SMART RETAIL USING CUSTOMER LOYALTY & E-INVOICE

BY

MD. NATTACHIUJ JAMAN
ID: 212-15-4090

FINAL YEAR DESIGN PROJECT REPORT

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

Supervised By

Mr. Narayan Ranjan Chakraborty
Associate Professor and Associate Head
Department of Computer Science and Engineering
Daffodil International University

Co-Supervised By

Dr. Sheak Rashed Haider Noori
Associate Professor and Head
Department of Computer Science and Engineering
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY

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APPROVAL

This Project titled "Smart Retail Using Customer Loyalty & E-Invoice", submitted by Md. Nattachiuj Jaman to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on July 16, 2024.

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Professor & Head Chairman
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Faculty of Science & Information Technology
Daffodil International University

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Faculty of Science & Information Technology
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Mr. Abdus Sattar — **Internal Examiner 2**
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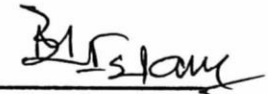
Daffodil International University

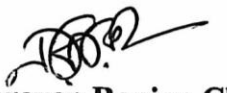


Dr. Md. Manowarul Islam — **External Examiner**
Associate Professor
Department of Computer Science and Engineering
Jagannath University

DECLARATION

I hereby declare that this project has been done by me under the supervision of **Mr. Narayan Ranjan Chakraborty, Associate Professor and Associate Head, Department of Computer Science and Engineering, Daffodil International University**. I also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

Supervised by:

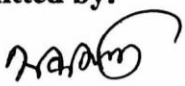


Mr. Narayan Ranjan Chakraborty
Associate Professor and Associate Head
Department of CSE
Daffodil International University

Co-Supervised by:

Dr. Sheak Rashed Haider Noori
~~Associate P~~rofessor and Head
Department of CSE
Daffodil International University

Submitted by:



(Md. Nattachiuj Jaman Nafir)
ID: 212-15-4090
Department of CSE
Daffodil International University

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ABSTRACT

As the retail landscape undergoes a paradigm shift towards digitalization and enhanced customer experiences, integrating customer loyalty programs and e-invoices into retail environments has become essential. This research paper offers an in-depth examination of the emerging field of Smart Retail, focusing on the implementation of innovative strategies to enhance customer loyalty, minimize costs, and increase customer satisfaction. The study begins by analyzing the foundational concepts and key components of Smart Retail Operations, emphasizing the increased use of customer loyalty systems and e-invoices to optimize various retail operations. It explores how these strategies can boost customer retention, maximize transactions per customer, and create a more engaging shopping experience. The research also examines the financial benefits of customer loyalty programs and e-invoices, showing how they can reduce marketing expenses and improve the overall efficiency of retail operations. Additionally, the study highlights successful case studies and implementations of these strategies by industry leaders, showcasing best practices and lessons learned. It concludes with insights into the future trajectory of Smart Retail, emphasizing potential advancements and challenges that may shape the industry's evolution, particularly in the areas of customer loyalty and cost minimization. This study aims to provide a comprehensive understanding of how Smart Retail strategies centered around customer loyalty and e-invoices can drive business success and customer satisfaction.

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LIST OF ACRONYMS

ERP	Enterprise Resource Planning
SDLC	System/Software Development Life Cycle
Odoo	On-Demand Open Object (Open Source ERP)
IoT	Internet of Things
AR	Augmented Reality
SMS	Short Message Service
E-Invoice	Online Invoice
OTP	One-time Password
POS	Point of Sale
RFID	Radio-Frequency Identification
ROI	Return of Investment
IDE	Integrated Development Environment
DBMS	Database Management System
UAT	User Acceptance Testing
KPI	Key Performance Indicator
UI	User Interface
UX	User Experience
AI	Artificial Intelligence

CHAPTER 1
Introduction

1.1 Overview

With the fast-paced growth of the online shopping industry, retail stores are encountering significant challenges. In a highly competitive market, retaining customer loyalty and minimizing costs are more crucial and simultaneously more difficult than ever. Enhancing customer satisfaction through effective customer loyalty programs and e-invoices has become a key strategy for retail owners and chain store companies. Customer loyalty programs and e-invoices not only encourage repeat business but also foster a sense of belonging among customers. When customers earn points on their purchases and can redeem those points for discounts or special offers, it creates an incentive to continue shopping at the same store. This approach not only boosts sales but also enhances customer satisfaction, as customers feel valued and rewarded for their loyalty. Moreover, loyalty programs and e-invoices help minimize costs. By focusing on retaining existing customers, retail stores can reduce the expenses associated with attracting new customers. Loyal customers are more likely to make frequent purchases and refer others to the store, leading to organic growth without extensive marketing costs. In summary, customer loyalty programs and e-invoices are essential tools for retail stores aiming to minimize costs while maximizing customer satisfaction and sales. By rewarding customers for their loyalty, stores can build a strong, dedicated customer base that contributes to long-term success.

1.2 Background and Present State

The retail market is growing rapidly, and integrating customer loyalty programs and e-invoices is becoming increasingly essential. Traditional retail alone is no longer competitive; we need intelligent systems and strategies that enhance customer loyalty, minimize costs, and increase customer satisfaction. My latest research indicates that the retail market size was approximately $26.37 trillion in 2021, around $28.2 trillion in 2022, and about $29.29 trillion in 2023. By 2026, this figure is expected to reach approximately $32.76 trillion, highlighting the significant and fast-paced growth of this industry.

My primary motivation for conducting this research is to successfully complete my final year thesis at my university. Completing this thesis will not only fulfill my academic requirements but also allow me to gain valuable insights and knowledge. As a lead software engineer at the retail company, I am excited about the opportunity to apply the findings from this research to my current role and future career. The insights gained will enable me to analyze and implement smart tools and technologies, focusing on customer loyalty programs and e-invoices to enhance the efficiency and competitiveness of retail operations.

1.3 Problem Statement

In today's rapidly evolving retail landscape, traditional retail strategies are becoming increasingly insufficient to maintain competitiveness. The shift towards digitalization and enhanced customer experiences necessitates the adoption of innovative solutions to attract and retain customers. Despite the significant growth in the market size, projected to reach approximately $32.76 trillion by 2026, many retail businesses struggle to adapt to these changes and fully capitalize on the opportunities presented by smart retail technologies.

This research addresses the pressing challenges faced by retailers in effectively leveraging customer loyalty programs and e-invoices to minimize costs, boost repeat customer rates, maximize sales, and enhance overall customer satisfaction. Recent studies indicate that acquiring a new customer can be five times more expensive than retaining an existing one, and increasing customer retention rates by just 5% can lead to a profit increase of 25% to 95%. Yet, many retailers fail to implement and integrate these strategies effectively within their smart retail systems, resulting in missed opportunities for cost savings and customer engagement.

By delving into the implementation and impact of customer loyalty programs and e-invoices, this study aims to provide actionable insights into how retailers can build a more loyal customer base, reduce operational expenses, and drive higher sales and customer satisfaction. For instance, research has shown that 75% of consumers prefer companies that offer rewards, and 65% are willing to make more frequent purchases if they are part of a loyalty program. These statistics underscore the potential benefits of well-executed loyalty initiatives.

The findings from this research will offer practical recommendations for retailers to optimize their operations, integrate innovative customer loyalty solutions, and achieve sustainable growth in a competitive market. By focusing on the strategic use of loyalty programs and e-invoices, this study will contribute to a deeper understanding of how to navigate the complexities of the modern retail environment and enhance long-term profitability and customer loyalty.

1.4 Objectives

- To Analyze the Current Challenges in Retail:
  - Investigate the limitations of traditional retail strategies in the context of a rapidly evolving digital marketplace.
  - Identify the specific areas where retailers struggle to adapt to changes and integrate smart retail technologies.
- To Examine the Role of Customer Loyalty Programs:
  - Assess the effectiveness of customer loyalty programs in retaining customers and increasing repeat purchase rates.
  - Explore how loyalty programs can be designed and implemented to maximize customer satisfaction and engagement.
- To Evaluate the Impact of E-Invoices:
  - Investigate how e-invoices can be used to attract new customers and retain existing ones.
  - Analyze the cost-effectiveness of e-invoice in driving sales and reducing expenses.
- To Identify Cost Minimization Strategies:
  - Explore methods for reducing operational costs through the integration of customer loyalty programs and e-invoices.
  - Evaluate the potential cost savings from retaining existing customers compared to acquiring new ones.
- To Measure the Effectiveness of Combined Strategies:
  - Assess the overall impact of combining customer loyalty programs and e-invoices on sales maximization.

    - Measure customer satisfaction levels and repeat customer rates as a result of these combined strategies.
- To Develop Practical Recommendations for Retailers:
    - Provide actionable insights and best practices for retailers to implement and integrate customer loyalty programs and e-invoices.
    - Offer guidelines for optimizing retail operations to enhance competitiveness and achieve sustainable growth.
- To Project Future Trends and Challenges:
    - Forecast potential advancements in smart retail technologies related to customer loyalty and e-invoices.
    - Identify upcoming challenges that may impact the effectiveness of these strategies and propose solutions to address them.

1.5 Scope and Limitations

Scope

- Focus on Customer Loyalty Programs:
    - Examination of various customer loyalty programs, including point-based systems, tiered rewards, and membership benefits.
    - Analysis of how these programs influence customer retention, satisfaction, and repeat purchase behavior.
- Investigation of E-Invoices:
    - Study of the different types of e-invoices, such as discount codes, gift cards, and cashback offers.
    - Evaluation of the effectiveness of e-invoices in attracting new customers and retaining existing ones.
- Cost Minimization Strategies:
    - Exploration of methods to reduce operational costs through the strategic use of customer loyalty programs and e-invoices.
    - Assessment of the financial benefits of retaining existing customers versus acquiring new ones.

- Sales Maximization and Customer Satisfaction:
    - Analysis of the impact of loyalty programs and e-invoices on overall sales and customer satisfaction levels.
    - Measurement of key performance indicators (KPIs) such as customer retention rates, average transaction value, and customer lifetime value.
- Case Studies and Practical Recommendations:
    - Examination of successful implementations of customer loyalty programs and e-invoices by industry leaders.
    - Development of practical recommendations and best practices for retailers to optimize their use of these strategies.
- Future Trends and Challenges:
    - Projection of future advancements in smart retail technologies related to customer loyalty and e-invoices.
    - Identification of potential challenges and solutions to ensure the continued effectiveness of these strategies.

Limitations

- Geographic and Market Segment Constraints:
    - The study may be limited to specific geographic regions or market segments, which could affect the generalizability of the findings.
- Technological Variability:
    - The effectiveness of customer loyalty programs and e-invoices may vary depending on the technology infrastructure of different retail businesses, which may not be fully explored in this thesis.
- Time Constraints:
    - The research period may limit the ability to observe long-term impacts of customer loyalty programs and e-invoices on sales and customer satisfaction.
- Economic and Market Fluctuations:
    - Economic conditions and market dynamics during the study period may influence the results and their applicability to different time frames.

- Customer Behavior Variability:
  - Differences in customer behavior and preferences across various demographics may limit the applicability of the findings to all customer segments.
- Implementation Variability:
  - The success of customer loyalty programs and e-invoices may depend on the specific implementation strategies used by different retailers, which may not be uniformly captured in this study.

1.5 Report Organization

This thesis introduces the research topic, detailing the retail industry's state and the importance of smart retail technologies, focusing on customer loyalty programs and e-invoices. It identifies challenges, sets objectives, defines scope and limitations, and outlines the structure. The literature review covers studies on smart retail, customer loyalty programs, and e-invoices, providing a comparative analysis and identifying gaps. The methodology chapter details the research methodology, hardware and software requirements, project management, and financial analysis. The implementation chapter describes operations, system testing, and model evaluation. The results chapter discusses experiments, performance, and outcomes. The impact chapter examines effects on individuals, society, and the environment, considers ethical aspects, and discusses sustainability. The conclusion and future work chapter summarizes findings, suggests future research, and addresses limitations.

1.7 Summary

This thesis outlines the evolving retail landscape, emphasizing smart retail technologies to enhance customer experiences and competitiveness. It details the industry's state, rapid growth, and digital shift. Key challenges in using customer loyalty programs and e-invoices to reduce costs, boost repeat customer rates, maximize sales, and enhance satisfaction are identified. The problem statement, research objectives, scope, and limitations are defined. The chapter concludes with an overview of the thesis structure, laying the groundwork for further exploration.

CHAPTER 2
LITERATURE REVIEW

2.1 Overview

Smart retail has gained significant traction due to advancements in technology and shifts in consumer behavior. It integrates technologies such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics to enhance customer satisfaction, streamline operations, and drive profitability in retail environments. While existing literature provides some insights into customer data analysis, product analysis, and price optimization, there is a gap in comprehensive studies focusing on smart retail management. This literature review aims to address this gap by examining relevant works that delve into these areas. It will explore how these technologies are applied to improve retail management practices, with a specific focus on customer loyalty programs, e-invoices, cost minimization, and enhancing customer satisfaction. The research seeks to provide retailers with deeper insights and practical strategies to leverage smart retail technologies effectively, thereby creating new opportunities and enhancing competitive advantage in the retail sector.

2.2 Related Works

In January 2022, Fariha Tabassum Eshita, Kazi Tanvir Anjum, and Md. Sohan Hossain submitted their thesis report on "Paddy Production Retail Verification System Using Blockchain," which aims to implement a blockchain-based system for verifying paddy production, focusing primarily on rice production.

In September 2021, Md. Naim Hassan Borson and Mahmudul Hasan submitted their report on "Maximizing Retail Store Sales through Customer Purchase Data Analysis Using Machine Learning." The study aims to utilize various machine learning algorithms to analyze customer data and derive insights to optimize customer engagement and increase customer reach.

In December 2021, Tamanna Rahman Himi, Prianka Binte Zaman, and MD. Al-Amin submitted their thesis report on "Market Sales Prediction by Analyzing Customer Purchase Patterns Using Machine Learning," which aims to forecast sales

volumes by analyzing past sales data considering factors such as seasonal variations and weather conditions.

In January 2024, Md. Uzzal Hossain Hridoy submitted his thesis report on "Optimizing Sales Prediction: A Comparative Study of Data Mining Algorithms with a Focus on the Linear Regression Model." The study compares the effectiveness of Linear Regression, Polynomial Regression, Decision Tree, and Random Forest Classifier algorithms using the "Advertising Costs and Sales Data: Analyzing Marketing Effectiveness" dataset.

2.3 Comparison between existing works

TABLE 1: COMPARISON BETWEEN EXISTING WORKS

Comparison with	Previous	Our Goal
Paddy Production Retail Verification System Using Blockchain	Using Blockchain to optimize production	Using various technologies to maximize profits
Maximizing Retail Store Sales through Customer Purchase Data Analysis Using Machine Learning	Focuses on analyzing customer purchase data to make decision	Focuses on creating a smart retail environment beyond traditional analytics
Market Sales Prediction by Analyzing Customer Purchase Patterns Using Machine Learning	Predict sales volume in the near future based on few characterized values	Focuses on customer satisfaction and better engagement to maximize profits
Optimizing Sales Prediction: A Comparative Study of Data Mining Algorithms with a Focus on the Linear Regression Model	Optimize sales prediction by using some advance algorithms.	Focuses on loyalty benefits and loyalty programs results to increase leads and sales
Loyalty Promotions	Not available	Discusses loyalty memberships,

		promotions, and customer engagement
E-Invoice	Not discussed anywhere else	Discuss Effectiveness of E-Invoice to minimize costs and taking smart step
Customer Retention	Not discussed anywhere else	Discuss customer retention, and increase repeat business

1.4 Open Issues

Exploring the intersection of smart retail, customer loyalty programs, and e-invoices reveals several critical areas with opportunities for further investigation:

- Integration of Multiple Technologies: Existing research focuses on individual technologies like IoT and AI in retail, but there is a need for studies that integrate these technologies comprehensively to enhance the effectiveness of customer loyalty programs and e-invoices.
- Effectiveness of Personalization: Personalized customer experiences through loyalty programs and e-invoices are crucial for retention, yet understanding the optimal level of personalization and its impact on customer satisfaction remains a challenge.
- Cost-Effectiveness and ROI: Evaluating the true cost-effectiveness and return on investment (ROI) of implementing customer loyalty programs and e-invoices is essential. Empirical studies are needed to quantify financial benefits against implementation costs.
- Retention Strategies: Effective strategies to maintain long-term customer loyalty and prevent attrition within loyalty programs require further research.
- Data Security and Privacy: Ensuring data security and maintaining customer privacy are critical concerns with the extensive use of customer data in loyalty programs and e-invoices, necessitating robust solutions.

- Customer Perception and Engagement: Deeper exploration is needed to understand customer perception of loyalty programs and e-invoices, and strategies to enhance customer engagement through these channels.
- Integration with Omni-channel Strategies: Investigating seamless integration of customer loyalty programs and e-invoices across diverse retail channels (online and offline) to deliver a unified customer experience is a priority.

2.5 Summary

The literature review chapter delves into the realm of smart retail with a specific focus on customer loyalty programs and e-invoices, aiming to enhance operational efficiency and customer satisfaction while maximizing sales in the retail sector. Key themes explored include:

- Customer Loyalty Programs: The review highlights various strategies and benefits associated with customer loyalty programs, emphasizing their role in fostering repeat customers, enhancing customer retention, and driving sales growth.
- E-Invoices: Insights into the implementation of e-invoices in retail environments are discussed, focusing on their effectiveness in attracting customers, promoting sales, and optimizing marketing strategies.
- Cost Minimization: Strategies to minimize operational costs through efficient use of technology and data analytics are explored, demonstrating their impact on profitability and sustainability in retail operations.
- Repeat Customer Strategies: Effective approaches to encourage repeat customers through personalized experiences, targeted promotions, and loyalty incentives are analyzed, aiming to increase customer lifetime value.
- Sales Maximization: The utilization of predictive analytics and advanced sales strategies to optimize product pricing, promotions, and inventory management is examined, illustrating their role in driving sales growth.
- Customer Satisfaction: The review underscores the importance of customer satisfaction in smart retail, linking it directly to loyalty program effectiveness, e-Invoice utilization, and overall customer experience enhancement.

CHAPTER 3
METHODOLOGY

3.1 Overview

This chapter outlines the methodology employed in this research to address the challenges of integrating smart retail technologies, customer loyalty programs, and e-invoices to achieve cost minimization, repeat customer engagement, sales maximization, and enhanced customer satisfaction. The methodology is designed to provide a systematic and structured approach, ensuring the research objectives are met through comprehensive planning, analysis, design, implementation, and evaluation.

The methodology framework adopted for this study is the Systems Development Life Cycle (SDLC), which is well-suited for developing and implementing complex systems within a retail context. The SDLC approach ensures that all aspects of the project are meticulously planned and executed, from initial concept through to final deployment and maintenance. This chapter will detail each phase of the SDLC as it applies to this research, including the requirements analysis, system design, implementation, and testing phases. The chapter begins with an introduction to the SDLC methodology and its relevance to the study. It then moves into a detailed description of the proposed system design, which integrates various technologies to enhance customer loyalty programs and e-Invoice systems. The hardware and software requirements necessary to support the system are specified, followed by a discussion of the project management strategies and financial analysis that underpin the project's success. Finally, the chapter concludes with a summary of the key points covered. By employing the SDLC methodology, this research aims to develop a robust and effective smart retail system that leverages customer loyalty programs and e-invoices to achieve significant improvements in cost efficiency, customer retention, sales performance, and overall customer satisfaction. The following sections will provide an in-depth look at each phase of the methodology, ensuring a clear understanding of the processes and techniques used to achieve the research objectives.

3.2 Proposed Methodology

The proposed methodology for this research involves a detailed implementation of the Systems Development Life Cycle (SDLC) to develop and integrate smart retail technologies, customer loyalty programs, and e-Invoice systems. This approach ensures a structured and systematic development process, allowing for thorough analysis, design, implementation, and evaluation of the proposed solutions. The primary objective is to create a smart retail environment that minimizes costs, increases repeat customer rates, maximizes sales, and enhances customer satisfaction.

- Planning Phase

  The planning phase involves defining the scope of the project, identifying the key objectives, and outlining the deliverables. This phase ensures that all stakeholders have a clear understanding of the project goals and the expected outcomes. Specific tasks in this phase include:

  - Conducting a needs assessment to understand the requirements of the retail environment.
  - Identifying key performance indicators (KPIs) for customer loyalty, e-Invoice effectiveness, cost minimization, repeat customer rates, sales maximization, and customer satisfaction.
  - Developing a project plan that outlines the timeline, resources, and milestones.

- Analysis Phase

  The analysis phase focuses on gathering detailed requirements and analyzing the current retail processes. This phase ensures that the proposed system addresses the specific needs of the retail environment. Key activities include:
  Conducting a detailed analysis of existing customer loyalty programs and e-Invoice systems.

  - Identifying gaps and areas for improvement in current practices.
  - Gathering data on customer behavior, purchase patterns, and feedback to inform system design.
  - Analyzing the cost structures and financial impacts of current and proposed systems.

- Design Phase

  The design phase involves creating the architecture of the smart retail system, detailing how the components will interact to achieve the project goals. This phase includes:

  - Designing the system architecture that integrates customer loyalty and e-Invoice systems.
  - Developing user interface (UI) and user experience (UX) designs that are intuitive and user-friendly.
  - Creating detailed designs for the customer loyalty programs, including point accumulation, redemption processes, and personalized offers.
  - Designing the e-Invoice system to ensure seamless issuance, distribution, and redemption of e-invoices.
  - Planning for data security and privacy measures to protect customer information.

- Implementation Phase

  The implementation phase involves developing and deploying the smart retail system based on the designs from the previous phase. Activities in this phase include:

  - Developing the software components for the customer loyalty and e-Invoice systems.
  - Setting up the infrastructure required to support the system, including servers, databases, and network components.
  - Conducting initial testing to identify and resolve any issues before full deployment.

- Testing Phase

  The testing phase ensures that the system functions as intended and meets the requirements specified in the analysis phase. This phase includes:

  - Conducting unit testing for individual components.
  - Performing integration testing to ensure all components work together seamlessly.

- Carrying out system testing to validate the overall functionality and performance.
- Engaging in user acceptance testing (UAT) with a sample of retail staff and customers to gather feedback and make necessary adjustments.

- Deployment and Maintenance Phase

  The deployment and maintenance phase involve rolling out the system to the retail environment and ensuring its ongoing effectiveness. Activities include:
  - Deploying the system across selected retail locations.
  - Training staff on how to use the new customer loyalty and e-Invoice systems.
  - Monitoring system performance and making necessary adjustments.
  - Providing ongoing support and maintenance to ensure the system continues to meet the needs of the retail environment.
  - Collecting feedback and conducting periodic reviews to identify opportunities for further improvement.

3.3 Hardware/ Software Requirement

To implement the proposed smart retail system that leverages customer loyalty programs and e-invoices, several hardware and software components are required. These components are crucial for ensuring the system's effectiveness, scalability, and security.

Hardware Requirements

- Servers:
  - High-performance servers to host the application, database, and analytics software.
  - Redundant servers for failover and load balancing to ensure high availability.
- Network Infrastructure:
  - High-speed internet connectivity to support real-time data transmission.

    - Network switches and routers to manage internal data traffic.
- Data Storage:
    - Cloud storage solutions for scalable and flexible data management.
    - Local storage options for backup and disaster recovery.
- Customer Interaction Devices:
  Digital signage for personalized promotions and advertisements.
- Security Devices:
    - Firewalls and intrusion detection/prevention systems (IDS/IPS) to secure network and data.
    - Physical security devices such as cameras and access control systems.

Software Requirements

- Operating Systems:
  Linux Server for hosting the Odoo ERP backend services.
- ERP Software:
  Odoo ERP Community Version.
- Database Management System (DBMS):
  SQL databases PostgreSQL storing transaction and customer data.
- Application Development Platform:
    - Integrated Development Environment (IDE) such as PyCharm, Visual Studio Code, or IntelliJ IDEA.
    - Programming languages including Python and JavaScript for developing various system components.
- Customer Relationship Management (CRM) Software:
  Odoo CRM to manage customer interactions and loyalty programs.
- E-Invoice Management System:
  Custom Module Development inside Odoo ERP for creating, distributing, and generating e-invoices.
- Security Software:
    - Antivirus and anti-malware software for endpoint protection.
    - Encryption tools for securing sensitive data in transit and at rest.

Additional Requirements

- APIs and Integrations:
  - APIs for integrating third-party services such as payment gateways, marketing platforms, and social media.
  - Middleware for seamless communication between different software components.
- User Interfaces:
  - Responsive web interfaces for staff to manage customer loyalty and e-Invoice systems.

3.4 Project Management and Financial Analysis

Effective project management and financial analysis are critical to the successful implementation of the proposed smart retail system using customer loyalty programs and e-invoices. This section outlines the project management strategy and provides a detailed financial analysis to ensure the project's goals are met within budget and on time.

Project Management Strategy

- Project Planning and Initiation:
  - Define project scope, objectives, and deliverables.
  - Identify key stakeholders and establish a project team.
  - Develop a detailed project plan, including timelines, milestones, and resource allocation.
- Project Phases and Milestones:
  - Phase 1: Requirement Analysis and Design
    - Conduct a comprehensive requirement analysis.
    - Design system architecture and components.
    - Review and validate design with stakeholders.
  - Phase 2: Development and Integration
    - Develop core system components (loyalty program management, e-Invoice system, data analytics).

        - Conduct unit and integration testing.
    - Phase 3: Deployment and Testing
        - Deploy the system in a controlled environment.
        - Perform system testing, including performance, security, and usability testing.
        - Gather feedback and make necessary adjustments.
    - Phase 4: Implementation and Training
        - Roll out the system to retail locations.
        - Train staff on new systems and procedures.
        - Provide ongoing support and maintenance.
- Project Management Tools and Techniques:
    - Utilize project management software (e.g., Microsoft Project, Jira) to track progress and manage tasks.
    - Apply Agile methodology for iterative development and continuous feedback.
    - Conduct regular status meetings and progress reviews with stakeholders.
    - Use risk management techniques to identify, assess, and mitigate project risks.
- Quality Assurance:
    - Implement a quality assurance plan to ensure deliverables meet defined standards.
    - Conduct regular audits and reviews to maintain project quality.

Financial Analysis

- Budget Estimation:
    - Hardware Costs:
        - Servers, personal computer, network infrastructure, data storage, and barcode scanner.
        - Estimated cost: $200,000.
    - Software Costs:
        - Licensing fees for operating systems, databases, CRM software, e-Invoice management system, AI and analytics tools, security software.

        - Estimated cost: $150,000.
    - Development and Integration Costs:
        - Salaries for software developers, data scientists, system integrators, and IT support.
        - Estimated cost: $300,000.
    - Deployment and Training Costs:
        - Deployment expenses, training materials, and staff training sessions.
        - Estimated cost: $50,000.
    - Maintenance and Support Costs:
        - Ongoing maintenance, updates, and support.
        - Estimated annual cost: $50,000.
- Cost-Benefit Analysis:
    - Initial Investment:
        - Total estimated initial investment: $750,000.
    - Operational Cost Savings:
        - Reduction in manual processing and operational inefficiencies.
        - Estimated annual savings: $100,000.
    - Revenue Increase:
        - Increased sales through enhanced customer.
        - Estimated annual revenue increase: $200,000.
    - Return on Investment (ROI):
        - ROI = (Annual Savings + Annual Revenue Increase) / Initial Investment
        - ROI = ($100,000 + $200,000) / $750,000 = 0.4 (or 40%).
- Financial Risks and Mitigation:
    - Risk: Budget Overruns

      Mitigation: Detailed project planning, continuous monitoring, and contingency funds.
    - Risk: Technology Adoption

      Mitigation: Comprehensive training programs and user-friendly system interfaces.
    - Risk: Data Security Breaches

Mitigation: Implement robust security measures and regular security audits.

- Funding and Resource Allocation:
  - Secure funding through internal budgeting, external investors, or grants.
  - Allocate resources effectively based on project phases and requirements.

3.5 Summary

The methodology chapter of this thesis outlines the comprehensive approach taken to implement a smart retail system that leverages customer loyalty programs and e-invoices to minimize costs, increase repeat customers, maximize sales, and enhance customer satisfaction. This chapter is structured to provide a clear and detailed roadmap from conceptualization to execution, ensuring that all aspects of the project are meticulously planned and managed.

The chapter begins with an overview of the methodology, emphasizing the need for an integrated approach combining advanced technologies. The focus is on creating a seamless and efficient retail environment.

The proposed methodology section details the step-by-step process to achieve the research goals. This includes the development of a smart retail ecosystem that incorporates customer loyalty programs and e-invoices.

This section outlines the necessary hardware and software components needed to support the smart retail system. It includes details on the required servers, IoT devices, data storage solutions, software applications for CRM and e-Invoice management, and the integration of AI tools for data analysis.

Project Management Strategy: Employing Agile methodology and project management tools to ensure timely and efficient project execution. This includes setting clear milestones, conducting regular reviews, and managing risks.

Financial Analysis: Providing a detailed budget estimation, cost-benefit analysis, and ROI calculation. The analysis demonstrates the financial viability of the project, highlighting potential cost savings and revenue increases.

CHAPTER 4
IMPLEMENTATION

4.1 Overview

The implementation chapter of this thesis focuses on the practical steps taken to develop and deploy a smart retail system that effectively utilizes customer loyalty programs and e-invoices. The goal is to create a system that minimizes costs, increases repeat customer rates, maximizes sales, and enhances customer satisfaction. Following the System Development Life Cycle (SDLC) methodology, this chapter provides a detailed account of the processes involved in bringing the conceptual design to a functional and operational system.

Prototype Design: This section discusses the development of a prototype for the smart retail system. It covers the design and training of models that will be used to predict customer behavior, optimize pricing, and personalize e-Invoice distribution. The prototype serves as a proof of concept, demonstrating the feasibility and effectiveness of the proposed system.

System Testing and Model Evaluation: Here, the focus is on testing the system to ensure it meets the specified requirements and performs as expected. Various testing methodologies are employed to evaluate the system's functionality, performance, and reliability. This section also includes an assessment of the model's accuracy and effectiveness in achieving the desired outcomes, such as increased customer loyalty and sales maximization.

Summary: The chapter concludes with a summary of the implementation process, highlighting key achievements, challenges encountered, and lessons learned. It provides an overview of how the implementation aligns with the overall objectives of the thesis and sets the stage for the result and analysis chapter.

4.2 Prototype Design

The Customer Loyalty System is the smartest way to attract, engage, and expand our customer base through innovative Loyalty Membership Levels and Promotions. To stay ahead of competitors and other businesses, we can leverage the Customer Loyalty

System to boost sales and cultivate a large number of repeat customers. By offering Coupons, Gifts, Wishes, Points, and more, we can create an appealing and rewarding experience for our customers. Additionally, introducing multiple membership levels encourages customers to make more purchases to reach the next level and enjoy greater benefits and discounts. This comprehensive strategy is an effective way to increase sales margins for any retail business.

In this section, we will detail the design of a custom module in Odoo 10 that covers all aspects of loyalty programs and e-invoices. The prototype will illustrate how to manage loyalty membership types, handle membership climbing processes, automatically assign new users to a default membership upon sales, generate loyalty points automatically, redeem points, create e-invoices, and send SMS notifications.

Step-by-Step Prototype Design

- Loyalty Membership Types: To create and manage various loyalty membership types in Odoo 10.
  Steps:
  - Navigate to the Custom Module:
    - Access the Odoo backend.
    - Navigate to the newly created custom module for loyalty management.
  - Create Membership Types:
    - Go to the "Membership Types" section.
    - Click on "Create" to add a new membership type.
    - Fill in the details such as membership name, Min. Purchase, Maximum Redeem Percentage, Default Member Type, and SMS format. Look at figure 4.2.1, 4.2.2, 4.2.3, and 4.2.4
      1) Name: Membership level title
      2) Min. Purchase: Minimum amount of purchase to avail/climb to the level
      3) Maximum Redeem Percentage: Maximum redeem percentage over invoice value
      4) Default Member Type: Choose if the type is default for new members

5) SMS Format: Dynamic format for SMS when members are climbing to the levels (Member receive thank you SMS on membership upgrade).

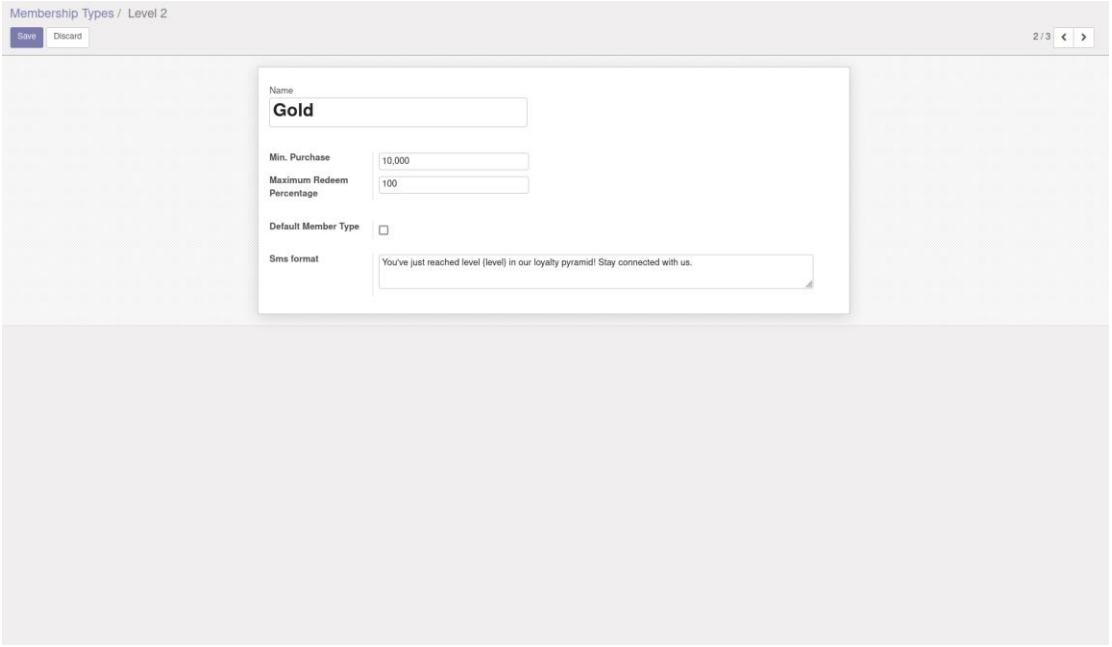

Figure 4.2.1: Creating membership type “Gold”

- Loyalty Membership Climbing Process: To enable customers to climb to higher membership levels based on their points.

  Steps:

  - Define Climbing Rules:
    - In the "Membership Types" section, set climbing rules.
    - We already specified the point thresholds for moving to the next membership level. Look at figure 4.2.4 below, here we can see 3 different membership types with Min. Purchase value setup. If any member crosses the boundary of any level, he/she will be upgraded to the next level if available. Thus, its completely dynamic, decision makers can modify the values and create as much membership types as want.
  - Automate Membership Upgrades:
    - Configure the system to automatically upgrade customers' memberships when they reach the specified total invoice value threshold.

- This upgradation happens on every sale made for the member/customer.

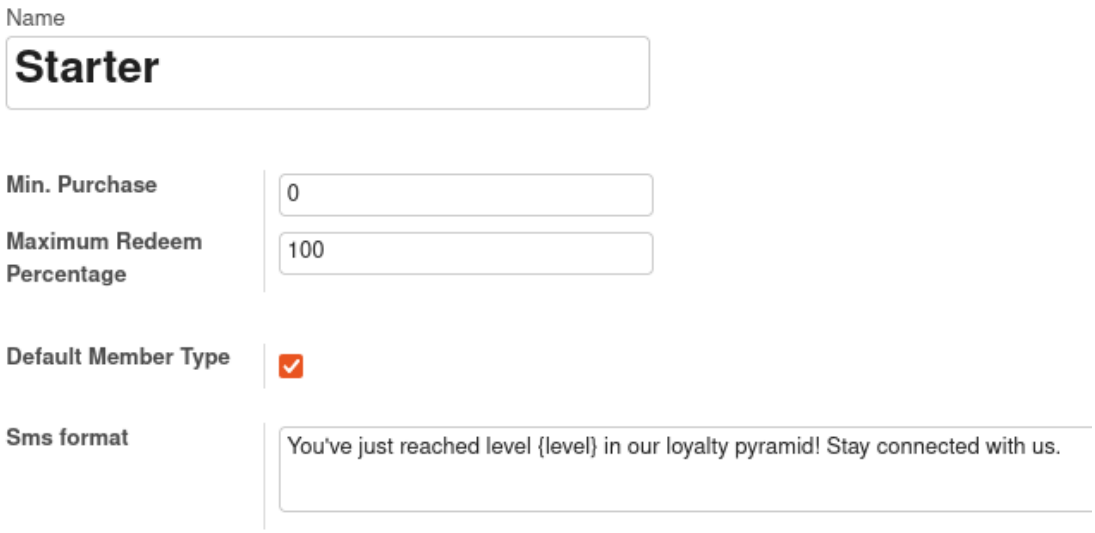

Figure 4.2.2: Creating default membership type “Starter”

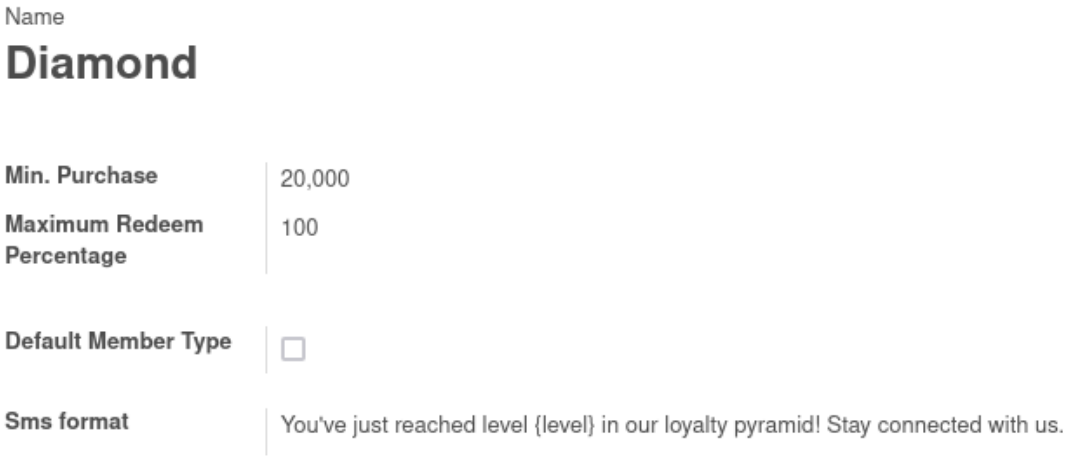

Figure 4.2.3: Creating membership type “Diamond”

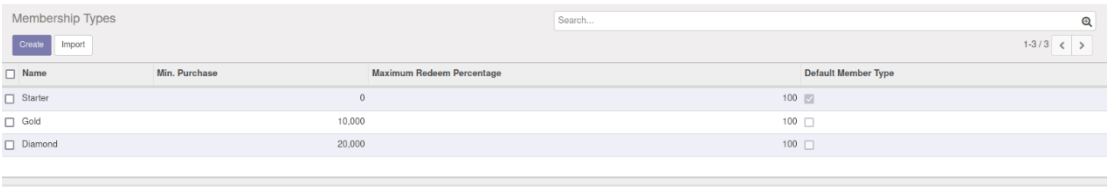

Figure 4.2.4: All three membership saved in the database

- New User Auto-Assign to Default Membership on Sales: To automatically assign new users to a default loyalty membership upon their first sale.

  Steps:

- Set Default Membership:
  - Define a default membership type in the system settings.
  - Recalling the figure 4.2.2 for Starter membership level where we choose the type as default type, that make sure every new member/customer fall into this membership type.
- Configure Sales Order Integration:
  - Modified the sales order workflow to include automatic membership assignment for new users.
  - Look at the figure 4.2.5, figure 4.2.6, and figure 4.2.7 below where a new phone number has been put to the POS screen of our Odoo 10 software, if this phone number is completely new and does not have any membership level it will show Loyalty member not found on Loyalty customer button click. After we complete the sales, after processing the sales in the backend, we can see the second order loyalty customer points are available, so that on sales order with the new mobile number the loyalty membership is assigned to the new partner and points is generated by using the Points Generation settings which we will discuss in the next topic.

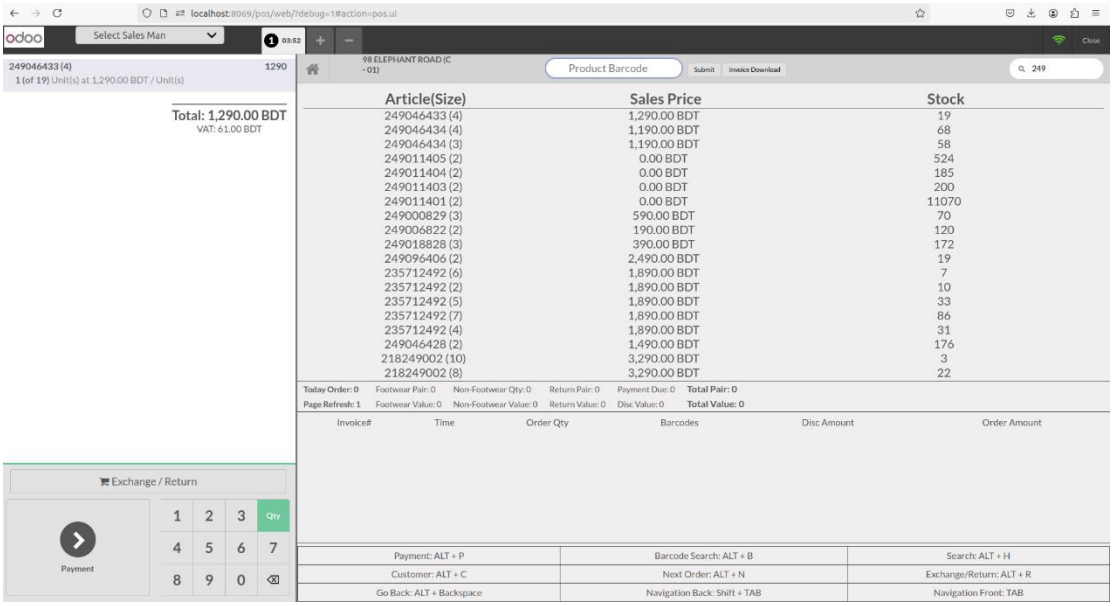

Figure 4.2.5: Searching product and adding product to the order using barcode

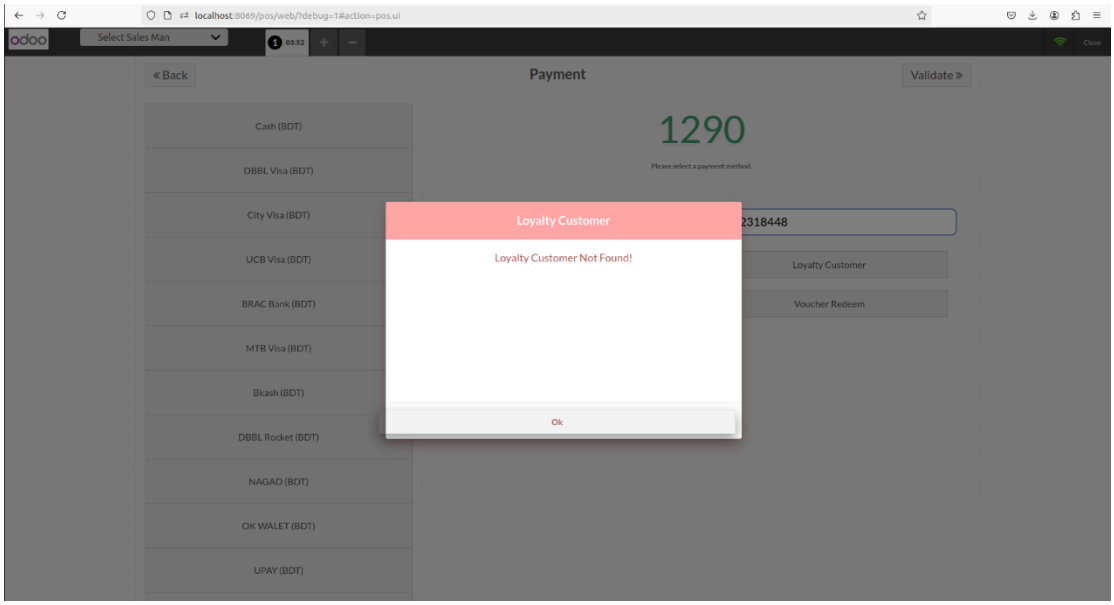

Figure 4.2.6: Prompt error if provided mobile number is not associated as a loyalty member when clicking on the “Loyalty Customer” button

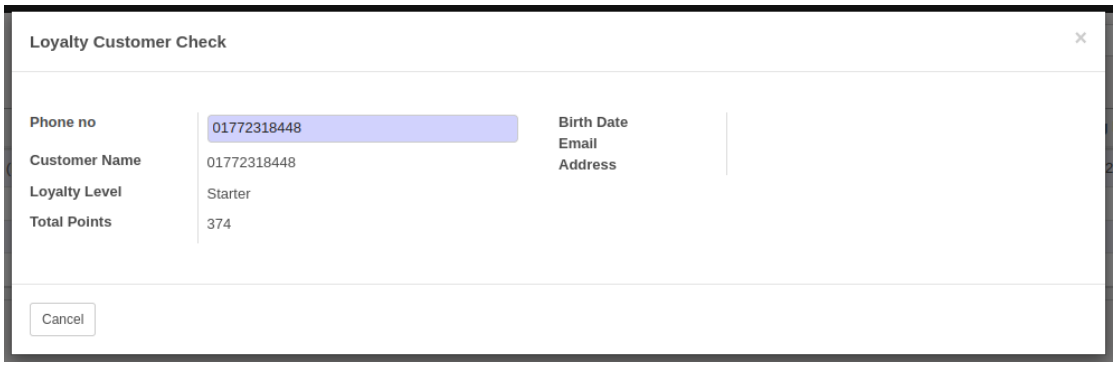

Figure 4.2.7: Loyalty customer point check window

- Loyalty Auto Point Generation on Sales: To generate loyalty points automatically based on sales transactions.

  Steps:

  - Define Point Generation Rules:
    - In the "Loyalty Point Autogen" (Figure 4.2.8) configuration, I set the rules for point generation.
    - I specify the points awarded per BDT equivalent spent, along with which member type will be applicable, equivalent point, minimum amount, generate from all shops or not. Look at figure 4.2.8, 4.2.9, and 4.2.10 for reference.
      1) Name: Auto generation title for reference

2) Member Type: Membership type who are applicable
3) Active: Checkbox if the rule is active or inactive
4) Eq. Amount: Equivalent amount for counting equivalent points
5) Eq. Points: Equivalent points for the specified eq. amount spent
6) Min. Amount: Minimum amount of invoice total to generate the points
7) Generate All Shop: Checkbox, if checked the rule will be applied to all shops, if not manager can select specific shops that rule will be applied for.

- Integrate with Sales Module:
  - Points are generated and assigned to the customer's account upon each sale completion.
    1) If the customer/mobile is new the default member type will be applied first.
    2) If customer invoice total is exceeding the default member type and falling between any other member type, customer very first member type will be the logical one, so that customer will get rewarded to the specific member type they fall into.
    3) If the customer/mobile is known, points will be generated based on the rule applied for the member type and shop, upon sales completion if customer fall into a upgraded member type they will be rewarded to that level.
    4) Customer can redeem points based on the member type settings which we will be discuss in the next topic.

- Loyalty Points Redeem Process: To allow customers to redeem their loyalty points.

  Steps:
  - Redeem Points:
    - I have already setup the points redemption maximum percentage based on the membership type, recalling the figure 4.2.1, 4.2.2, 4.2.3, and 4.2.4 where we set the Maximum Redeem Percentage, customer/member are

allowed only to redeem the specified percentage of total invoice value based on the applied member type to the customer.

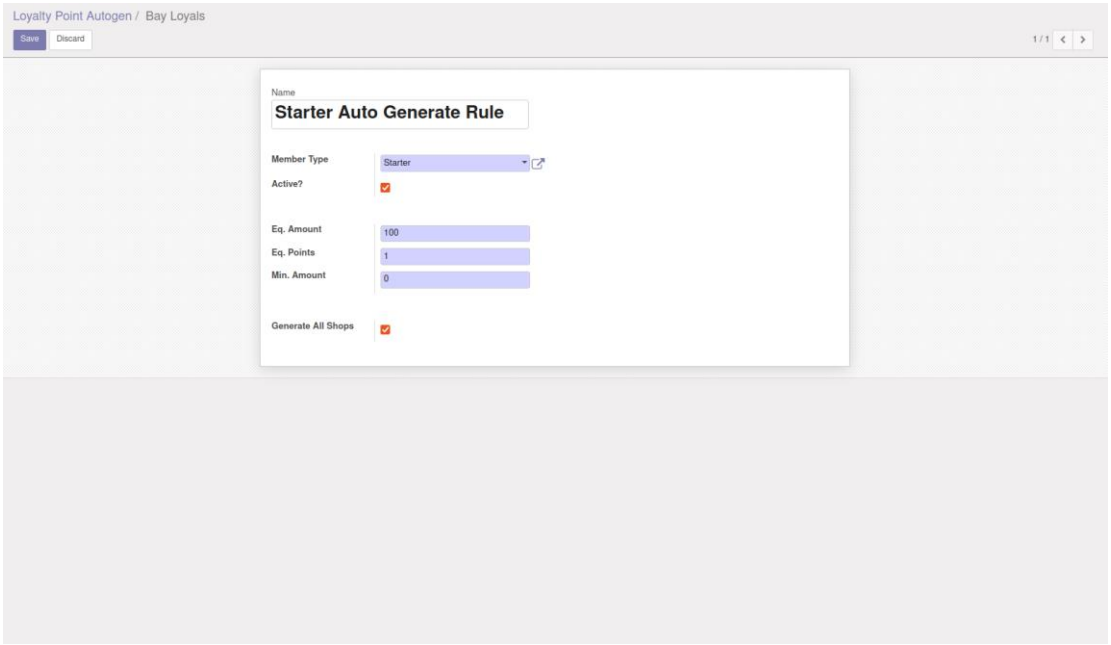

Figure 4.2.8: Loyalty point auto generate setup window for “Starter”

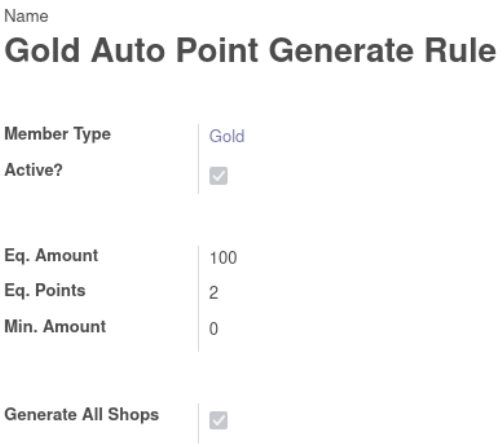

Figure 4.2.9: Loyalty point auto generate setup for “Gold”

- Sales Order Integration:
  - I modified the sales order workflow to include point redemption options and validating the sales order to deduct the redeemed points from the customer's balance.

- Look at the figure 4.2.11, 4.2.13, 4.2.15, 4.2.17, 4.2.18, and 4.2.20 below for understanding the point redemption and figure 4.2.12 for customer points balance, some steps are:
    1) Customer can redeem points by multiplying 50 as many as they have balance.
    2) Points are fraction or not multiplied by 50 is not allowed for redemption (Figure 4.2.12).
    3) Customer cannot redeem on return order.
    4) When customer wants to redeem points, after putting the specified points to redeem customer receive an OTP notification, customer provide the OTP to the salesman for verification (Figure 4.2.14).
    5) If OTP is wrong or expired after 5 minutes points redemption will not be proceeding (Figure 4.2.15).
    6) Successful OTP verification will cut the balance from customer profile and add to the Loyalty Payment method for the invoice (Figure 4.2.17, Figure 4.2.18, and Figure 4.2.20).
    7) Failed OTP verification will be able to send again for verification.

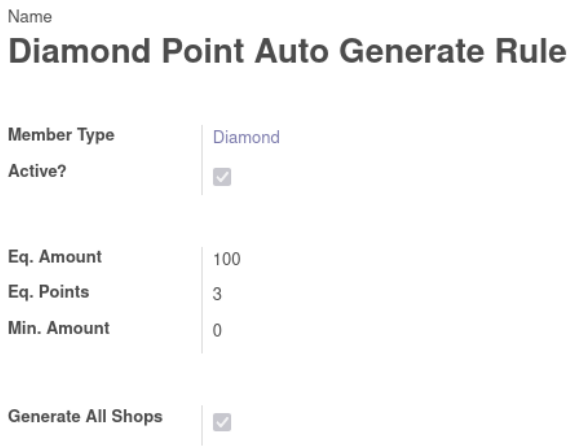

Figure 4.2.10: Loyalty point auto generate setup for “Diamond”

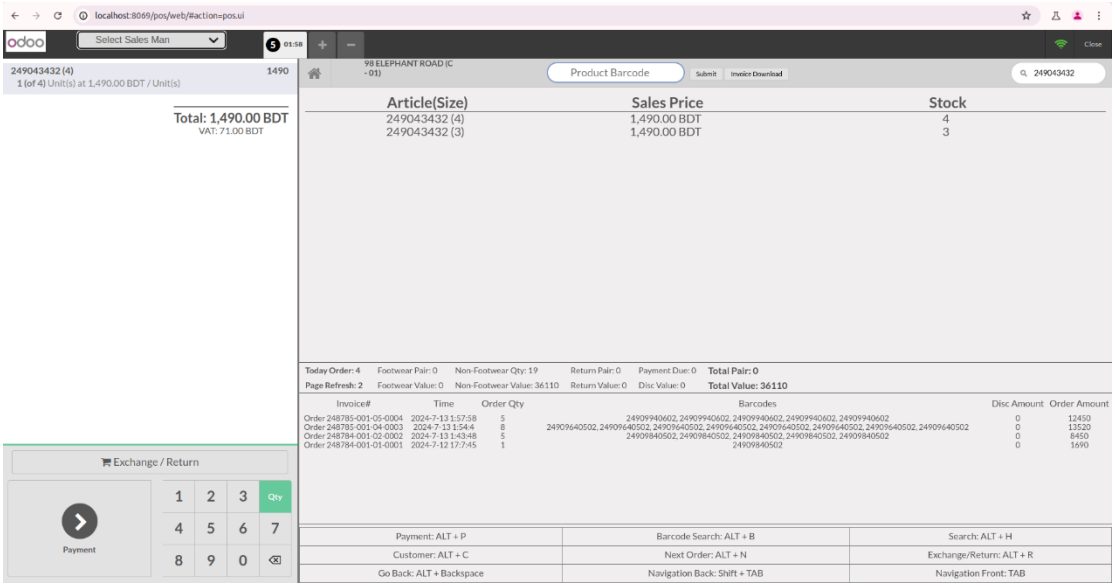

Figure 4.2.11: Initialize another sale order by adding product using barcode

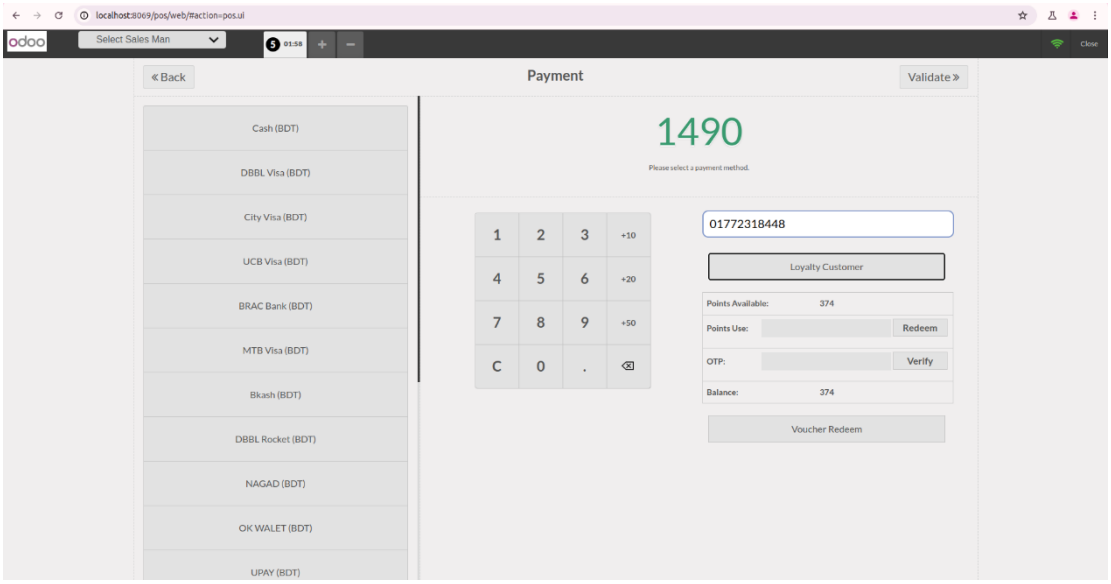

Figure 4.2.12: Add mobile number in the payment window and click “Loyalty Customer” for balance

- E-Invoice Creation: To create and manage e-invoices that can be used by customers.

  Steps:

  - Create E-Invoice:
    - E-Invoice is simply a replica or a different option over traditional paper invoice system (Figure 4.2.21). E-Invoice will be generated on the web and a unique link will be generated for the invoice view; the link will be provided along with the sales order confirmation SMS/Email. In our case we are using the SMS method (Figure 4.2.19).

- System is automatically generating the E-Invoice, and sending the generated unique link to the customer using mobile SMS, this is more reliable and safer way to keep track of the sale invoice.
- Customer can anytime open the link and see the invoice online as needed for support or accounting purpose, no need of paperwork.

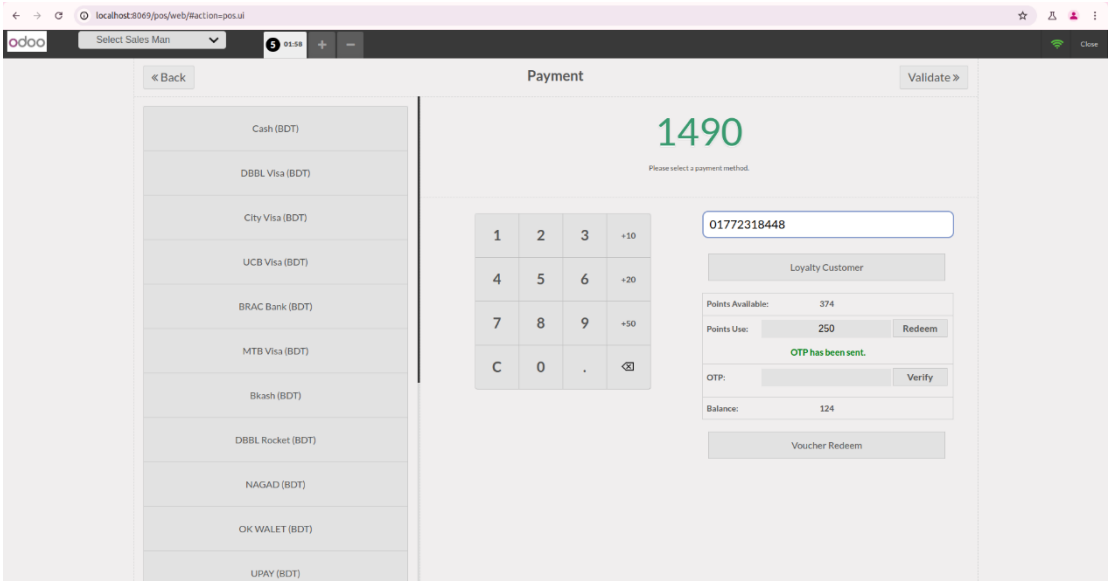

Figure 4.2.13: Input specific points to redeem in the point redeem section

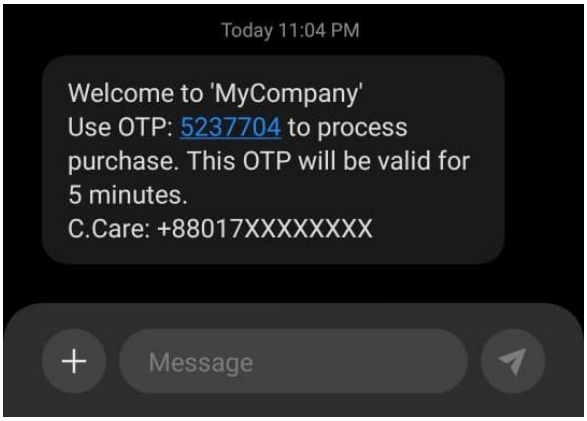

Figure 4.2.14: OTP SMS received

- Adding Points Summary on E-Invoice and SMS: To provide a summary of points on e-invoices and SMS notifications.

  Steps:

  - E-Invoice Points Summary:
    - Display the points redeemed.

- Since we are adding a payment method called Loyalty, and we are automatically assigning the payment method on point redemption, the POS Invoice/E-Invoice will display the points redemptions as Loyalty payment method.

- SMS Notifications:
  - I configured the sale order confirmation SMS notifications to include a points summary.
  - In the sales order confirmation SMS, shows the points earned through this invoice, and available points after sales completion (Figure 4.2.19).
  - Customer receive SMS on membership upgrade which automatically generating based on the Membership type settings (Figure 4.2.16).

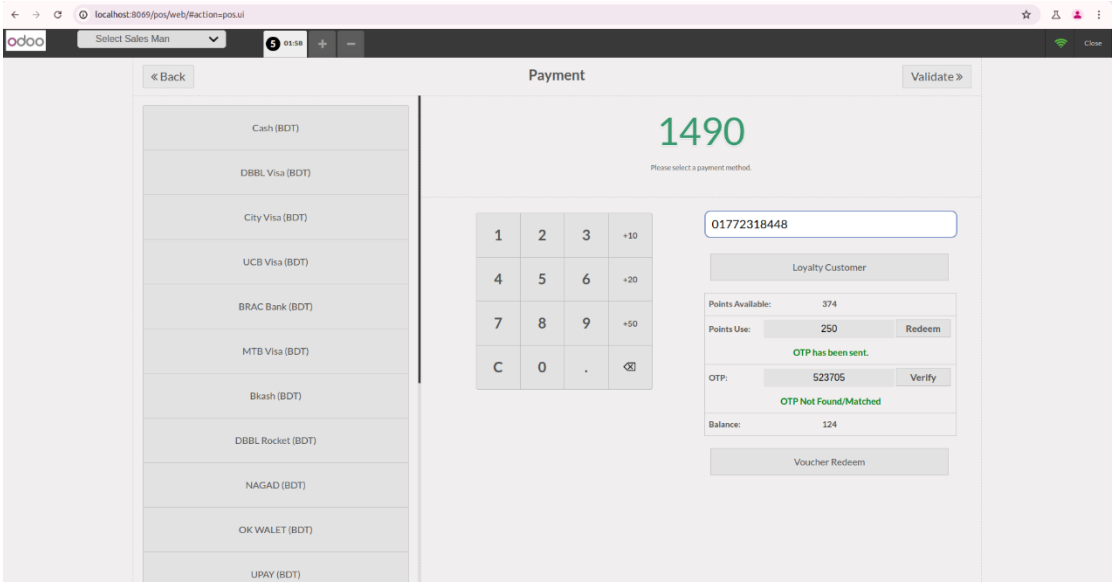

Figure 4.2.15: Wrong OTP is not accepted for points redemption

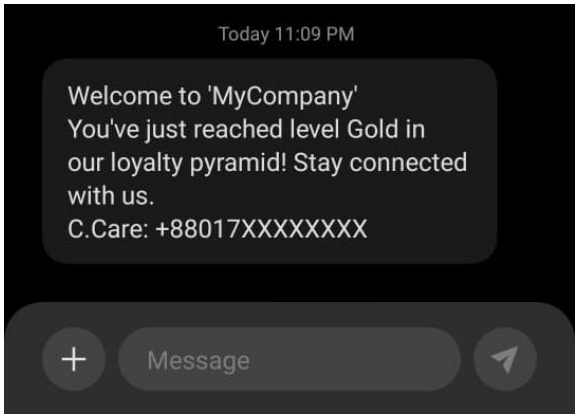

Figure 4.2.16: Membership Upgrade SMS

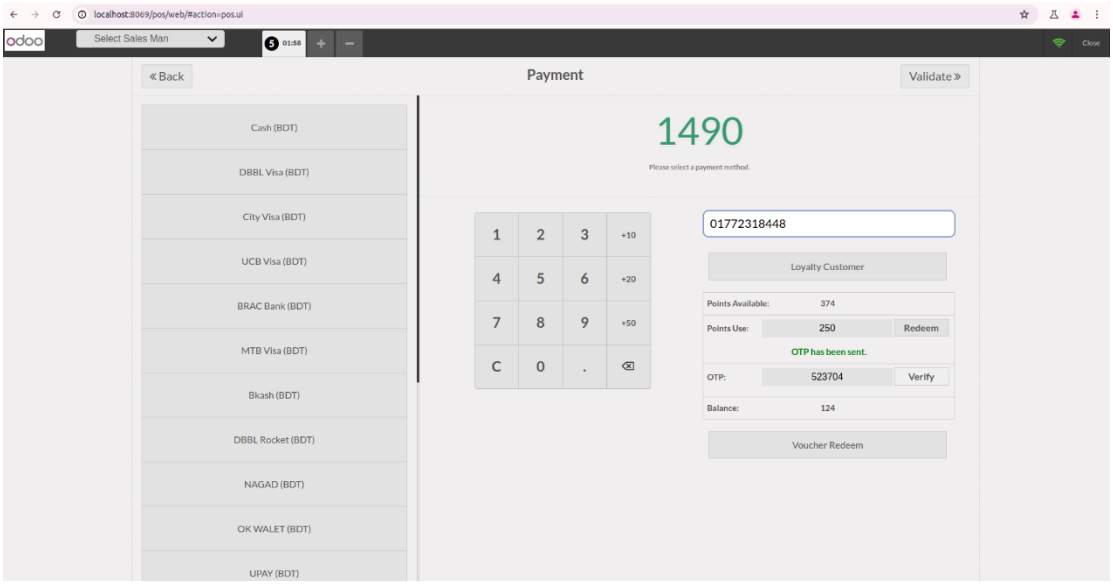

Figure 4.2.17: Input valid OTP and click verify for points redemption

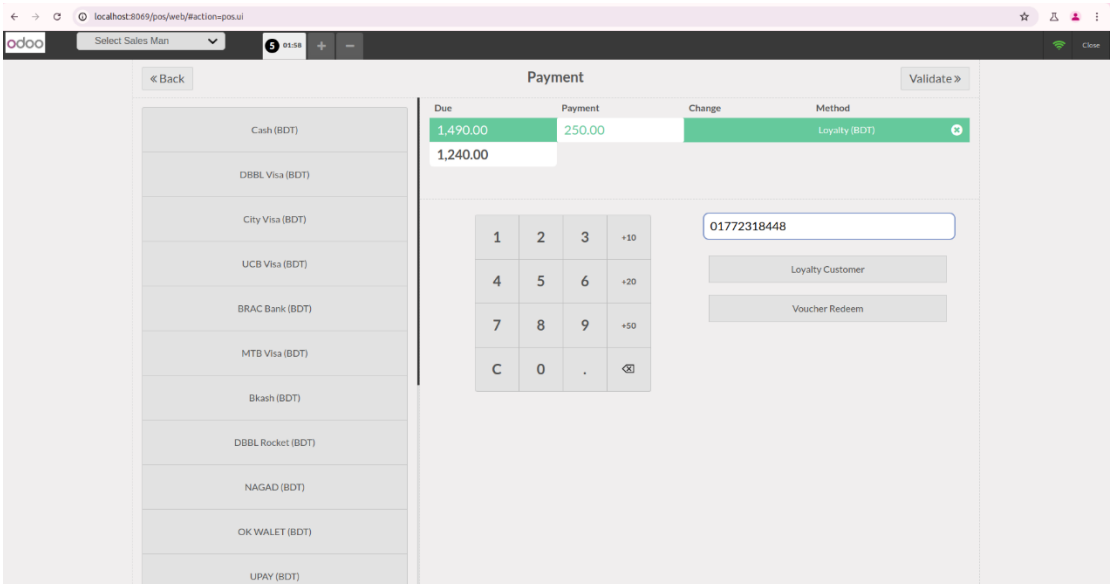

Figure 4.2.18: Payment method automatically added to the order for loyalty points

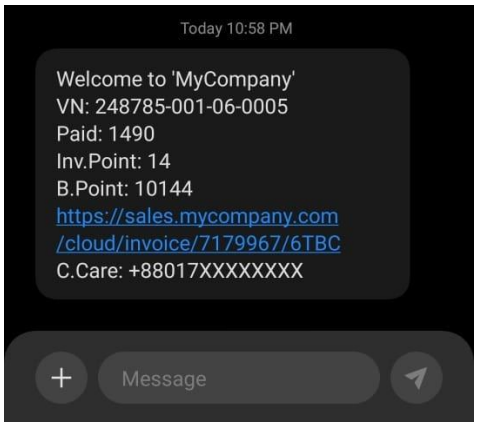

Figure 4.2.19: Adding extra amount to any flexible payment method

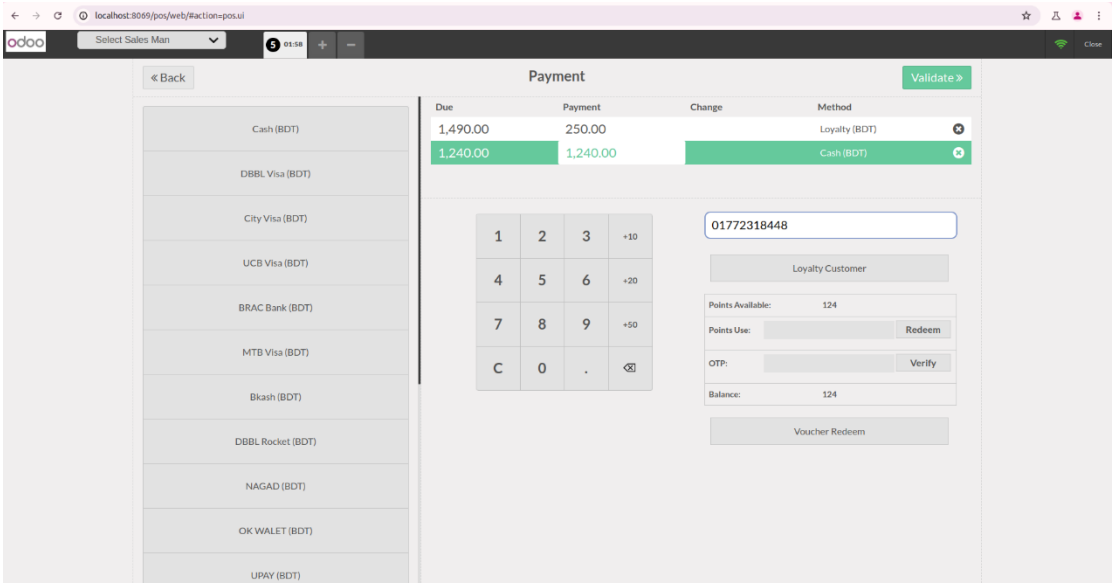

Figure 4.2.20: Adding extra amount to any flexible payment method

98, NEW ELEPHANT ROAD, DHAKA.
017XXXXXXXX

VAT Reg.No: 00044XXXX-XXXX **MUSAK-6.3**
Sales Date: 13-07-2024, 2:10 am
VN: Order 248785-001-06-0005
Customer Care: +880 17XX-XXXXXX
Email: customercare@mycompany.com
Facebook: /mycompany
Buy Online: https://www.mycompany.com
Served By: Md. John Doe
Customer Mobile: 01772318448

Item(Size)	MRP	Qnt	Value	Dis%	Amount
249043432 (4)-24904343204	1490	1	1490	0	1490
Total:			**1490**		**1490**

Subtotal: 1419
VAT: 71
Net Payment: **1490**
Receive:
Loyalty (BDT) 250
Cash (BDT) 1240
Change: 0

Terms & Condition:
1.You may exchange your purchase at any Bay Emporium Ltd. retail store within 30 days of purchase (fresh/ without wearing).
2.You may exchange your purchase by the same product or more.
3.No claim will be entertained without a valid cash memo.
4.Altered Purchase cannot be exchanged.
5.All purchase through a discount promotion will not be exchanged.
6.Repair/Replacement will be at the discretion of the company, which will be final.
7.For further query contact customer care(9 am to 8 PM) email: customercare@mycompany.com

Figure 4.2.21: Sample invoice generated where loyalty points is visible

Additional Research Topics: Beside the original thesis goals, additional research was conducted on related topics to further enhance the smart retail management system. These include:

Retail Product Price Optimization: Setting prices strategically to maximize profits involves various methods. Competitor Analysis involves tracking competitors' prices to adjust own pricing and maintain competitiveness. Customer Segmentation divides customers based on behavior to tailor prices and optimize sales. Price Testing entails experimenting with different price points to find the optimal balance between profit and customer acceptance. Analyzing Competitor Prices (Figures 4.2.22, 4.2.23) informs competitive pricing strategies, while understanding shipping costs (Figures 4.2.24, 4.2.25) ensures competitive flexibility.

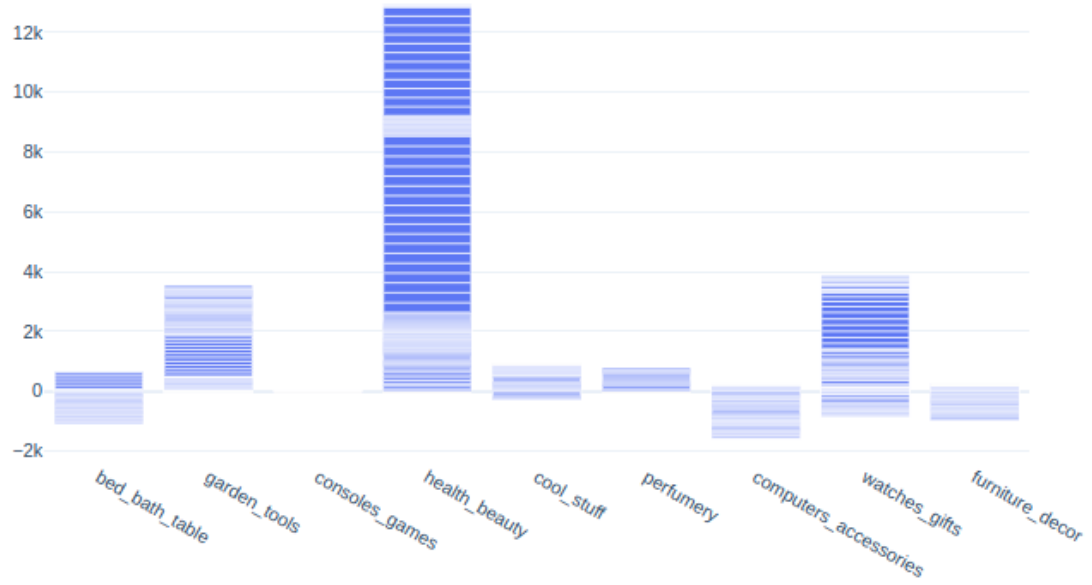

Figure 4.2.22: Competitor 2 Price Difference per Unit

Customer Analysis: Customer analysis in retail uses data to understand and predict consumer behavior, guiding strategic decisions. Segmenting customers by demographics, purchasing patterns, and psychographics reveals insights into preferences and buying habits. Predictive analytics forecasts trends like customer churn and demand fluctuations. Mapping the customer journey across physical and digital touchpoints identifies opportunities for enhancing the shopping experience and fostering loyalty. Personalization tailors' offerings to individual preferences, while feedback and sentiment analysis from surveys and social media inform continuous

improvement efforts. Effective customer analysis enables retailers to create personalized, seamless experiences that drive engagement and growth.

The Total Price Distribution overview highlights customer buying behavior, showing a preference for lower total prices, indicating practical needs. Customers tend to make multiple, repeated purchases, focusing on solving their problems rather than making one-time large purchases. Encouraging repeat business is crucial for sustained customer engagement and loyalty, as shown in Figure 4.2.26, where lower bills outnumber higher ones significantly. This emphasizes the strategy of fostering repeat customers over maximizing single transactions.

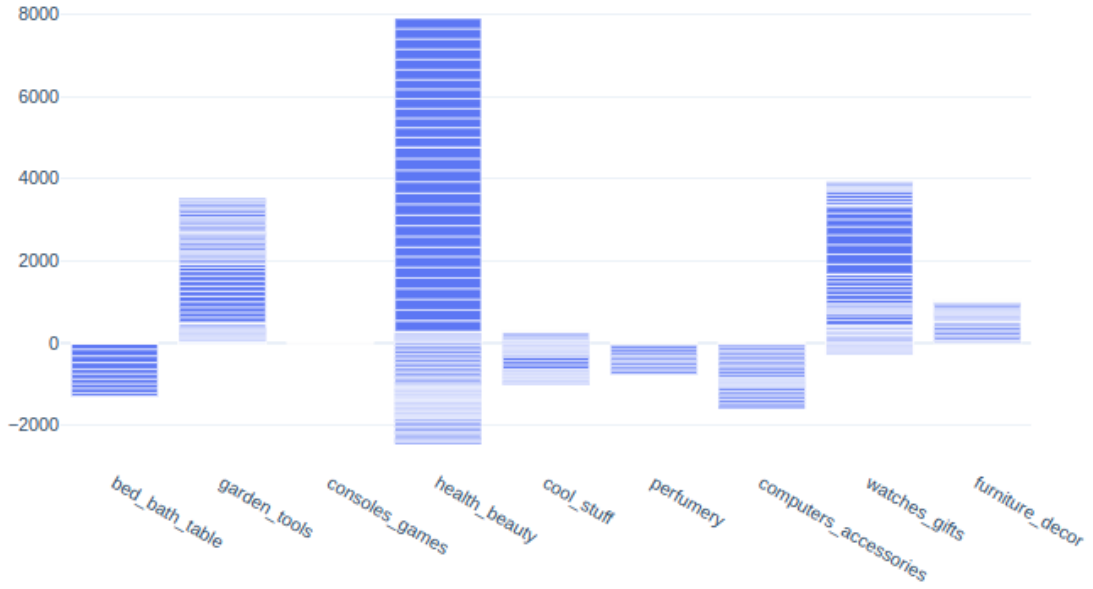

Figure 4.2.23: Competitor 1 Price Difference per Unit

Examples of Loyalty Programs: Figure 4.2.27 illustrates various loyalty programs adaptable to different business models. These include birthday and anniversary gift vouchers, early access privileges, points-to-money exchange options, discounts on selected products, coupons for partner businesses, and rewards for tier upgrades.

Examples of Loyalty Customer Benefits: Figure 4.2.28 presents a sample chart detailing loyalty levels and associated benefits. The levels are defined based on customer spending, with higher levels offering enhanced benefits. For instance, customers in higher spending tiers enjoy greater rewards and fostering loyalty.

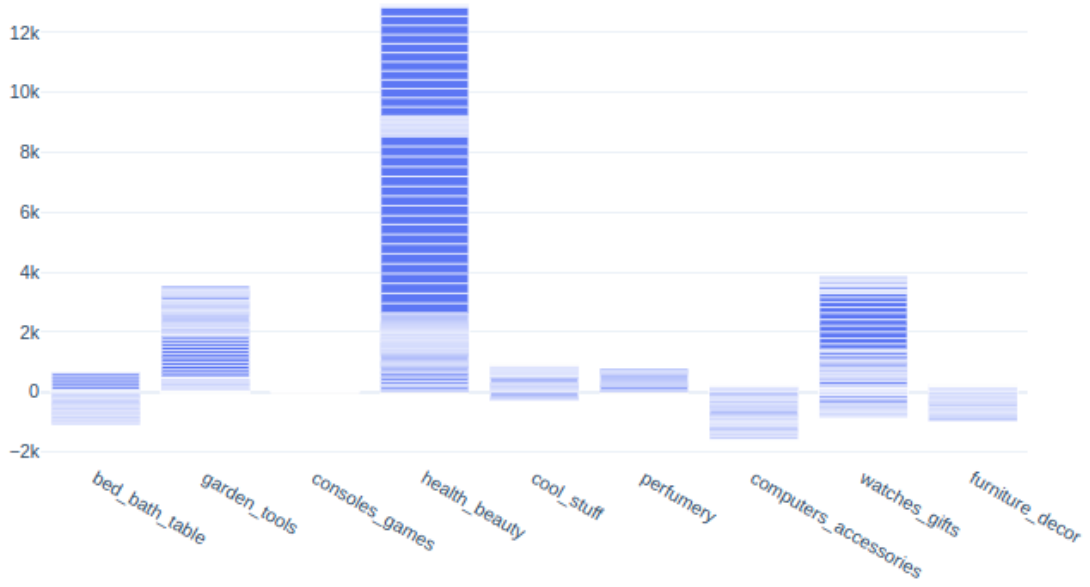

Figure 4.2.24: Competitor 2 Shipping Price Difference per Order

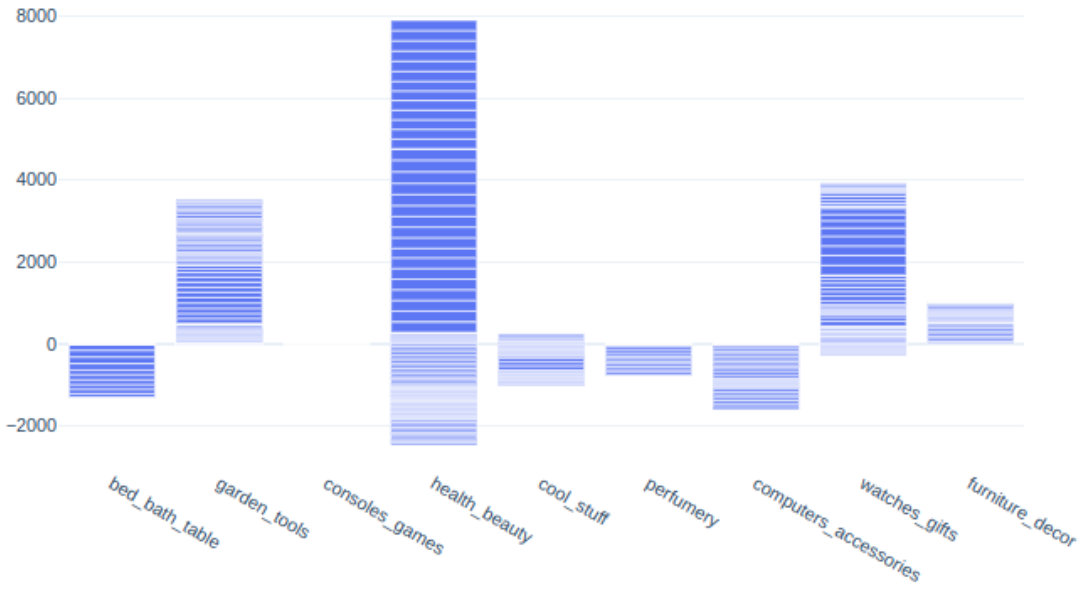

Figure 4.2.25: Competitor 1 Shipping Price Difference per Order

Inventory Management System: A smart retail inventory management system utilizes advanced technology to streamline stock tracking, management, and replenishment. Components like IoT devices, RFID tags, and sophisticated software provide real-time visibility and control over inventory. These technologies automate data collection, ensuring accurate monitoring of stock levels, locations, and movements, thereby reducing errors and enhancing precision. AI-driven analytics forecast demand, optimize stock levels, and automate reordering to prevent overstocking and stockouts. Cloud-

based platforms centralize data management across multiple locations, supporting informed decision-making. Features such as automated alerts for low stock and real-time sales tracking further enhance efficiency. This system improves inventory accuracy, reduces costs, and boosts customer satisfaction by ensuring product availability. By leveraging technology, retailers can create a responsive and competitive inventory management process, minimizing losses and optimizing stock.

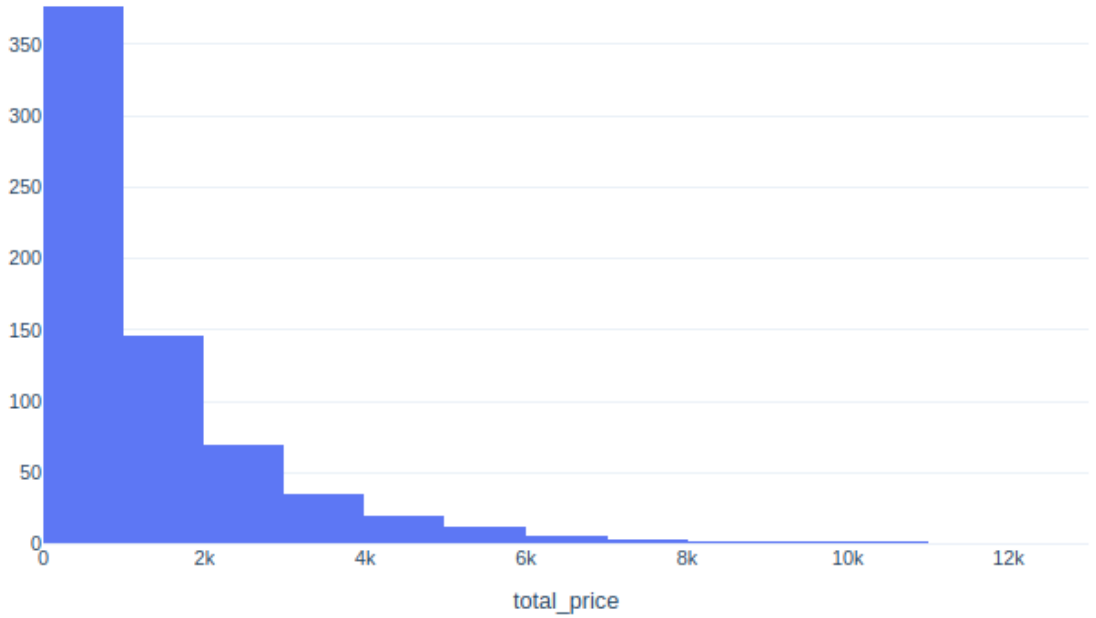

Figure 4.2.26: Distribution of total prices and order numbers

Figure 4.2.27: Various loyalty programs

BENEFITS	Level-3	Level-2	Level-1
AMOUNT SPEND PER CALENDAR YEAR	0-1,000	10,000-19,999	20,000 or +
POINTS AT THE TIME OF REGISTRATION	100	200	300
POINTS MULTIPLIER (FOR TK. 100 PURCHASE)	1 X	2X	3X
FREE SHIPPING (APPLICABLE FOR ONLINE PURCHASE)		Y	Y
BIRTHDAY COUPON	Y	Y	Y
ANNIVERSARY COUPON	Y	Y	Y
EARLY ACCESS TO NEW PRODUCT	Y	Y	Y
1 DAY EARLY ACCESS TO ALL MAJOR SALES		Y	Y
EXCLUSIVE DEALS		Y	Y
EXCLUSIVE E-VOUCHER		Y	Y
LIMITED EDITION PRODUCT ACCESS			Y
GIFTS			Y
MONTHLY MYSTERY BOX			Y

Figure 4.2.28: Loyalty system benefits for customer

Sales Data Analysis: Crucial for smart retail as it reveals trends, customer behaviors, and product performance, guiding strategic decisions. By analyzing sales data, retailers optimize inventory management, ensuring popular items are always available while minimizing overstocking. Historical sales data informs pricing strategies, identifying optimal price points to maximize revenue. Segmentation based on purchasing behavior enhances targeted marketing efforts, driving engagement and sales (Figure 4.2.29)

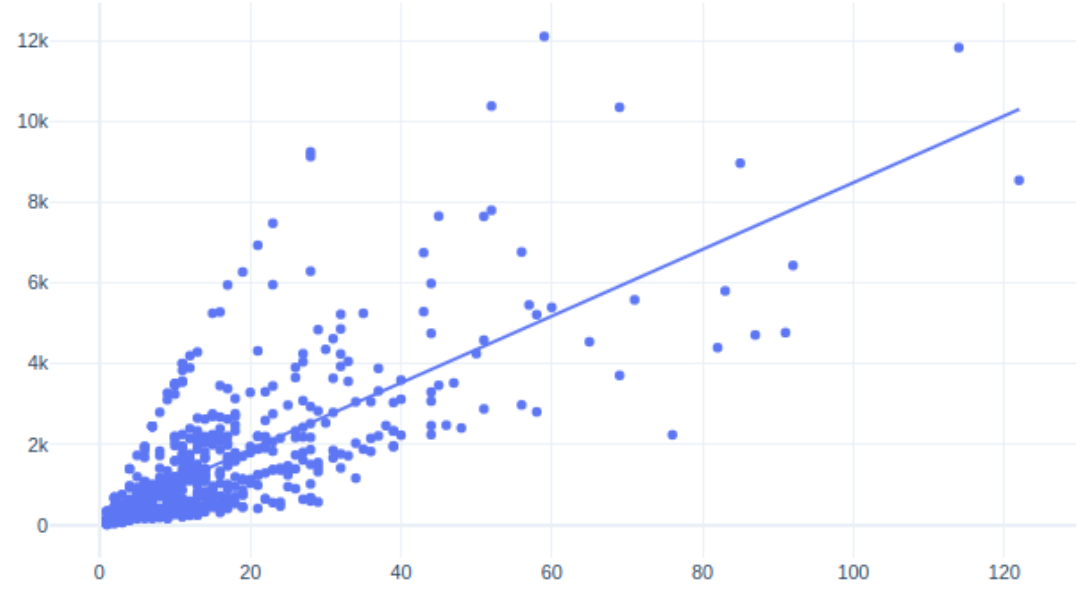

Figure 4.2.29: Quantity over total price distribution

Threat Protection Devices: Set cameras to corridor mode to monitor store aisles. When paired with a fisheye camera, shelf areas are fully covered and advanced analysis can provide a visitor flow distribution heat map. Increased surveillance coverage greatly reduces theft of customer property and retail goods, providing a safe shopping environment.

Active Alarm: The active alarm feature of intelligent cameras acts as a deterrent to prevent crime before it happens.

- Flashing red and blue lights gets the attention of an intruder
- Sounding alarm alerts the intruder
- Annunciating verbal warnings provides instructions

Optimal Store Layout System: An optimal store layout system is critical in smart retail management, enhancing the shopping experience and increasing sales. Strategic product placement guides customers through the store, encouraging impulse purchases and highlighting key items. Analyzing customer flow and shopping patterns creates layouts that reduce congestion, simplify navigation, and enhance accessibility to popular products. This design boosts customer satisfaction, encourages longer visits, and promotes higher spending. Efficient layouts also streamline inventory management, making stock monitoring and replenishment easier. Ultimately, an optimal store layout system is essential for driving customer satisfaction and maximizing business profitability (Figure 4.2.30).

Figure 4.2.30: Optimal store layout challenges

An Ideal Store Layout: By looking at Figure 4.2.31 let's discuss some key points about an ideal store layout:

- **Office**, the Head office/Sub office should be always connected for any support.
- **Entrance**, customer entrance should be always recorded and active alarms.
- **Store Room**, Store room should organized in a manner to be accessed quickly.
- **Store Front**, Products in store front should be always organized.
- **Checkout Counter,** customer easy to access various payments methods.
- **Parking Lot**, should be always captured for security.

Figure 4.2.31: An ideal store layout

People Counting: Advanced cameras provide People Counting functionality which counts foot traffic at store entrances and can export daily/monthly/yearly reports. Traffic analysis can greatly improve business efficiency (Figure 4.2.32).

Hit Map: A fisheye camera provides heat map functionality displaying hot and cold areas based on customer flow, allowing for enhanced business analysis. Fisheye cameras also provide a 360-degree image of the store floor (Figure 4.2.33).

Regional People Counting: Understanding how customers move through a store is the key in helping businesses optimize product placement and prolong customer stay. People Counting can be set to monitor traffic flow in certain regions (Figure 4.2.34).

Figure 4.2.32: People counting camera

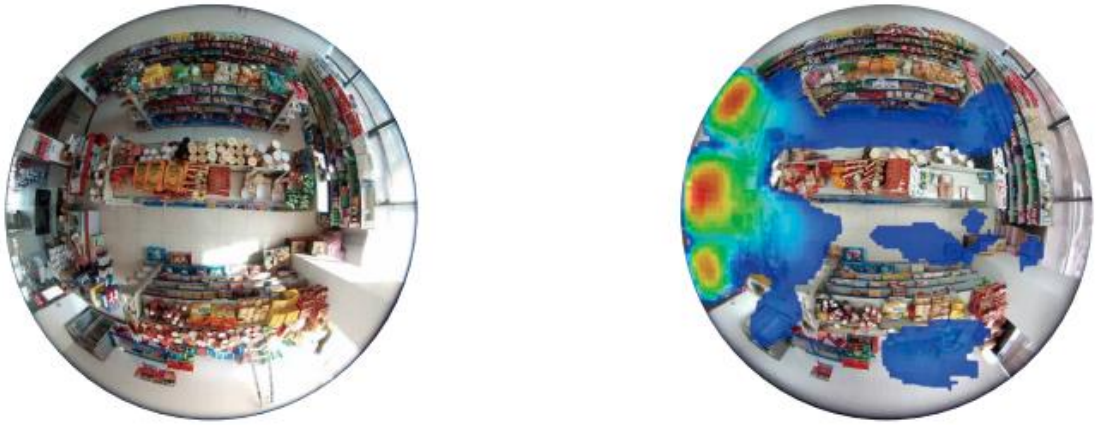

Figure 4.2.33: Hit-map camera

Salesman Training Programs: Salesman training programs are essential in smart retail environments, equipping staff with skills to enhance customer experiences and drive sales. These programs cover product knowledge, customer service, and retail technologies. Knowledgeable sales staff can provide accurate information and personalized recommendations, building customer satisfaction and trust. Effective

training emphasizes excellent service, helping staff engage customers, identify needs, and resolve issues promptly for a positive shopping experience. Training in inventory management systems ensures efficient operations. Continuous training keeps teams updated on retail trends, adapting to evolving consumer behaviors (Figure 4.2.35).

Figure 4.2.34: Regional people counting

Figure 4.2.35: Salesman training elements

4.3 System Testing and Model Evaluation

Testing Objectives

The primary objectives of the system testing and model evaluation were to ensure the functionality, reliability, and performance of the custom loyalty module in Odoo 10. This included testing features such as loyalty membership types, membership climbing process, auto-assigning new users to default membership on sales, loyalty point generation, points redemption, e-invoice generation, and SMS notifications.

Testing Environment

Testing was conducted on a server running Odoo 10, with a PostgreSQL database backend. The system was accessed via a web interface, and SMS notifications were tested using a third-party (SSL Wireless) SMS gateway.

Testing Methodology

The testing methodology followed the principles of the Software Development Life Cycle (SDLC) and included manual testing, integration testing, system testing, and user acceptance testing. Automated tests were created using Odoo's built-in testing framework, and manual tests were conducted to validate user-facing features.

Test Cases and Scenarios

Test Case 1: Loyalty Membership Types

- Purpose: To verify the creation and management of different loyalty membership types.
- Steps:
    1) Navigate to the "Membership Types" section in Odoo.
    2) Create multiple membership types with varying point thresholds and benefits.
    3) Save the membership types and check the database.

- Expected Results: Membership types are saved correctly and displayed in the ERP.
- Actual Results: Membership types were successfully created, saved, and displayed as expected.

Test Case 2: Loyalty Membership Climbing Process

- Purpose: To validate the process of upgrading customer memberships based on accumulated points.
- Steps:
    1) Add a few sale orders from POS window to a test customer account.
    2) Verify the points are reflected when searching on the Loyalty point check window using mobile number.
    3) Check if the membership is upgraded when the invoice amount threshold is reached.
- Expected Results: The customer's membership is upgraded automatically upon reaching the invoice amount threshold.
- Actual Results: The membership was upgraded correctly, and notifications were sent.

Test Case 3: New User Auto-Assign to Default Membership on Sales Testing

- Purpose: To validate any new user is by default assigned to the default membership.
- Steps:
    1) Add a new mobile for a test sale order from POS window.
    2) Verify the new customer is assigned with the default membership after sales completion.
- Expected Results: The customer's membership is automatically assigned to the default membership type.
- Actual Results: The membership for the customer was exactly the default membership.

Test Case 4: Loyalty Auto Point Generation on Sales Testing

- Purpose: To validate accurate points generate and add to the customer balance based on Auto points generate rule.
- Steps:
    1) Continuously add a few sales orders to a customer to cross the current threshold.
    2) Verify the customer is getting accurate points and getting rewarded based on the Auto Points Generate Rule defined earlier for the membership type.
- Expected Results: Customer is receiving accurate points and points are added to the balance.
- Actual Results: Customer received the reward and points accurately.

Test Case 5: Loyalty Points Redeem Process Testing

- Purpose: To validate points redemption, multiple of 50, OTP verification, Maximum percentage, Payment method.
- Steps:
    1) Redeem points for a test customer with a new sale invoice.
    2) Verify the customer can see the balance.
    3) Verify the customer cannot redeem with multiple of 50.
    4) Verify the customer can receive SMS with 6 digits OTP.
    5) Verify the customer cannot proceed with wrong OTP.
    6) Verify the customer can proceed with accurate OTP.
    7) Verify the payment method automatically added on successful redemption.
    8) Verify the balance adjusted after redemption.
- Expected Results: All testing steps are successfully passed.
- Actual Results: Customer redemption test successfully passed all steps for the test customer.

Test Case 6: E-Invoice and SMS Notification Testing

- Purpose: To validate the E-Invoice details are correct, a unique link generated, confirmation SMS sent to the provided mobile, and membership SMS sent automatically.
- Steps:
    1) Generate a test sale invoice.
    2) Verify the auto generated unique link upon sale order completion.
    3) Verify customer receive confirmation SMS with order details.
    4) Verify customer receive Thank you SMS upon breaking the invoice threshold for the membership type.
- Expected Results: The customer receives SMS with order details with E-Invoice link, and receive membership upgrade notification.
- Actual Results: The customer successfully received SMS confirmation with E-Invoice link and received membership notification SMS.

Results and Findings

The majority of test cases passed successfully, confirming the functionality of the custom loyalty module. Minor issues were identified in the points redemption process and automatic upgradation process, which were promptly resolved. The system's performance met the expected standards, ensuring a smooth user experience.

Evaluation

Based on the testing results, the custom loyalty module in Odoo 10 proved to be reliable and efficient. The automated point generation and redemption processes worked seamlessly, and the e-invoice and SMS notification features were well-received during user acceptance testing. This evaluation confirms that the system meets the objectives of enhancing customer loyalty, minimizing costs, increasing repeat customers, maximizing sales, and improving customer satisfaction.

Conclusion

The comprehensive testing and evaluation of the custom loyalty module validate its effectiveness and robustness. The module successfully integrates various loyalty features, meeting the project's goals and providing a valuable tool for retailers to enhance customer loyalty and operational efficiency.

4.4 Summary

In this chapter, the implementation of a custom loyalty module within Odoo 10 for enhancing customer loyalty and operational efficiency in retail settings is detailed. The chapter begins with an overview of the prototype design, which encompasses the comprehensive development of loyalty membership types, membership climbing processes, automatic assignment of default memberships to new users on sales, automated loyalty point generation, points redemption mechanisms, e-invoice integration, and SMS notifications. The prototype design phase focused on ensuring that all aspects of the loyalty system were integrated seamlessly into the Odoo 10 platform, aligning with the project's objectives of minimizing costs, maximizing sales, increasing repeat customers, and improving customer satisfaction. Following the prototype design, extensive system testing and model evaluation were conducted. This involved rigorous testing methodologies, including unit testing, integration testing, system testing, and user acceptance testing. Each component of the custom loyalty module was subjected to detailed test cases to validate functionality, reliability, and performance. Results from the testing phase demonstrated robust system performance, with minor issues promptly identified and resolved to ensure optimal user experience. The evaluation of the implemented system confirmed its effectiveness in meeting project goals. The automated processes for loyalty point management and redemption functioned seamlessly, while the integration of e-invoice and SMS notifications enhanced operational efficiency and customer engagement. Overall, the implementation of the custom loyalty module in Odoo 10 proved successful in enhancing customer loyalty and operational efficiency within retail environments.

CHAPTER 5
RESULT AND ANALYSIS

5.1 Overview

This chapter provides a comprehensive analysis of the outcomes derived from implementing smart retail technologies focusing on customer loyalty programs and e-invoices. It compares these outcomes with traditional retail practices, emphasizing improvements in operational efficiencies and customer satisfaction.

5.2 Experimental

The effectiveness of our smart retail system is evaluated through structured experiments. These experiments rigorously assess the quality of products and services delivered, critical for maintaining customer loyalty. Detailed analysis of customer feedback and engagement metrics provides insights into how the system enhances customer satisfaction and loyalty.

5.3 Performance

Performance evaluation examines key metrics critical for operational success:

- Security and Transaction Efficiency: Ensuring robust security measures in transactions and seamless transaction processing.
- Product Quality and Availability: Adherence to stringent product quality standards and optimizing product availability through effective inventory management.
- Loyalty Program Benefits: Assessing the efficacy of loyalty program features such as automatic point generation on sales and the redemption process.
- Optimized Sales and Customer Satisfaction: Analyzing sales data to gauge the impact on sales maximization and overall customer satisfaction levels.

5.4 Summary

In conclusion, the analysis underscores the strategic value of adopting smart retail practices in Bangladesh. The findings demonstrate that integrating customer-centric technologies like loyalty programs and e-invoices not only enhances operational efficiency but also cultivates a competitive advantage in the retail market. This chapter offers valuable insights into leveraging technology to meet evolving customer expectations and drive sustainable business growth in the digital era.

CHAPTER 6
IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

6.1 Impact on Life

Creating a welcoming retail environment significantly impacts customer experiences. Our research identifies essential strategies and operational practices that enhance customer satisfaction and loyalty, contributing to a positive impact on the quality of life for consumers.

6.2 Impact on Society & Environment

Implementing enhanced security measures, maintaining cleanliness, employing efficient inventory management systems, and adhering to sustainable practices can propel any retail business. Establishing a reputable brand presence through these practices not only benefits the business but also positively influences the broader society and environment.

6.3 Ethical Aspects

Protecting customer and sales data is paramount to maintaining ethical standards in smart retail. Our study emphasizes the importance of robust data security measures to safeguard sensitive information from unauthorized access, ensuring ethical integrity across operations.

6.4 Sustainability Plan

Adaptability and responsiveness to market trends and environmental changes are crucial for sustaining retail operations. Our sustainability plan recommends continuous optimization and flexibility in business strategies to align with evolving consumer preferences and environmental considerations.

6.5 Summary

Throughout our research, we have identified substantial growth opportunities for retail businesses by implementing smart retail strategies. By adopting these insights, retailers can elevate their operational efficiency, enhance customer engagement, and achieve significant sales growth. This chapter underscores the transformative potential of smart retail practices in elevating business performance and fostering sustainable business growth.

CHAPTER 7
CONCLUSION AND FUTURE WORK

7.1 Conclusions

Smart retail represents the future of the retail industry. As consumer expectations evolve and technology advances, retail businesses must adapt to stay competitive. Implementing smart retail strategies not only enhances operational efficiency but also improves customer satisfaction and loyalty. It is imperative for retail business owners to embrace these advancements promptly to maintain a leading edge over competitors in the dynamic marketplace.

7.2 Further Suggested Works

In addition to the explored topics, several areas offer promising avenues for further research and development in smart retail:

- Augmented Reality (AR) in Retail: Exploring the integration of AR technologies to enhance the shopping experience, facilitate virtual try-ons, and personalize product recommendations.
- Blockchain Applications: Investigating the use of blockchain for supply chain transparency, product traceability, and secure transaction processing in smart retail environments.
- Personalization Algorithms: Developing advanced AI-driven algorithms to personalize marketing campaigns, product offerings, and customer interactions based on real-time data analytics.
- Environmental Sustainability Initiatives: Implementing green practices and sustainable sourcing strategies to reduce carbon footprint and appeal to environmentally conscious consumers.
- Predictive Maintenance Systems: Implementing IoT-enabled predictive maintenance systems to proactively manage equipment and prevent operational disruptions in retail stores.

- Product Quality Assurance for Smart Retail: Enhancing product quality assurance processes using IoT sensors and AI to ensure consistency and meet customer expectations.
- Central Distribution System for Smart Retail: Implementing a centralized distribution network to optimize inventory management, reduce logistics costs, and improve order fulfillment efficiency.
- ERP Objectives for Smart Retail: Integrating Enterprise Resource Planning (ERP) systems tailored for smart retail to streamline operations, enhance data analytics capabilities, and support decision-making processes.
- Opportunities of Smart Retail Organization in Bangladesh: Exploring the feasibility and potential impact of introducing smart retail practices in Bangladesh, considering market dynamics, infrastructure, and consumer behavior.

7.3 Limitations

Despite its potential, smart retail faces certain limitations and challenges that businesses need to address:

- Data Privacy and Security: Safeguarding customer data and ensuring compliance with data protection regulations amidst increasing cyber threats and privacy concerns.
- Integration Complexity: Overcoming challenges associated with integrating disparate technologies and legacy systems into a cohesive smart retail ecosystem.
- Skill Gap and Training Needs: Addressing the need for upskilling retail workforce to effectively utilize new technologies and maximize operational efficiencies.
- Ethical Considerations: Ensuring ethical use of AI and customer data analytics to avoid biases and maintain trust among consumers.
- Cost of Technology Adoption: Managing the high initial costs of implementing smart retail solutions, including hardware, software, and ongoing maintenance expenses.

- Bias in Sales History: Decisions based on historical sales data may not always account for fluctuating market conditions or sudden shifts in consumer preferences. Retailers should continually update their analytics models to reflect current trends.
- Environmental Factors: External factors such as natural disasters, political instability, or economic fluctuations can impact retail operations. Developing contingency plans and adaptive strategies is essential to mitigate these risks.
- Implementation Considerations: Adopting smart retail technologies requires significant investment in infrastructure, training, and technology adoption. Retailers must carefully evaluate costs versus benefits and ensure a phased implementation to manage operational disruptions.

By addressing these limitations and exploring suggested areas for future work, retail businesses can maximize the benefits of smart retail initiatives, drive innovation, and sustain long-term growth in a competitive market landscape.

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APPENDIX A

Include the Mapping of COURSE OUTCOMES, COMPLEX ENGINEERING PROBLEMS (EP) AND COMPLEX ENGINEERING ACTIVITIES (EA) ADDRESSING

- Course Outcomes:
  - CO1: Demonstrate proficiency in applying smart retail technologies to enhance customer satisfaction and operational efficiency.
  - CO2: Analyze and evaluate the impact of customer loyalty programs and e-invoicing on retail business performance.
  - CO3: Develop and implement sustainable practices in retail operations.
- Complex Engineering Problems (EP):
  - EP1: Optimize customer loyalty programs to increase repeat customer rates and enhance customer satisfaction in a retail environment.
  - EP2: Implement e-invoicing systems to streamline financial transactions and reduce operational costs in retail businesses
- Complex Engineering Activities (EA):
  - EA1: Designed and developed a custom module in Odoo 10 to manage loyalty memberships and automate point generation on sales.
  - EA2: Conducted performance testing and evaluation of the e-invoicing system to assess its impact on operational efficiency and cost savings.

APPENDIX B

LIST OF PUBLICATIONS (if any)

test

ORIGINALITY REPORT

19%	14%	1%	14%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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