchased product and make payment automatically using RFID tag. It will scan automatically & The billing is made in the cart itself. Nowadays, shopping has become a daily activity in today's world. We can see large queues in many

shopping malls waiting for billing. The objective of our project is to overcome the problem of standing in queue and wasting time. To overcome the above problem, we are proposing a smart trolley billing system that will audit the purchased products and the payment is made online automatically using the RFID tag. It will automatically identify and scan the product and the final billing is made from the cart itself .So that customers are free from waiting in a long queue at checkout. It also provides the centralized and automated billing system using RFID. This model is a reasonable and profitable smart shopping cart handled by the IOT innovations. The primary goal is to provide a technology oriented, time saving and commercial oriented system for enhanced shopping experience. This system will also provide suggestions for the products based on user purchased history from a consolidated system. In this system, every product in the mart will have an RFID tag, and every cart will have an RFID Reader attached to it. These features will save time and make shopping easier. Overall we can gain the best shopping experience.

[3] **Paper Name -:** Smart shopping cart for automatic billing in supermarket

Author-: Thakur Prerana, Shikha Ranjana

Publisher-: IJEDR 2017

Observation-: In this paper the project consists of RFID reader, motion detection sensor, LCD, push button, switches, Zigbee. This project consists of RFID reader, motion detector sensor, Liquid Crystal Display, push buttons, switches and Zigbee. If the user wants to use smart trolley functions then the start button should be pressed. When a user puts some product in a trolley then its code will be detected using RFID reader and cost of a product added to the list and sensor will sense the direction of motion of the product for fault detection and buzzer will be on if fault detected. At last, the counter with the least number of queues will be detected and displayed on the cart LCD. Then, the final bill will be transferred to the counter having least waiting list using zigbee The billing is made in the cart itself. Nowadays, shopping has become a daily activity in today's world. We can see large queues in many shopping malls waiting for billing. The objective of our project is to overcome the problem of standing in queue and wasting time. To overcome the above problem, we are proposing a smart trolley billing system that will audit the purchased products and the payment is made online automatically using the RFID tag. It will automatically identify and scan the product and the final billing is made from the cart itself .So that customers are free from waiting in a long queue at checkout. It also provides the centralized and automated billing system using RFID. This model is a reasonable and profitable smart shopping cart handled by the IOT innovations. The primary goal is to provide a technology oriented, time saving and commercial oriented system for enhanced shopping

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[4] Paper Name -: Smart Trolley for Smart Shopping with an Advance Billing System using IoT

Authors-: S.K. Shankar; S Balasubramani; S Akbar Basha; Sd Ariz Ahamed; N Suneel Kumar Reddy
Publisher-: IEEE

Observation-: In the current scenario, people are more attracted to buy groceries from Supermarket/Hypermarket. In such a case, finding the essential need of any customer in supermarket consumes more time and after all findings the customer need to wait in the billing queue to complete billing process of the selected product. Currently, due to the covid-19 pandemic, the customers are strictly instructed to maintain social distance but practically it is not possible especially in the billing process. To overcome this significant challenge, this research work proposes a smart trolley based on Internet of Things [IoT] with an advanced billing system that makes shopping easier and secured and also avoids standing in long queue. The proposed system consists of a smart trolley attached with LCD display, barcode scanner and a raspberry-pi. This exploratory model is intended to completely eradicate the tedious shopping interaction and administration-related issues. The proposed framework can be undoubtedly implemented at a business scale under the genuine situation.

[5] **Paper Name-:** Collaborative Product Recommendation System for E-commerce Websites

Author-: S. Ganesh Sundaram

Publisher-: IEEE

Observation-:Product advice are the important thing elements for convincing the patron in a proper way, to shop for the goods in any e-trade internet site. The online patron score are completely based on every patron real enjoy which could comprise significant and greater person-orientated information. The advice is probably important on cost, feature, formerly bought emblem and plenty of greater parameters. In this paper we purpose to decorate the advice provider by comparing trendy score out of all of the rankings to be had in numerous e-trade internet site for any precise product. The end result is that the quantity of merchandise could be decreased upto atleast one-third of the general quantity of merchandise to have the below class and

the person is inclined to buy product. Finally, only a few merchandise is advocated to the person by means of making use of person-supplied filtering capabilities and suggested single five-scale score.

[6] **Paper Name-:** Arduino Based Smart Billing System Using RFID"

Author-: Iswarya.C, Josuva.D, Vasanthakumar.R

Publisher-: IEEE

It have stated that even though substantial research has been carried out on applications related to Supply Chain Optimization, yet there is insufficiency of understanding of essentials and the advantage of further organizing and managing the data within business intelligence infrastructures that allow distributing, integrating and inspecting RFID data. Although the system has been proposed by them and explained well but they have not implemented the system and therefore, the results coming out of their proposed system is unknown and cannot be compared. The usage of RFID tags and reader makes the system pretty efficient when it comes to the scanning of products.

[7] **Paper Name-:** ARDUINO BASED SMART CART.

Author-: Ashmeet Kaur, Avni Garg, Abhishek Verma, Akshay Bansal, Arvinder Singh

Publisher-: IEEE

if you are to scan 10,000 items, the time taken by a barcode system shall be 53 hours but the time taken for the same number of items by a RFID system is just 2 hours. This goes to explain how productive RFID systems are as compared to the existing barcode system.

[8] **Paper Name-:** Ingenious Shopping Cart: RFID Enabled for Automated Billing

Author-: Tanushree, Siddharth Yadav, Saksham Aggarwal, Sagar , Mohit Yadav , Neeraj Gupta , Shruti Karkra **Publisher-:** IEEE

If you have a look at the research work and proposal paper of you shall find that the usage of a RFID based system shall not only reduce the hassle that we get to see in supermarkets but it shall also eliminate the wastage of paper making the system economical as well as environment friendly.

[9] **Paper Name-:** Intelligent Trolley System

Author-: Areeb Asif, Bhavana Singh, Ayush Kr. Sonkar, Hardik Dua, Preeti Dhiman

Publisher-: IEEE

In this paper they say that one of the many problems faced by supply chains is the maintenance of dealing records and the lack of live inventory lead to problems such as products being unavailable for sale, and gradual but painful loss of customers.

[10] **Paper Name-:** Automated Billing Cart

Author-: Muhib A. Lambay, Abhishek Shinde, Anupam Tiwari, Vicky Sharma

Publisher-: IEEE

According to paper, the RFID system enables the retailers to get several additional details about the product as compared to the Barcode system. Therefore, when it comes to efficiency and accuracy, RFID systems prove to be a better option compared to the existing Barcode System.

CHAPTER 3 Software Requirements Specification

3.1 Introduction

Purchasing products has become a routine and mandatory task in today world. Billions of consumers go shopping every day in the world, particularly on the weekends and holidays when large crowds near shopping malls are observed. Currently, shopping is performed with the help of traditional carts. The billing process is time-consuming also tedious task to stand in the large queue and has created the need for shops to employ more human resource. We develop smart cart that will do billing and give recommendation off clothes on an android app.

3.1.1 Project Scope

The proposed system aims at designing a Smart Cart which simplifies the process of shopping effectively and efficiently. The main objective is to reduce the waiting time at billing counters in shopping marts. Also, additional features are incorporated in the cart like recommendations, billing etc

3.1.2 User Classes and Characteristics

User: Have to pick cart,connect to cart and put products in cart.

System: Will provide recommendation and Billing info.

3.1.3 Assumptions and Dependencies

Assumptions:

1. User must be trained for basic application functionalities.
2. User must be able understand the android app.
3. Application must be well placed so that power supply should not be down.

Dependencies:

1. Power supply should be given
2. Mobile and cart should be in Bluetooth range

3.2Functional Requirements :

3.2.1 System Feature

One part is the RFID tag attached to each product and the other is RFID reader that reads the product information efficiently. After this, each product recommendation shows in the Mobile application.

The customer easily manages the shopping list in Mobile application according to preferences. Then

shopping information sends to the server wirelessly and automatically generates billing.

3.3 External Interface requirement

3.3.1 User Interfaces

The user will be provided with a simple and user friendly application. The components of the System will be developed using android. The application provides good throughput for the user that operate on the system, performing the required task such as sending bill details and input to system

3.3.2 Hardware Interface

Hardware Components	Quantity	Cost per component
Power Supply[Cell]	4	100.00
ESP32	1	850.00
RFID Scanner	1	240.00
RFID Tags	As Per Requirement	20.00
Ultrasonic Sensor	1	210.00
Buzzer	1	50.00
LED	1	2.00
Connecting wires	AS Required	10.00

Table 3.1 Hardware Interface

- Router
- LAN Cables
- PC
- Ardunio
- Jumper wires
- HC-05 Bluetooth module
- RC522 RFID Reader/Scanner
- UltraSonic Sensor

o ESP32 Microcontroller:

▪ The ESP32 serves as the central processing unit for the smart shopping cart system.

▪ It controls and coordinates the operations of all components.

▪ Manages data communication with the internet for remote monitoring and control.

o Ultrasonic Sensor:

▪ Used for obstacle detection and collision avoidance.

▪ Measures the distance between the shopping cart and nearby obstacles, such as shelves or other carts.

▪ Sends distance data to the ESP32 for processing. o Buzzer:

▪ Provides auditory feedback to the user.

▪ Can sound an alarm in case of obstacles detected too close to the cart.

▪ Alerts the user during RFID tag detection or any other system events.

o RFID Scanner:

▪ Reads RFID tags attached to products or items.

▪ Identifies products added to or removed from the cart.

▪ Sends RFID tag data to the ESP32 for processing and further actions.

o Internet Connectivity:

▪ The ESP32 connects to the internet via Wi-Fi or other means.

▪ Enables remote monitoring and control of the shopping cart system.

▪ Facilitates communication with a central server or cloud platform for data logging,analytics, and other online services.

o Data Processing and Control Logic:

▪ The ESP32 processes data from sensors, such as ultrasonic sensor and RFID scanner, to make

3.3.3 Software Interface

- Android Studio
- Ardunio IDE

3.3.4 Communication Interface

The stakeholders will communicate through the application interface.

3.4 Nonfunctional Requirements

3.4.1 Performance Requirements

The proposed system that we are going to develop will be used by the large scale and small scale organizations at private level. Therefore, it is expected that the system would perform functionally all the requirements that are specified.

1. The performance of the system should be fast and accurate
2. System shall handle expected and non-expected errors in ways that prevent loss Such that there is no hindrance while manipulating diseases

3.4.2 Safety Requirements

Systems Knowledge base should be saved somewhere else(back up) for future use of similar kind of work and also for extending this work.

3.5 System Requirements

3.5.1 Database requirement

MySQL is a relational database management system based on SQL – Structured Query Language. The application is used for a wide range of purposes, including data warehousing, e-commerce, and logging applications. The most common use for mySQL however, is for the purpose of a web database.

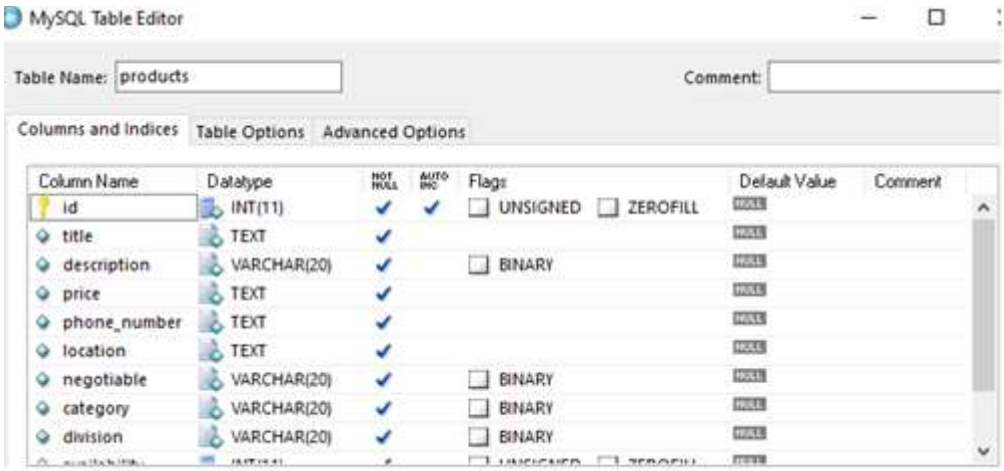


Fig.3.1 Database Requirements

3.5.3Software Requirement

3.5.3.1 Android Studio

Android Studio is the official integrated development environment for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems.

3.5.3.2 Ardunio:

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller (MCU) and developed by Arduino.cc and initially released in 2010. The microcontroller board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits

3.6 Analysis Models: SDLC Model to be applied

We have used waterfall model in this project. Below are steps

The Waterfall" approach, the whole process of software development is divided into separate phases.

Requirement Analysis: All possible requirements of the system to be developed are captured in this phase and documented in a requirement specification document.

1. Which hardware we have to use
2. Flow of the system

3. Which tool to be used
4. Identification of any competitor.

System Design: The requirement specifications from first phase are studied in this phase and the system design is prepared. This system design helps in specifying hardware and system requirements and helps in defining the overall system architecture.

1. We created UML diagrams using star UML
2. Architecture of the project got final
3. Ardunio we have used
4. Android was decided to implement the project.

Implementation − With inputs from the system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality, which is referred to as Unit Testing.

1. We started the development in this phase
2. We created android app to view recommendation

Integration and Testing − All the units developed in the implementation phase are integrated into a system after testing of each unit. Post integration the entire system is tested for any faults and failures. Testing phase of raspi camera and python code was done

Deployment of system − Once the functional and non-functional testing is done; the product is deployed in the customer environment or released into the market.

Maintenance − There are some issues which come up in the client environment. To fix those issues, patches are released. Also to enhance the product some better versions are released. Maintenance is done to deliver these changes in the customer environment.

3.7 System Implementation Plan

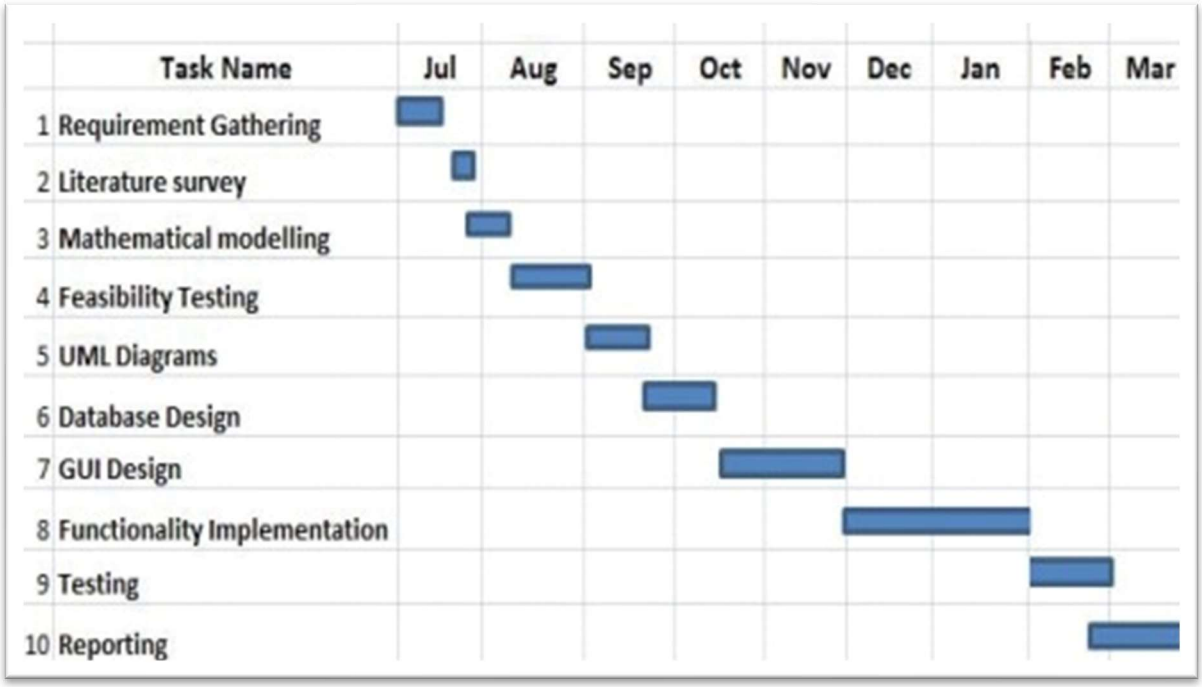


Table 3.2 System implementation plan

CHAPTER 4 : SYSTEM DESIGN

4.1 System Architecture

1. **RFID and Ultrasonic Sensor:**
    - RFID: Radio Frequency Identification (RFID) tags are likely attached to products. The RFID reader on the trolley scans these tags to identify items placed in the trolley.
    - Ultrasonic Sensor: This sensor is used for measuring distances, possibly to detect if items are placed in or removed from the trolley.
2. **Central Microcontroller:**
    - This component (likely an ESP8266 or a similar microcontroller) processes data from the RFID and ultrasonic sensors. It acts as the central unit of the smart trolley.
3. **Buzzer:**
    - Connected to the microcontroller, the buzzer provides auditory feedback or alerts to the user, potentially for actions such as successful item scanning or errors.
4. **Database (SQL):**
    - The system uses a SQL database to store and manage data. This could include inventory information, user data, transaction logs, etc.
    - The microcontroller communicates with the SQL database to update and retrieve data as necessary.
5. **Internet Connectivity:**
    - The microcontroller connects to the internet, allowing it to sync data with the SQL database and possibly interact with other services.
6. **Mobile Application (Android Mobile):**
    - An Android mobile app interfaces with the system, allowing users to view their shopping lists, track expenses, receive notifications, and manage their account.
    - The app communicates with the microcontroller and the database over the internet.

System Flow:

1. **Item Scanning:**
    - As items are placed in the trolley, the RFID reader scans the tags.
    - The ultrasonic sensor detects the presence or removal of items, providing additional context to the system.
2. **Data Processing:**
    - The microcontroller processes the sensor data, updating the item list in the trolley.
    - If an item is successfully added, the buzzer might beep to confirm the action.
3. **Database Interaction:**
    - The microcontroller sends data to the SQL database, updating the inventory and user's shopping cart information.
    - The database might also send data back to the microcontroller or directly to the user's mobile app.
4. **User Interaction:**
    - Users can view their current shopping cart, total cost, and other details via the Android mobile app.
    - The app communicates with the SQL database and possibly the microcontroller to provide real-time updates.

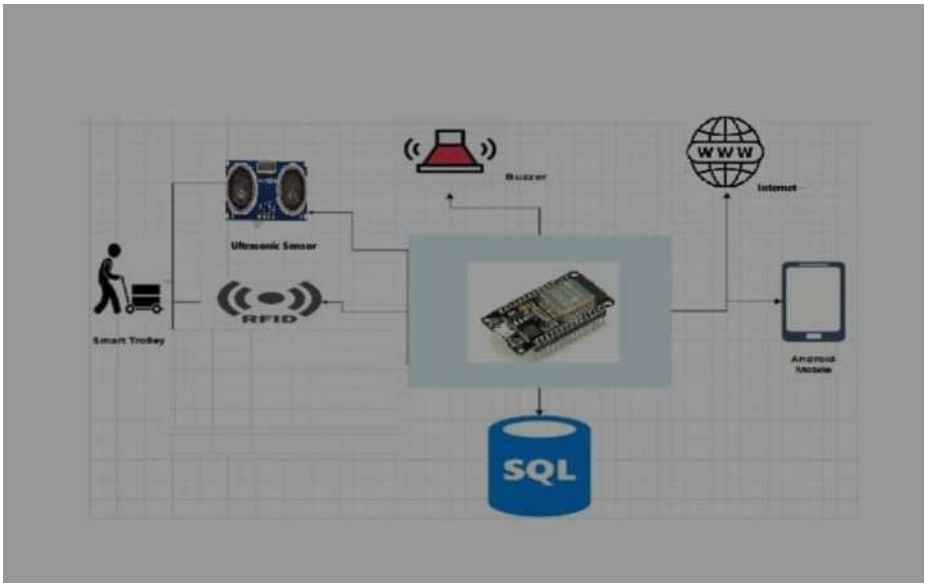


Fig 4.1 Architecture diagram

4.2 Data Flow Diagrams

DFD Level 0:

This is the highest-level DFD, which provides an overview of the entire system. It shows the major processes, data flows, and data stores in the system, without providing any details about the internal workings of these processes.

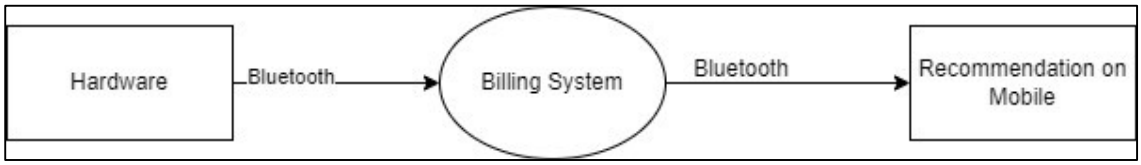


Fig 4.2 DFD 0 diagram

DFD Level 1:

This level provides a more detailed view of the system by breaking down the major processes identified in the level 0 DFD into sub-processes. Each sub-process is depicted as a separate process on the level 1 DFD. The data flows and data stores associated with each sub-process are also shown.

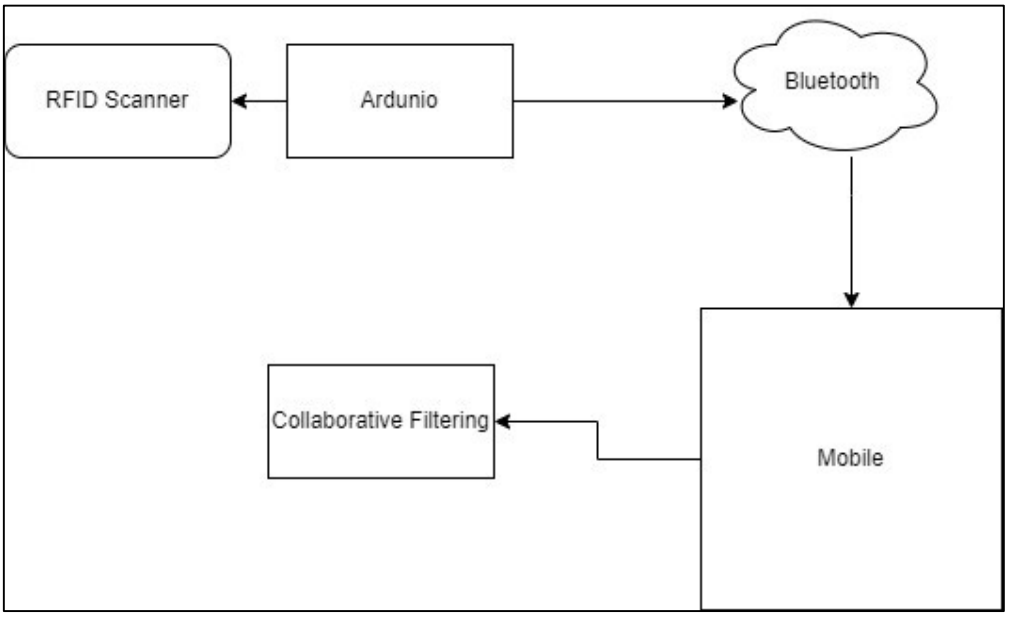


Fig 4.3 DFD 1 diagram

4.2 ER Diagram

An Entity Relationship (ER) Diagram is a type of flowchart that illustrates how “entities” such as people, objects or concepts relate to each other within a system.

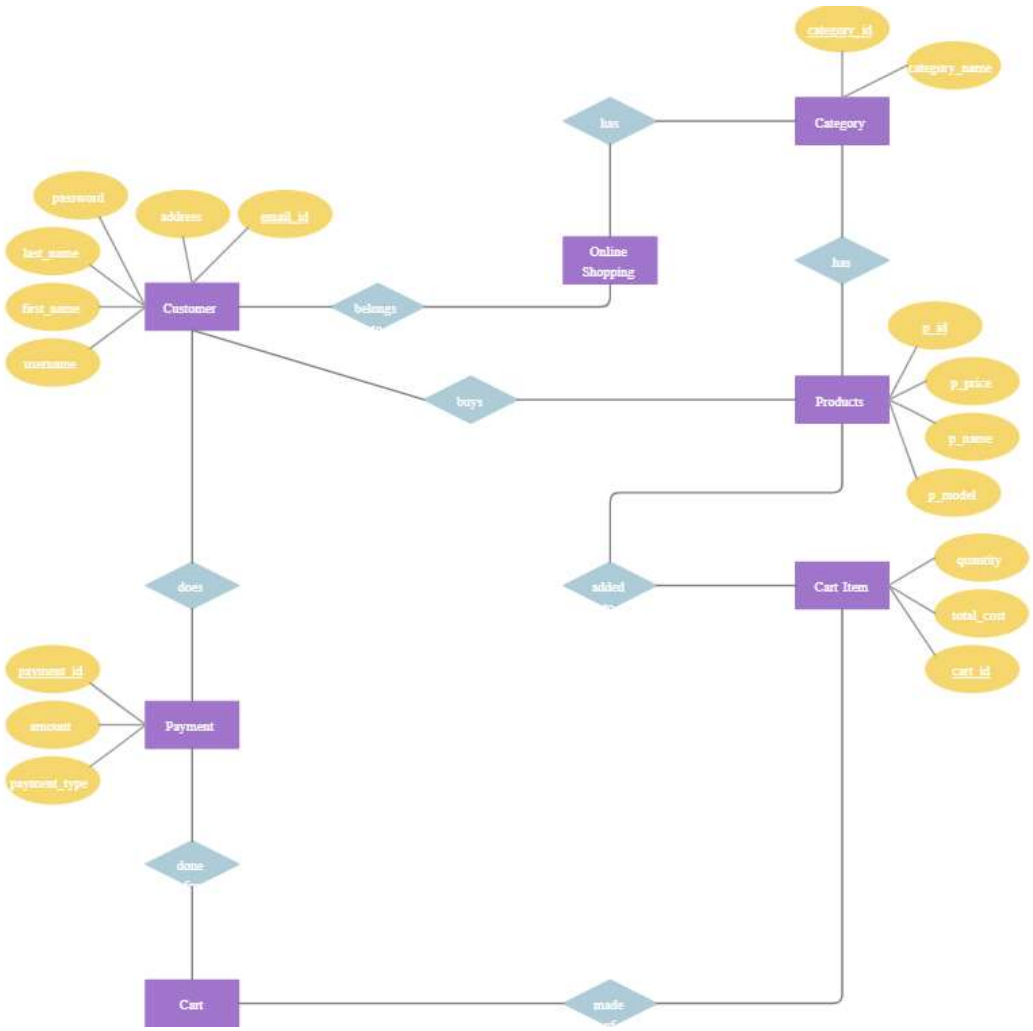


Fig 4.4 ER diagram

4.4 UML Diagram

4.4.1 Use case:

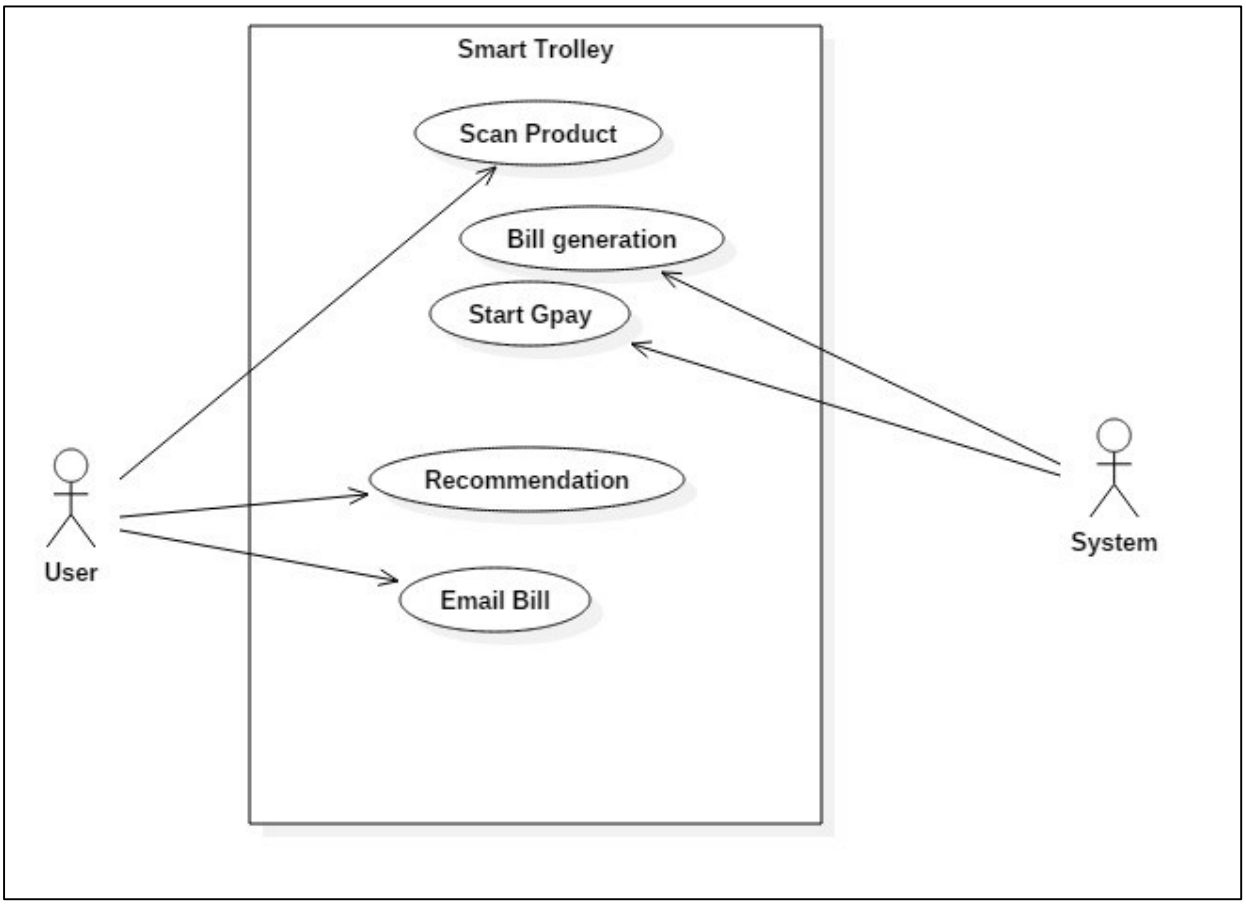


Fig 4.5 Use case diagram

4.4.2 Activity Diagram:

Activity diagram are intended to model both computational and organizational processes(i.e. workflows).Activity diagrams show the overall flow of control. Activity diagrams are constructed from a limited number of shapes, connected with arrows.

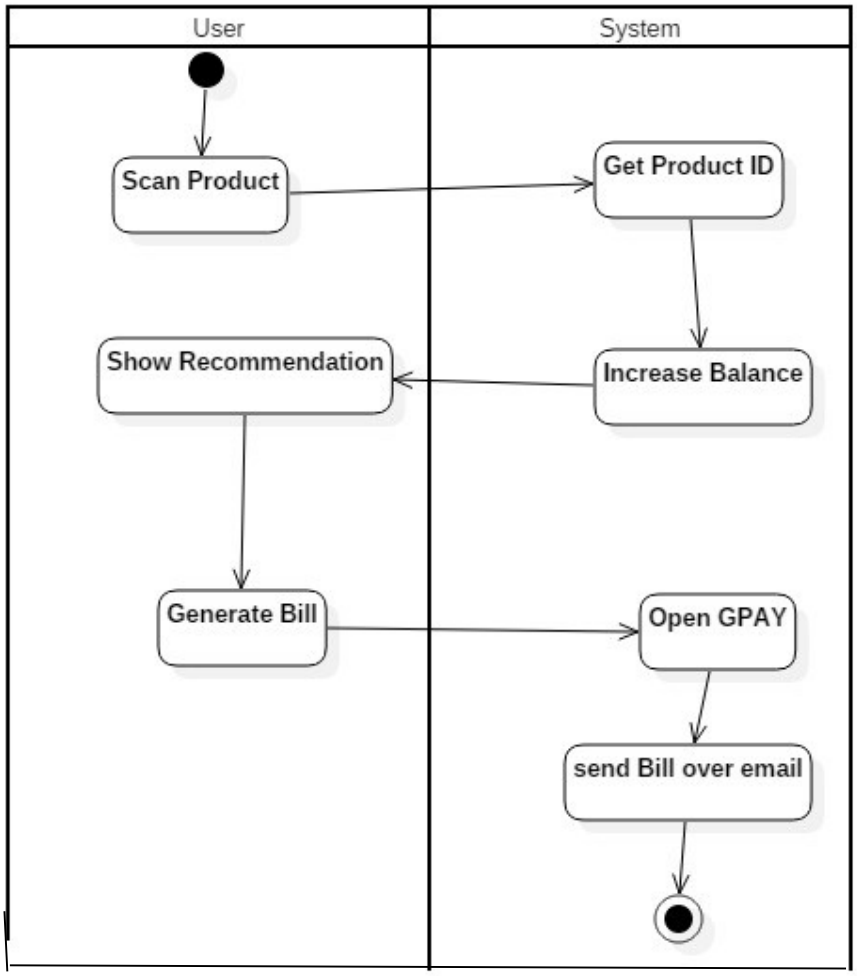


Fig 4.6 Activity diagram

4.4.3 State Chart Diagram

Start Chart diagram demonstrates the elements as they interact over the period of time, their interaction or interaction instance. State chart diagram is an interaction diagram that focuses on the ordering of messages. State chart diagram can be drawn along two axes. The horizontal axis and vertical axis

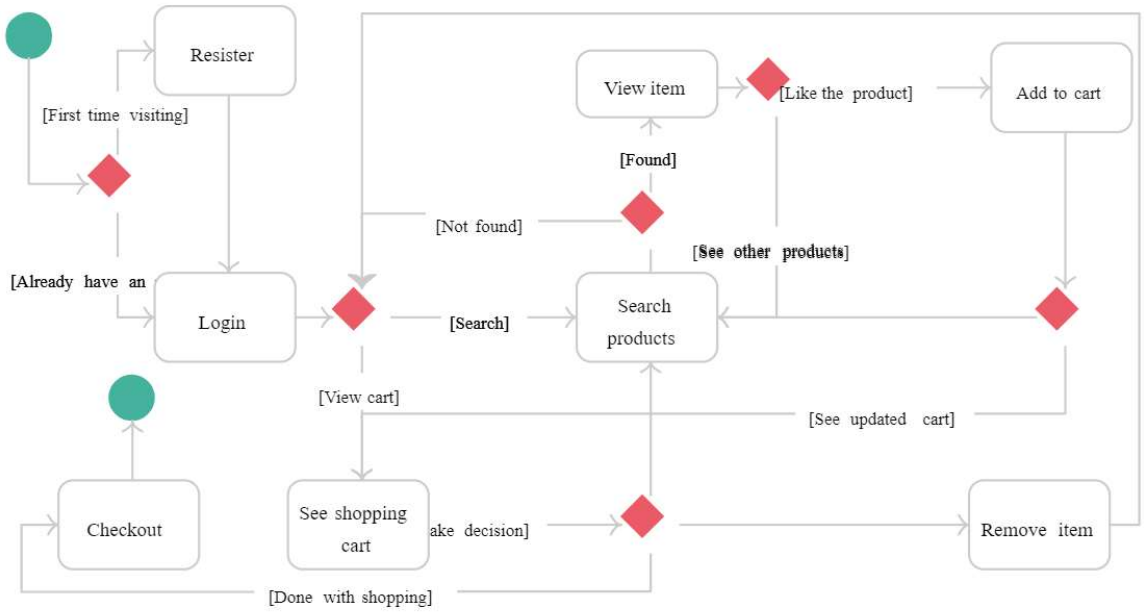


Fig 4.7 State chart diagram

4.4.4 Component Diagram :

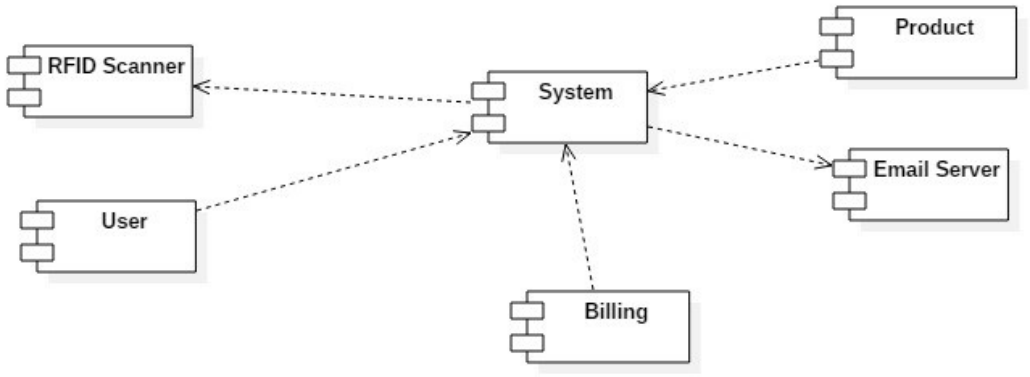


Fig 4.8 Component diagram

Components and Interactions

RFID Scanner:

Role: The RFID scanner is responsible for reading RFID tags attached to products. This scanner captures the unique identifiers of the items when they are placed in or removed from the trolley.

Interaction: It sends the scanned information to the central system for processing.

User:

Role: Represents the end-user, typically a shopper using the smart trolley.

Interaction: The user interacts with the system through actions like adding or removing items from the trolley, and possibly via a mobile application for managing their shopping cart and viewing details.

System:

Role: Acts as the central hub that processes data from various sources. It manages the overall operations, such as processing RFID scans, updating product information, handling billing, and sending notifications.

Interactions: Receives input from the RFID Scanner. Communicates with the Product database to retrieve product details. Interacts with the Billing component to update and manage transaction details. Sends emails via the Email Server to notify users about their purchases or any other updates.

Product:

Role: Represents the database or repository that contains detailed information about the products,

Such as names, prices, descriptions, and possibly stock levels.

Interaction: The system queries the Product database to fetch and update product information based on the scanned RFID tags.

Billing:

Role: Handles all financial transactions related to the user's purchases. This includes calculating the total cost, applying discounts, and processing payments.

Interaction: The system communicates with the Billing component to update the user's cart total, generate invoices, and process payment transactions.

Email Server:

Role: Responsible for sending emails to users. These emails could include receipts, promotional offers, and other notifications.

Interaction: The system sends requests to the Email Server to deliver various types of emails to the user.

CHAPTER 5: PROJECT PLAN

5.1 Project Estimates

5.1.1 Reconciled Estimates

5.1.1.1 Cost Estimate:

We have a Hardware priced at 6,000 rupees, a camera costing around 800 rupees,and miscellaneous expenses estimated at approximately 3,000 rupees. Thus, the total approximate amount required for the entire project is approximately 9,800 rupees.

5.1.1.2 Time Estimates: 8 months

5.1.2 Project Resources

Project resources includes People like customer in shopping mall

Hardware like Processor, Ram, hard disk and Software like android and Tools like Eclipse, Jupyter , Notepad++.

5.2 Risk Management NP Hard analysis

5.2.1.1 Risk Identification

1. Security Information and Event Management (SIEM):Analyze and cor- relate large amounts of real-time data from network and security de- vices to manage external and internal security threats, improve incident response time and compliance reporting.
2. Application Log Monitoring: Improve analysis of application log data to better manage system resource utilization, security issues, and diagnose and preempt production application problems.
3. Network Intrusion Detection: Monitor and analyze network traffic to detect, identify, and report on suspicious activity or intruders.
4. Fraud Detection: Use pattern/anomaly recognition on larger volumes and variety of data to detect and prevent fraudulent activities by external or internal parties

5.Risk Modelling: Improve risk assessment and associated scoring by building sophisticated machine learning models on Cloud

5.2.2 Risk Analysis

The risks for the Project can be analyzed within the constraints of time and quality

ID	Risk Description	Probability	Impact		
			Schedule	Quality	Overall
1	Security Info and Event Management	Low	Low	Low	Low
2	Hardware Failure	High	High	High	High
3	Network Intrusion Detection	Low	High	Low	Low
4	Risk Modelling	High	High	High	High

Table 5.1: Risk Table

Probability	Value	Description
High	Probability of occurrence is	>75%
Medium	Probability of occurrence is	26 –75%
Low	Probability of occurrence is	<25%

Table 5.2: Risk Probability definitions

5.2.3 Overview of Risk Mitigation, Monitoring, Management

Following are the details for each risk.

Impact	Value	Description
Very high	>10%	Schedule impact or Unacceptable quality
High	5 –10%	Schedule impact or Some parts of the project have low quality
Medium	<5%	Schedule impact or Barely noticeable degradation in quality Low Impact on schedule or Quality can be incorporated

Table 5.3: Risk Impact definitions

Risk ID	1
Risk Description	Analyze And correlate large amount of real time data from network and security devices to manage external and internal security threats, improve incident response time and compliance reporting.
Category	Security Information And Event Management.
Source	Cloud Cluster.
Probability	Low
Impact	Low
Response	Mitigate
Strategy	High Performance
Risk Status	Rarely Occurred

Risk ID	2
Risk Description	Improve analysis of application log data to better man- age system resource utilization, security issues and di- agnose and preempt production application problems.
Category	Application Log Monitoring
Source	Main node
Probability	High
Impact	High
Response	Continuous
Strategy	Multi Tenancy.
Risk Status	Occurred

Risk ID	3
Risk Description	Monitor and analyze network traffic to detect, identify and report on suspicious activity or intruders.
Category	Network Intrusion Detection
Source	Name Node.
Probability	Low
Impact	Low
Response	Mitigate
Strategy	High Scalability
Risk Status	Identified

Risk ID	4
Risk Description	Use pattern/anomaly recognition on larger volumes and variety of data to detect and prevent fraudulent activities by external or internal parties.
Category	Vehicle Prediction and Detection
Source	Data Server.
Probability	Low
Impact	Low
Response	Mitigate
Strategy	Easy Data Ingestion
Risk Status	Identified

Risk ID	5
Risk Description	Improve risk assessment and associated scoring by building sophisticated machine learning models on Cloud that can take into account hundreds or even thousands of indicators.
Category	Risk Modelling
Source	Local Data Cluster.
Probability	High
Impact	High
Response	Continuous
Strategy	Existing application work
Risk Status	Occurred

5.3.Project Schedule

5.2.4 Project taskset

Major Tasks in the Project stages are:

- Task 1:RequirementGathering
- Task 2: Literature survey
- Task 3: Mathematical modeling
- Task 4: Feasibility testing
- Task 5: UML diagrams
- Task 6: Database design
- Task 7: GUI design
- Task 8: Functionality implemented
- Task 9:Testing
- Task 10:Reporting

5.2.5 Task network

Project tasks and their dependencies are noted in this diagrammatic form.

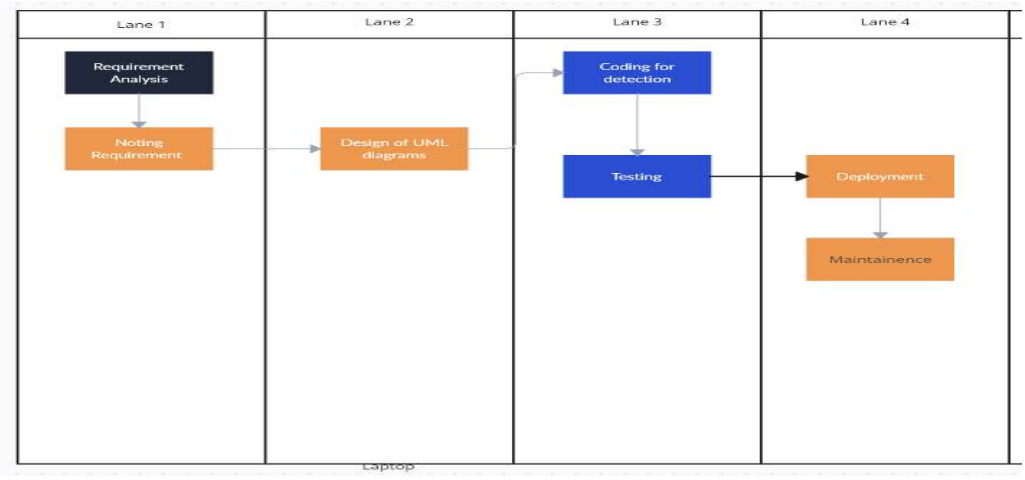


Figure 5.1: Task Network

5.2.6 Timeline Chart

A project timeline chart is presented. This may include a time line for the entire project.

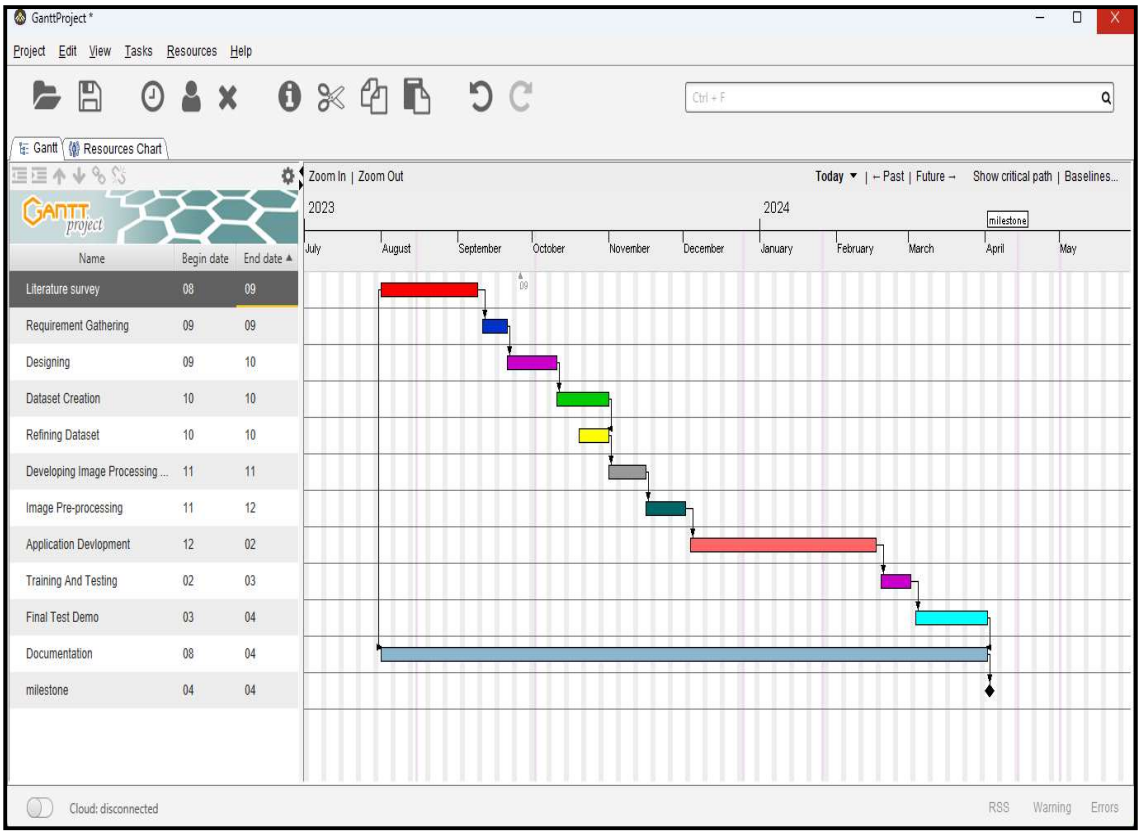


Table 5.4: Timeline Chart

1. Timeline Chart The Timeline Chart represents the overall progress of the project, with the x-axis indicating the duration of the project, and the y-axis showing the various activities involved. Each bar on the chart represents a specific task, phase, or milestone.

2. Activities and Phases:

Literature Survey (Months 1-2): In this phase, we will conduct a thorough study of the existing literature on the subject.

Requirement Gathering (Months 3-4): This phase involves gathering the requirements from stakeholders, defining the project scope, and documenting the requirements.

Designing (Months 5-6): During this phase, we will design the overall architecture of the system and select appropriate tools and technologies for the project.

Dataset Creation (Months 7-8): In this phase, we will create a dataset by collecting relevant data, annotating it, and ensuring its quality.

Refining Dataset (Months 9-10): In this phase, we will refine the dataset by removing duplicates, cleaning the data, and performing any necessary preprocessing.

Developing Image Processing (Months 11-12): In this phase, we will develop algorithms for image processing and integration with the dataset.

Image Pre-processing (Months 13-14): This phase involves preprocessing the images in the dataset, including resizing, normalization, and data augmentation.

Application Development (Months 15-16): In this phase, we will develop the core functionality of the application, such as training the model, testing its performance, and deploying it.

Training and Testing (Months 17-18): In this phase, we will train the model using the preprocessed dataset and evaluate its performance using various metrics.

Final Test Demo (Months 19-20): In this phase, we will perform a final test of the application and create a demonstration for the client.

Documentation (Months 21-22): In this phase, we will document the entire project, including the design, implementation, and evaluation processes.

3. Milestones:

A milestone in a Gantt chart represents a significant event, achievement, or completion of a key deliverable within a project, often marked by a diamond or triangle symbol to denote an important point in the project timeline.

5.3 Team Organization

5.3.1 Team structure

Name	Role
Gautami Kadam & Jay Sawant	Software Developer
Pranav Mule & Saurabh Kale	Hardware Developer
All	Tester
All	Documentation

Table 5.5 Team Structure

CHAPTER 6 : PROJECT IMPLEMENTATION

6.1 Overview of Project Modules

- **o ESP32 Microcontroller:**
  - The ESP32 serves as the central processing unit for the smart shopping cart system.
  - It controls and coordinates the operations of all components.
  - Manages data communication with the internet for remote monitoring and control.

- **Ultrasonic Sensor:**
  - Used for obstacle detection and collision avoidance.
  - Measures the distance between the shopping cart and nearby obstacles, such as shelves or other carts.
  - Sends distance data to the ESP32 for processing.

- **Buzzer:**
  - Provides auditory feedback to the user.
  - Can sound an alarm in case of obstacles detected too close to the cart.
  - Alerts the user during RFID tag detection or any other system events.

- **RFID Scanner:**
  - Reads RFID tags attached to products or items.
  - Identifies products added to or removed from the cart.
  - Sends RFID tag data to the ESP32 for processing and further actions.

- **Internet Connectivity:**
  - The ESP32 connects to the internet via Wi-Fi or other means.
  - Enables remote monitoring and control of the shopping cart system.
  - Facilitates communication with a central server or cloud platform for data logging,analytics, and other online services.

- **Data Processing and Control Logic:**

- The ESP32 processes data from sensors, such as ultrasonic sensor and RFID scanner, to make decisions.

- It implements control logic to manage the behavior of the shopping cart, such as obstacle avoidance, item tracking, and user interaction.
- Controls the buzzer to provide feedback and alerts.

- **Internet Communication Protocol:**

- Utilizes communication protocols such as HTTP, MQTT, or WebSocket to exchange data with remote servers or cloud platforms.
- Sends sensor data, cart status, and other relevant information to the backend server.
- Receives commands and updates from the server for remote control and configuration adjustments.

- **Backend Server or Cloud Platform:**

- Receives data from multiple smart shopping carts deployed in the store.
- Stores and manages shopping cart data, including item lists, user interactions, and system events.

6.2 Tools and Technologies Used

A. Java Programming Language:

- Java is one of the powerful general-purpose programming languages, created in 1995 by Sun Microsystems (now owned by Oracle). Java is Object-Oriented. However, it is not considered as pure object-oriented as it provides support for primitive data types (like int, char, etc).
- Java syntax is similar to C/C++. But Java does not provide low-level programming functionalities like pointers.
- Also, Java code is always written in the form of classes and objects.

Android heavily relies on the Java programming language all the SDK's required to build for android applications use the standard libraries of Java.If one is coming from a traditional programming background like C, C++, Java is easy to learn.

B. Android Development:

Android operating system is the largest installed base among various mobile platforms across the globe.

Hundreds of millions of mobile devices are powered by Android in more than 190 countries of the world. It conquered around 71% of the global market share by the end of 2021, and this trend is growing bigger every other day.

The company named Open Handset Alliance developed Android for the first time that is based on the modified version of the Linux kernel and other open-source software.

Google sponsored the project at initial stages and in the year 2005, it acquired the whole company. In September 2008, the first Android-powered device was launched in the market.

Android dominates the mobile OS industry because of the long list of features it provides.

It's user-friendly, has huge community support, provides a greater extent of customization, and a large number of companies build Android-compatible smartphones.

6.3 Algorithm

In collaborative filtering, we ignore the features of an individual item. Instead, we focus on a similar group of people using the item and recommend other items that the group likes.

Similar users are divided into small clusters and are recommended new items according to the preferences of that cluster. Let's understand this with an easy movie recommendation example:

Users	Movie 1	Movie 2	Movie 3	Movie 4
User 1	5	4		5
User 2	4		3	
User 3		1		2
User 4	1	2		

What we can infer from this user-item matrix is:

Users 1 and 2 liked Movie 1. Since User 1 liked movies 2 and 4 a lot, there's a high chance of User 2 enjoying the same.

Users 1 and 3 have opposite tastes.

Users 3 and 4 both disliked Movie 2, so there's a high chance User 4 will also dislike Movie 4.

User 3 might dislike Movie 1.

This is the logic behind employing a user-item interaction matrix - to find clusters of similar users through collaborative filtering.

CHAPTER 7

SOFTWARE TESTING

7.1 Type of Testing

White box testing is a testing technique that examines the program structure and derives test data from the program logic/code. The other names of glass box testing are clear box testing, open box testing, logic driven testing or path driven testing or structural testing. Black-box testing is a method of software testing that examines the functionality of an application without peering into its internal structures or workings. This method of test can be applied to virtually every level of software testing: unit, integration, system and acceptance.

Unit Testing is focuses on the smallest unit of software design i.e. the smallest component or module. Important control paths are tested to uncover errors within the boundary of the module. It focuses on the internal processing logic and data structures within the boundaries of a component. This type of testing can be conducted in parallel for multiple components. **Integration Testing** is a systematic technique for constructing the software architecture while at the same time conducting tests to uncover errors associated with interfacing. The different modules in our project were interfaced and tested in small increments, thus making the errors easy to isolate and correct. This is known as incremental integration.

Validation Testing begins at the culmination of integration testing, when individual components have been exercised, software is completely assembled as a package, and interfacing errors have been uncovered and corrected. Here, testing focuses on user visible actions and user recognizable output from the system. Validation succeeds when the software functions in a manner that can be reasonably expected by the customer. In our project, all functions and performance characteristics are tested and they conform to the required specifications and are accepted.

System Testing is the final step in testing. In this phase, we tested the entire system as a whole with all forms, code, modules and class modules. This form of testing is known as Black Box testing or System testing. Black Box testing enables us to derive sets of input conditions that will fully exercise all functional requirements for program.

7.2 Test cases & Test Results

Sr. No	Test Case ID	Test Case Objective	Pre-condition	Steps	Test Data	Expected Result	Actual Result	Status
1	TC 1	Registration	App should open	1.Open URL 2.Fill Form	First name Last Name Email id etc	Registration should be done	Registration is done	Pass
2	TC 2	Login	TC 1 is done	1.Open URL 2.Fill emaild and password	Username password	Username and password will validated. If correct open product list page	Product list page is open	Pass
3	TC 3	Login	TC 1 is done	Open URL Fill Email id and incorrect password	emailid	Login page will open with incorrect password msg	Login page is opened with login invalid msg.	Pass
4	TC 4	Forget Password	TC 1 is done	TC1 done	TC 2	Send Email with password link	Password link send to user	Pass

Table 7.1 Test Case Results

CHAPTER 8

RESULT

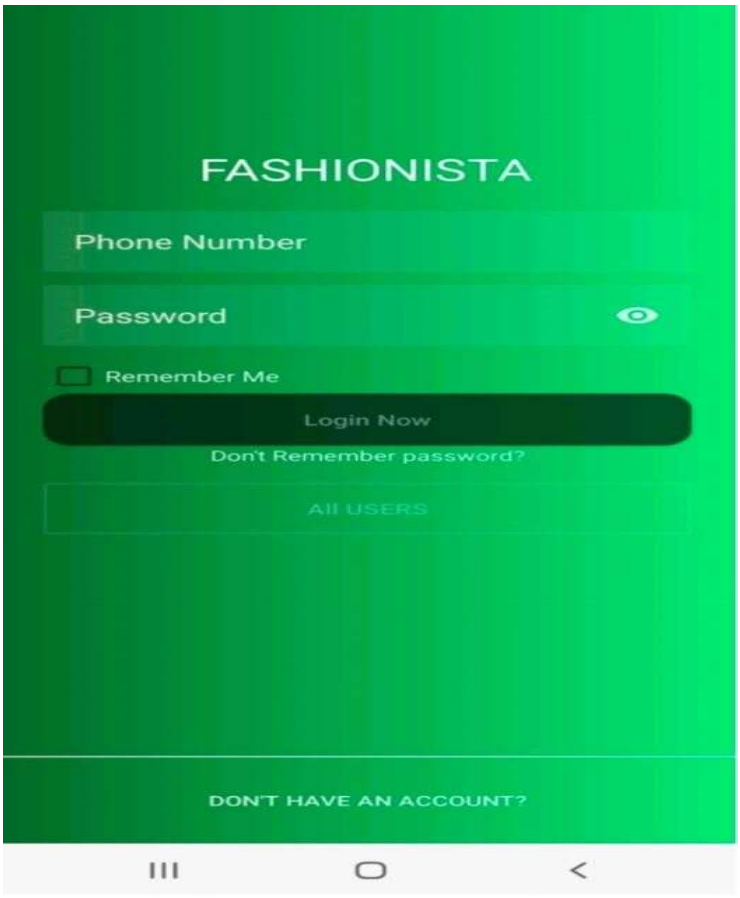
8.1 Outcomes

- Hardware will be developed using an ultrasonic sensor and RFID scanner/reader. Whenever the user puts the product in a trolley it will send a notification to the Android app.
- Android app will update the price and will provide the recommendation
- At the time of registration in the Android app, we will ask the likes of the user and based on that we will recommend the products.
- When the user checks out Google Pay will be open for pay**.**

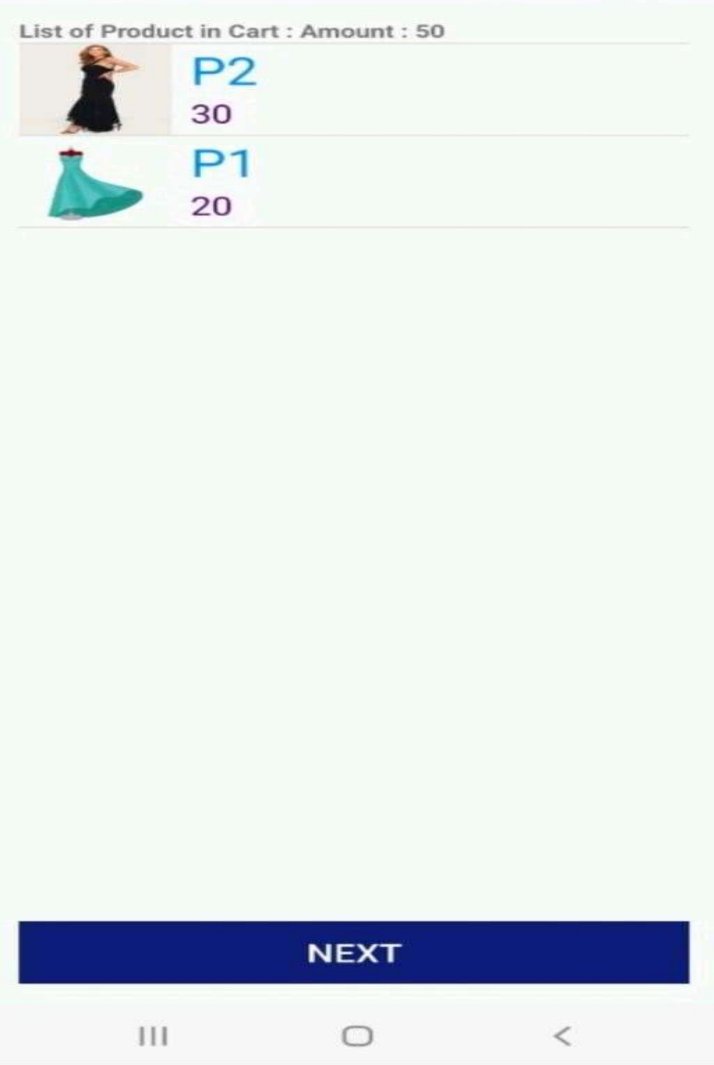
8.2 Screen Shots

In the first case we have install the android app in our mobile system and fill the login details for getting the information of customer accordingly. By using this login details customer can enter without login until next visit. By this credentials we can access the application and identify the customer details.

Case 2:



In this case we have entered personal details of customer such as phone number and password which we have given in login details . By using the particular password we can access in the application easily until next visit.



In this case as we have entered scanned products and according to that products the recommended items present in the shopping mall will be known to the customer. The various number of products we have added that credentials is known to us by its counting. so that we can integrate easily that how many products we have added in that and how many we want to remove.

In this case we fill the details for billing purpose after choosing the items . Whenever we want to create bill for overall items in the trolley we have to fill all the details in this page and confirm it so that it will go towards PhonePe , Gpay for billing purpose and it will automatically count the over all amount.

Case 5:

Here in the above picture we scan every product using RFID reader through internet connection. As we scan the product over here the buzzer and LED will blow out and the product details will be display in our created applications.

CHAPTER 9: CONCLUSION &FUTURE SCOPE

9.1 Conclusion

The proposed model is easy to use, low-priced and does not require any special training. This model keeps an account and uses of the existing developments and various types of radio frequency identification and detection technologies which are used for item recognition, billing and inventory update. As the whole system is becoming smart, the requirement of manpower will decrease, thus benefiting the retailers. Theft in the mall will be controlled using this smart system, which further adds to the cost efficiency. The time efficiency will increase phenomenally since this system will eliminate the waiting queues. More customers can be served at the same time thus benefiting the retailers and customers as well

9.2 Future Scope

The current system can be extended to allow the users to create accounts and save products in to wish list.

• The users could subscribe for price alerts which would enable them to receive messages when price for products fall below a particular level

• The current system is confined only to the shopping cart process. It can be extended to have an easy to use check out process.

• Users can have multiple shipping and billing information saved. During checkout they can use the drag and drop feature to select shipping and billing information.

Appendix A:

Problem Statement Feasibility Assessment

Problem Statement
Developing a Smart Shopping Cart system that automatically prices products, provides product information, and offers personalized recommendations.

Feasibility Assessment Using Satisfiability Analysis and Computational Complexity

Satisfiability Analysis

To determine the feasibility of the Smart Shopping Cart, we first need to analyze the satisfiability of the underlying problems:

1. Automatic Pricing:
   - Problem: Ensure correct pricing of items added to the cart.
   - Constraints: Accurate price database, reliable barcode/RFID reading, real-time data processing.
   - Satisfiability: This problem is straightforward and generally satisfiable with current technology. Efficient database queries and error-checking mechanisms ensure that the pricing is accurate.

2. Product Information:
   - Problem: Provide detailed information about products.
   - Constraints: Maintain a comprehensive and up-to-date product database.
   - Satisfiability: This problem is satisfiable using modern database management systems and API integrations with manufacturers and retailers for real-time data updates.

3. Recommendation System:
   - Problem: Provide personalized product recommendations.
   - Constraints: Real-time processing, accurate user profiling, robust recommendation algorithms.
   - Satisfiability: This problem is more complex but satisfiable with machine learning techniques such as collaborative filtering and neural networks.

Computational Complexity Analysis

To classify the problems in terms of computational complexity, we refer to categories such as P, NP, NP-Complete, and NP-Hard.

1. Automatic Pricing:
   - Nature: Querying and retrieving data.
   - Complexity Class: P (Polynomial Time). Database queries and real-time processing can be done in polynomial time with efficient algorithms and data structures.

2. Product Information:
   - Nature: Retrieval and display of data.
   - Complexity Class: P. Similar to pricing, retrieving and displaying product information from a database can be handled in polynomial time.

3. Recommendation System:

- Nature: Personalized recommendations based on user data.
- Complexity Class:
  - Collaborative Filtering: Often P for basic algorithms (e.g., user-user or item-item similarity), but can become more complex with increasing data size.
  - Advanced Techniques (e.g., Neural Networks): These may fall into NP due to the need for training and optimization. Training neural networks can be computationally intensive and is not always guaranteed to be polynomial time, but many practical implementations are feasible with current technology.

Modern Algebra and Mathematical Models

The Smart Shopping Cart can be modeled using various mathematical tools:

1. Set Theory and Functions:
   - Sets: Define sets for users, products, and transactions.
   - Functions: Map products to prices, users to preferences, and transactions to recommendations.

2. Graph Theory:
   - Represent users and products as nodes in a bipartite graph for recommendation systems.
   - Use algorithms to find user-product similarities and suggest products.

3. Linear Algebra:
   - Matrix factorization techniques in collaborative filtering (e.g., Singular Value Decomposition).
   - Represent user-item interactions as matrices.

4. Probability and Statistics:
   - Use probabilistic models for product recommendations (e.g., Bayesian networks).
   - Statistical analysis for trend detection and anomaly detection in pricing.

Conclusion

The feasibility of developing a Smart Shopping Cart system that handles automatic pricing, product information, and personalized recommendations is high. The problems associated with pricing and product information retrieval are in the P complexity class, ensuring efficient solutions. The recommendation system, while more complex, can be effectively managed using a combination of polynomial-time algorithms and more advanced machine learning techniques. Mathematical models from modern algebra provide a robust framework for modeling and solving these problems.

Appendix B:

Details of paper publication:

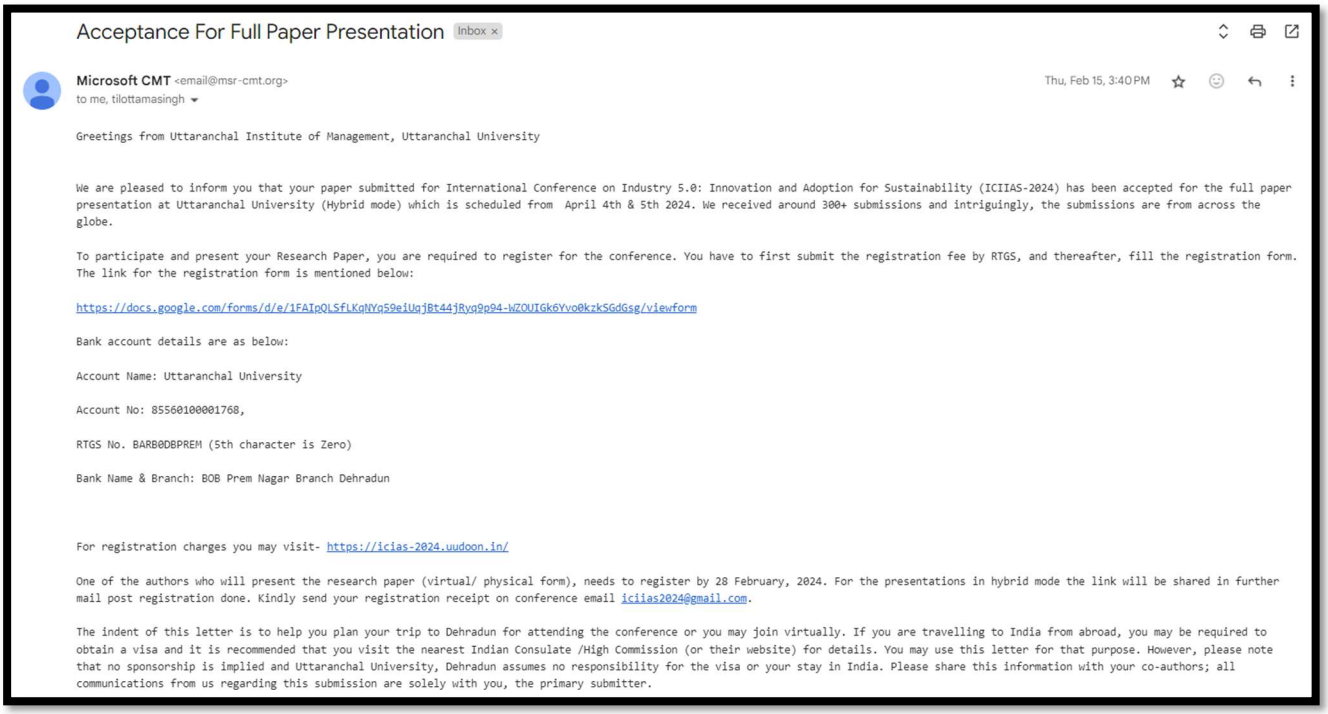
ICIIAS-2024 (International Conference on Industry 5.0: Innovation and Adoption for Sustainability)

About Conference : ICIIAS-2024

The idea of Industry 5.0 is not limited to Industry." It applies to every sector, every organization and every business one can think of. Industry 5.0 blows the whistle on sustainable transformation led through technology and innovation.
The International Conference on Industry 5.0: Innovation and Adoption for Sustainability (ICIIAS-2024) is dedicated to achievements, trends, and sustainable solutions for creating sustainable global organisations worldwide. This hybrid platform aims to address the interconnected nature of transformation and technological innovation which paves their consistency through a sustainable framework. Researchers and experts from Academia and Industry will showcase the exchange of perspectives, ideas, identifying the crucial linkages and potential for collaboration towards making the contribution in sustainable tech world for the present and future generations. In an era where environmental concerns, social responsibility, and ethical business practices have become paramount, this conference is an international platform of innovators and researchers who thrive in contributing to a sustainable world, anticipating the future trends that will shape the business and global economy landscape.

Certificate:

Paper Acceptance:



Acceptance For Full Paper Presentation Inbox ×

Microsoft CMT <email@msr-cmt.org>
to me, tilottamasingh

Thu, Feb 15, 3:40 PM

Greetings from Uttaranchal Institute of Management, Uttaranchal University

We are pleased to inform you that your paper submitted for International Conference on Industry 5.0: Innovation and Adoption for Sustainability (ICIIAS-2024) has been accepted for the full paper presentation at Uttaranchal University (Hybrid mode) which is scheduled from April 4th & 5th 2024. We received around 300+ submissions and intriguingly, the submissions are from across the globe.

To participate and present your Research Paper, you are required to register for the conference. You have to first submit the registration fee by RTGS, and thereafter, fill the registration form. The link for the registration form is mentioned below:

https://docs.google.com/forms/d/e/1FAIpQLSfLKqNYq59eiUqjBt44jRvq9p94-WZOUIGk6Yvo0kzkSGdGsg/viewform

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Account Name: Uttaranchal University

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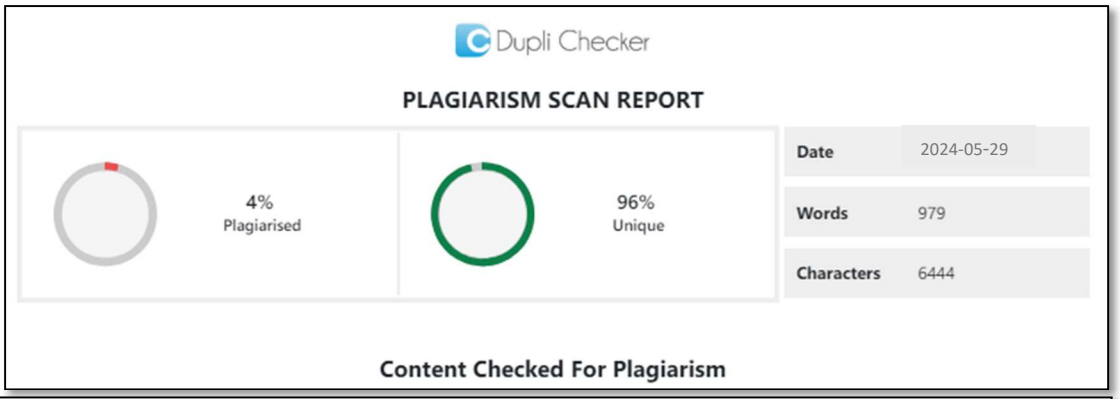
For registration charges you may visit- https://icias-2024.uudoon.in/

One of the authors who will present the research paper (virtual/ physical form), needs to register by 28 February, 2024. For the presentations in hybrid mode the link will be shared in further mail post registration done. Kindly send your registration receipt on conference email iciias2024@gmail.com.

The indent of this letter is to help you plan your trip to Dehradun for attending the conference or you may join virtually. If you are travelling to India from abroad, you may be required to obtain a visa and it is recommended that you visit the nearest Indian Consulate /High Commission (or their website) for details. You may use this letter for that purpose. However, please note that no sponsorship is implied and Uttaranchal University, Dehradun assumes no responsibility for the visa or your stay in India. Please share this information with your co-authors; all communications from us regarding this submission are solely with you, the primary submitter.

Appendix C: Plagiarism Check Report



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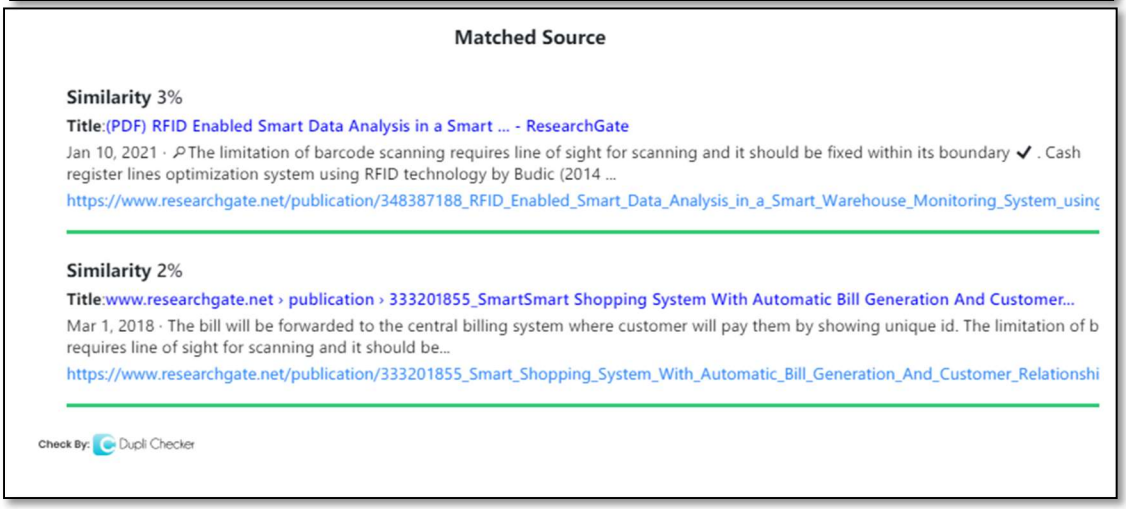

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Mar 1, 2018 · The bill will be forwarded to the central billing system where customer will pay them by showing unique id. The limitation of b requires line of sight for scanning and it should be...

https://www.researchgate.net/publication/333201855_Smart_Shopping_System_With_Automatic_Bill_Generation_And_Customer_Relationshi

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