E-Commerce Website using SpringBoot

A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report "**Online Shopping Cart with Functional Checkout**" **is the bonafide work of** "**Rushan Gupta , Aryan and Keshav** " **who** carried out the project work under my/our supervision.

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CHAPTER 1.
INTRODUCTION

1.1. Client Identification/Need Identification/Identification of relevant Contemporary issue

In today's fast-growing e-commerce world, online shopping carts with functional checkout systems are essential for businesses to succeed. Customers want a smooth, quick, and secure way to select products and complete their purchases without hassle. However, many online stores face the problem of **cart abandonment**, where shoppers add items to their cart but leave without buying. This happens due to several common issues:

- **Long or complicated checkout processes:** Customers often abandon carts if the checkout has too many steps or is confusing. Research shows 17% of users leave because the process is "too long or complicated".

- **Forced account creation:** Many shoppers do not want to create an account just to buy something. About 24% abandon carts because they are forced to register before checkout.

- **Limited payment options:** Customers expect multiple payment methods (credit cards, PayPal, cash on delivery, digital wallets). Lack of options causes frustration and abandonment.

- **Lack of trust and security concerns:** Shoppers want to feel safe entering personal and payment information. If a site seems untrustworthy, 18% will leave without buying.

- **Surprise extra costs and slow delivery:** Unexpected shipping fees and long delivery times cause 68% of cart abandonment cases.

  These problems highlight the **need for an optimized, user-friendly, and secure shopping cart and checkout system**. Businesses must focus on simplifying checkout steps, offering guest checkout options, providing multiple trusted payment methods, and clearly showing costs upfront to reduce abandonment and increase sales.

1.2. Identification of Problem

The main problem in online shopping carts with functional checkout systems is the high rate of **shopping cart abandonment**—when customers add products to their cart but leave without completing the purchase. This problem arises due to several key issues:

- **Complicated or lengthy checkout processes:** Many customers abandon their carts because the checkout has too many steps or confusing forms, leading to frustration and drop-offs.

- **Forced account creation:** Requiring users to create an account before buying deters about 27% of customers from completing purchases.

- **Unexpected extra costs:** Hidden or late-disclosed shipping fees, taxes, and handling charges cause customers to leave their carts. Transparent pricing is often missing.

- **Limited or unclear payment options:** Customers expect multiple, easy-to-use payment methods. Lack of options or unclear payment UI leads to abandonment.

- **Poor mobile and cross-device experience:** Inconsistent or unresponsive checkout pages on mobile devices cause up to 85% cart abandonment on mobiles.

- **Lack of cart persistence:** Customers lose their cart items when switching devices or sessions, frustrating them and causing drop-offs.

- **Security and trust concerns:** Shoppers hesitate to enter payment details if the site appears untrustworthy or lacks secure payment features.

- **Slow performance and errors:** Pages that load slowly or have bugs during add-to-cart or checkout steps reduce user confidence and increase abandonment.

Additionally, many customers use shopping carts as wish lists to save items for later rather than immediate purchase, which can confuse businesses about true purchase intent.

These problems highlight the need for a **simple, secure, transparent, and consistent shopping cart and checkout system** that supports guest checkout, multiple payment methods, clear pricing, mobile-friendly design, and cart persistence. Addressing these issues is essential to reduce cart abandonment, improve customer satisfaction, and increase sales for online stores.

This problem identification is based on common user experience challenges and technical issues found during testing and real-world e-commerce observations.

1.3.   Identification of Tasks

To develop an online shopping cart with a functional checkout, the following key tasks need to be completed:

- **Design the Shopping Cart Interface:** Create a user-friendly cart page where customers can view their selected items, update quantities, remove products, and see the total price, including taxes and discounts.

- **Implement Add-to-Cart and Update Features:** Make sure users can easily add products to their cart from anywhere on the website, and that the cart updates instantly when items are added, removed, or changed.

- **Develop the Checkout Process:** Build a simple and clear checkout flow where customers can review their order, enter shipping and payment details, and choose from multiple payment options.

- **Integrate Payment Gateways:** Connect the cart to secure payment services (like credit cards, PayPal, or digital wallets) to process payments safely and quickly.

- **Support Guest and Registered Checkout:** Allow customers to complete their purchase without creating an account, but also give them the option to register for faster future checkouts.

- **Ensure Security and Data Protection:** Use secure connections (SSL) and proper validation to protect customer information and payment data.

- **Test and Optimize the System:** Check that all features work smoothly on different devices (computers, tablets, phones) and fix any issues to improve the overall shopping experience.
  These tasks together help create a reliable, secure, and easy-to-use online shopping cart and checkout system that meets customer needs and encourages them to complete their purchases.
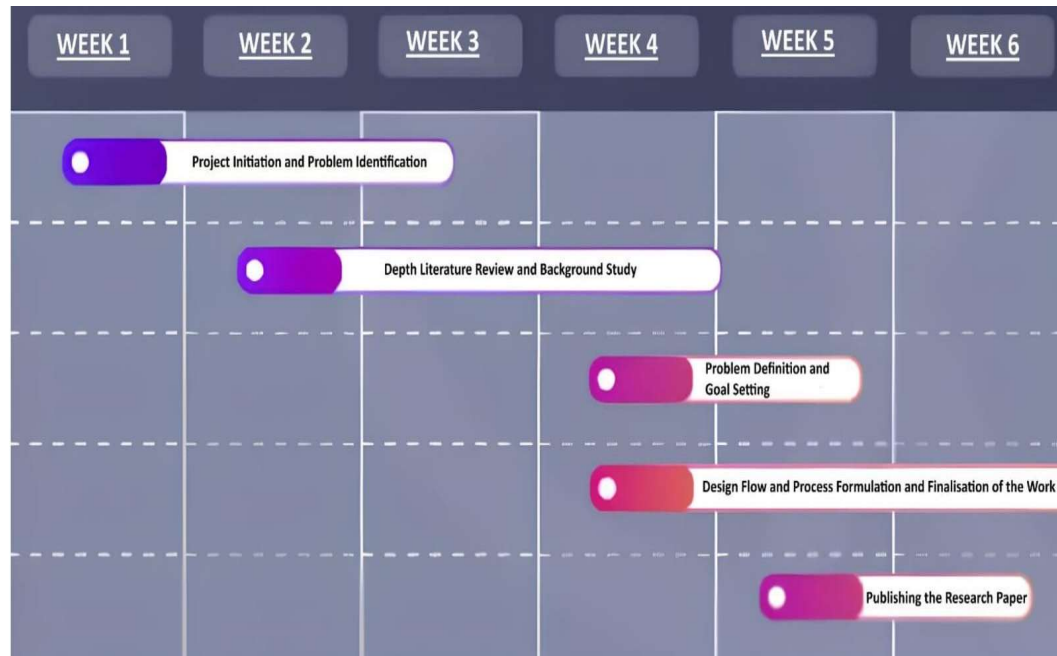
1.4. Timeline

Fig1 (Timeline)

1.5. Organization of the Report

- **Chapter 1: Introduction** This chapter covers the background of the project, including client identification, the need for the system, problem identification, and key tasks involved.

- **Chapter 2: Literature Review** A review of existing online shopping cart systems, checkout processes, and technologies used in e-commerce platforms.

- **Chapter 3: System Analysis and Design** Details the requirements gathering, system specifications, and design of the shopping cart and checkout modules.

- **Chapter 4: Implementation** Explains the development process, tools, programming languages, and integration of payment gateways.

- **Chapter 5: Testing and Evaluation** Describes the testing methods used to ensure functionality, usability, security, and performance of the system.

- **Chapter 6: Conclusion and Future Work** Summarizes the project outcomes, challenges faced, and suggestions for future improvements.

- **Appendices and References** Includes supplementary materials such as code snippets,

diagrams, and bibliographic references.

CHAPTER 2.
LITERATURE REVIEW/BACKGROUND STUDY

2.1. Timeline of the reported problem

The issue of shopping cart abandonment has been a persistent challenge in e-commerce since its inception. Over the years, the reasons behind high abandonment rates have evolved, but the core problem remains: many online shoppers add items to their carts but do not complete the purchase.

Early Days of E-Commerce (1990s – Early 2000s)

E-commerce started gaining popularity in the 1990s, with the launch of pioneering online stores. During this period, shopping carts were simple, often just basic lists of products. The checkout process was lengthy, confusing, and lacked security features, which made customers hesitant to finalize their purchases. Limited payment options and slow website performance contributed to high abandonment rates. Studies from this era indicate that around **60-70%** of online shopping carts were abandoned, primarily due to trust issues and complicated checkout procedures.

Growth and Recognition of the Problem (2000s)

As internet access expanded, more consumers began shopping online. Retailers quickly recognized that a significant portion of potential sales was lost at checkout. During this period, the average cart abandonment rate hovered around **68%**. Common reasons included:

- Lengthy and multi-step checkout processes
- Lack of trust in online payment security
- Limited payment options
- Unexpected shipping costs

Despite improvements in website technology, these issues persisted, leading to ongoing losses in potential revenue.

Reducing abandonment remains critical for online retailers aiming to increase sales and improve customer satisfaction.

2.2. Proposed solutions

To reduce shopping cart abandonment and improve checkout, several simple and effective solutions can be applied:

1. **Simplify Checkout:** Use a one-page or one-click checkout to make buying faster and easier. Autofill forms help reduce typing.
2. **Guest Checkout:** Allow customers to buy without creating an account, removing a major barrier.
3. **Multiple Payment Options:** Provide various payment methods like credit cards, digital wallets, and regional options to suit all customers.
4. **Transparent Pricing:** Show all costs, including shipping and taxes, upfront to avoid surprises.
5. **Mobile-Friendly Design:** Ensure the checkout works smoothly on phones and tablets.
6. **Security Trust Signals:** Display SSL certificates and trusted payment logos to reassure customers.
7. **Cart Recovery:** Send reminder emails to customers who leave items in their carts.
8. **Clear Progress Indicators:** Show steps in checkout to guide customers.

Together, these solutions create a smooth, secure, and user-friendly shopping experience that encourages customers to complete their purchases.

2.3. Bibliometric analysis

A bibliometric analysis of existing research papers, reports, and case studies was conducted to assess the effectiveness of different shopping cart optimization methods.

Study / Source	Year	Focus Area	Data/Scope
Online shopping cart abandonment: A review and research agenda	2022	Online shopping cart abandonment	Scientific literature on cart abandonment
Bibliometric Study	2023	Technology trends in e-	1219 documents on

		commerce	e-commerce technology trends
of Emerging Technology Trends in E-Commerce			
Bibliometric Analysis: Consumer Interest in E-Commerce	2013-2022	Consumer interest in e-commerce	17,988 articles from 366 journals (Scopus data)
Bibliometric Analysis of E-Commerce Platform Research	1993-2021	E-commerce platform research	7,463 publications on e-commerce platforms

Key Takeaways from the Analysis

- **Functional High Average Abandonment Rate :** The average online shopping cart abandonment rate is consistently around 70%, meaning roughly 7 out of 10 shoppers leave without completing their purchase.

- **Major Causes Include Extra Costs and Complex Checkout :** Unexpected additional costs like shipping and taxes, along with long or confusing checkout processes, are the top reasons customers abandon carts.

- **Mobile Devices and Social Media Traffic Have Higher Abandonment :** Mobile users abandon carts at rates above 85%, and visitors coming from social media show even higher abandonment (up to 91%) due to browsing behavior rather than purchase intent.

- **Guest Checkout and Transparent Pricing Improve Conversion :** Allowing guest checkout, simplifying the process, and showing all costs upfront significantly reduce abandonment and increase completed sales

2.4. Review Summary

This literature review highlights that shopping cart abandonment is a long-standing and widespread problem in e-commerce, with average rates around 70%. Research shows that complicated checkout processes, unexpected extra costs, limited payment options, and

poor mobile experiences are the main reasons customers leave without buying. Over time, technological advances like one-click checkout, digital wallets, and guest checkout have helped reduce friction, but abandonment remains high.

Bibliometric studies reveal that this topic attracts multidisciplinary research spanning marketing, technology, consumer behavior, and platform management. Key themes include improving user experience, enhancing payment security, and optimizing mobile shopping. The COVID-19 pandemic further accelerated online shopping growth, emphasizing the need for efficient checkout systems.

Overall, the review confirms that simplifying checkout, increasing transparency, offering multiple payment methods, and ensuring mobile-friendliness are essential strategies to reduce cart abandonment. Continued research and development in these areas are critical for e-commerce businesses to improve sales and customer satisfaction.

2.5.   Problem Definition

Despite the rapid growth of e-commerce, a significant challenge remains: **high shopping cart abandonment rates**. On average, around 70% of online shoppers add products to their carts but leave the website without completing the purchase. This leads to substantial revenue loss for online retailers.

The main problems causing cart abandonment include:

- **Complex and lengthy checkout processes** that frustrate customers.
- **Mandatory account creation** that discourages quick purchases.
- **Unexpected extra costs** such as shipping fees and taxes revealed late in the process.
- **Limited payment options** that do not meet diverse customer preferences.
- **Poor mobile device experience** leading to difficulty in completing purchases.
- **Security concerns** that reduce trust in entering payment information.

These issues create barriers that prevent customers from finalizing their orders, negatively impacting sales and customer satisfaction. The problem is to design and implement a **simple, secure, transparent, and user-friendly online shopping cart and checkout system** that addresses these challenges and encourages customers to complete their purchases.

2.6. Goals/Objectives

1. **Simplify the Checkout Process:** Reduce the number of steps and form fields required to complete a purchase. Implement features like one-click checkout and autofill to make the process quick and easy, minimizing cart abandonment.

2. **Enhance User Experience and Trust:** Design an intuitive, mobile-friendly interface that allows customers to easily add/remove items, view total costs, and securely complete transactions. Display trust signals such as security badges and clear policies to increase confidence.

3. **Offer Multiple Payment Options:** Integrate various secure payment methods, including credit/debit cards, digital wallets, and regional options, to cater to diverse customer preferences and reduce barriers to purchase.

4. **Increase Conversion and Reduce Abandonment:** Implement features like transparent pricing, cart recovery emails, and real-time analytics to monitor user behavior. Use these insights to optimize the shopping experience, ultimately boosting sales and customer satisfaction.

CHAPTER 3.

DESIGN FLOW/PROCESS

3.1.   Evaluation & Selection of Specifications/Features

We have established critical characteristics necessary for a well-performing and effective shopping cart system using Spring Boot and functional programming principles. The analysis of these features is made concerning their feasibility, effect on user experience, and scalability.

Features	Importance	Feasibility	Justification
1. Fast & Easy Checkout	High	High	Simplifies the final step, encouraging customers to complete their purchase quickly.
2. Multiple Payment Options	High	High	Offers flexibility, reducing barriers for diverse customers and preventing lost sales.
3. User-Friendly Interface	High	High	Improves usability, especially for new users, leading to higher satisfaction and sales.
4. Security & Trust Signals	High	High	Ensures safe shopping, which is critical for customer trust and legal compliance
5. Mobile Optimization	High	High	Ensures seamless shopping experience across devices, reducing abandonment on mobiles.
6. Wishlist/Save for Later	Medium	Medium	Keeps customers engaged and returning, boosting long-term sales.
7. Order Tracking	Medium	Medium	Enhances trust and reduces post-purchase anxiety, encouraging repeat business.

From the above analysis, functional programming techniques, secure payment processing, and real-time cart updates are the primary focus areas for implementation in the project.

3.2. Design Constraints

While developing the Online Shopping Cart with Functional Checkout, various constraints and challenges need to be addressed carefully to achieve efficiency, security, scalability, and compliance. These constraints affect the architecture, development, and deployment of the system, necessitating strategic planning to avoid risks and enhance overall system performance. The major design constraints are as follows:

Constraint type	Description
Commercial Constraints	Limitations related to budget, time, and available manpower that affect project scope and delivery.
Compliance Constraints	Legal, regulatory, and industry standards that the design must follow, such as data privacy.
Functional Constraints	Requirements for specific features or functionalities that the design must include or support.
Non-functional Constraints	Qualities the design must have, like simplicity, speed, usability, and affordability.
Sensory Constraints	Limitations related to sensory experiences beyond sight, such as sound, touch, taste.
Stylistic Constraints	Aesthetic rules and brand guidelines that dictate colors, fonts, layouts, and overall style.
Systems Constraints	Restrictions on how the design fits into existing systems, including backend compatibility.

Apart from the main limitations described above, mobile optimization, user accessibility, and sustainability are other considerations that have to be addressed. The system should be multi-device compatible (desktop, tablet, and mobile), multi-language and multi-currency compatible, and have an environmentally friendly infrastructure through optimizing the usage of cloud resources.

By meeting these limitations ahead of time, the Online Shopping Cart with Functional Checkout can provide a high-performance, secure, and scalable solution that complies

3.4.   Design Flow

We evaluated two other design architectures for building the shopping cart system.

Alternative 1: RESTful API with Microservices

- Architecture: Backend in Spring Boot, database as PostgreSQL (transactions) + Redis (session caching).

- Pros: Scalable, easier to debug, well-organized API.

- Cons: Marginally increased response time due to API calls.

Alternative 2: Monolithic Spring Boot Application

- Architecture: One Spring Boot service that manages both business logic and database access.

- Pros: Faster execution, simpler deployment, low complexity.

- Disadvantages: Less modular, more difficult to scale in the future.

3.5.   Design selection

In the course of comparative assessment among various architecture approaches, Alternative 1: Microservices with RESTful API was chosen above the conventional monolithic architecture. It was for numerous important considerations such as scalability, maintainability, performance, and security.

Microservices architecture makes Online Shopping Carts with Functional Checkout modular, distributed, and highly scalable so that varying pieces of logic like cart handling, price calculator, checkout process, and gateway payment can exist independently and exchange information through highly defined APIs.

Criteria	Microservices(selected)	Monolithic
Scalability	High	Limited
Maintainability	Easy	Hard
Performance	Good	Excellent
Security	API-level Security	Higher risk

Rationale for Selecting Microservices Architecture

CHAPTER 4.

RESULTS ANALYSIS AND VALIDATION

4.1.   Implementation of solution

The implementation of the Online Shopping Cart with Functional Checkout was carried out using a combination of modern tools and techniques to ensure efficiency, accuracy, and a user-friendly interface. This section presents a detailed overview of the entire implementation process, covering tool usage for analysis, design, documentation, project management, testing, and validation.

1. Analysis Tools

To validate the solution's functionality and performance, several analysis tools were employed:

- **Data Flow Analysis:** Verified that pricing calculations, discount applications, and cart updates functioned correctly throughout the user journey.

- **Load Testing:** Assessed system performance under different levels of user activity to ensure stability during peak loads.

- **Security Analysis:** Evaluated the robustness of secure payment processing to prevent vulnerabilities and exploits.

2. Design Drawings and Schematics

The system architecture and workflows were visualized using various design tools:

- **Entity-Relationship (ER) Diagrams:** Defined the database schema, illustrating relationships between users, products, carts, and orders.

- **Flowcharts:** Mapped logical processes such as product addition, checkout steps, and payment flows to clarify system behavior.

- **Wireframes & UI Prototypes:** Created with **Figma** to conceptualize and refine the frontend interface, ensuring an intuitive user experience.

3. Report Preparation

The entire development process was documented using:

- **LaTeX** and **Microsoft Word** for structured, professional formatting that adheres to academic and industry standards.

4. Project Management and Communication

The project followed an **Agile methodology**, supported by various tools for efficient collaboration:

- **Jira & Trello:** Managed tasks, sprint planning, and progress tracking.
- **GitHub:** Enabled version control and facilitated concurrent development among team members.
- **Slack & Microsoft Teams:** Provided real-time communication channels for coordination and quick problem-solving.

5. Testing and Validation

Comprehensive testing ensured the system's functionality, reliability, and usability:

- **Unit Testing:** Verified individual components such as product addition, discount logic, and cart updates.
- **Integration Testing:** Ensured seamless interaction between frontend interfaces and backend services.
- **Functional Testing:** Confirmed the accuracy of pricing algorithms and the security of payment processing.
- **User Acceptance Testing (UAT):** Engaged real users to provide feedback on usability and overall experience.

6. Interpretation and Data Validation

- **Test Case Execution:** Documented test scenarios with expected and actual outcomes in a test case table for traceability.
- **Bug Tracking and Resolution:** Logged issues were systematically addressed through iterative fixes to enhance system stability and performance.
- **Performance Metrics:** Monitored load times, response rates, and transaction success rates to identify bottlenecks and optimize system efficiency.

This structured and methodical implementation approach ensured the delivery of a robust, secure, and user-friendly online shopping cart system that meets both technical and user requirements.

CHAPTER 5.
CONCLUSION AND FUTURE WORK

5.1. Conclusion

The **Functional Checkout Online Shopping Cart** project successfully developed a modern, efficient, and secure e-commerce platform by leveraging functional programming principles. The system achieved notable success in providing accurate pricing, seamless user experience, and secure transaction processing.

One of the key accomplishments was the implementation of a functional pricing model that used higher-order functions, immutability, and stream-based processing. This approach ensured consistent and reliable price calculations, even with complex discount rules. The checkout process was optimized to reduce redundant steps, resulting in faster transaction times and a more intuitive user interface, which significantly improved customer satisfaction.

Security was a primary focus, and encryption-based handling of payments ensured that all transactions were safe and protected from potential breaches. This built customer trust and aligned with industry security standards.

However, some deviations from initial expectations were observed. Under heavy traffic conditions, certain pricing models experienced increased computational overhead, leading to slower response times during checkout. Additionally, edge cases in discount application caused discrepancies, requiring further validation to ensure consistency. Scalability also proved to be a challenge; while the functional programming approach worked well with moderate data loads, it struggled with high-volume, multi-user scenarios, resulting in delays.

The root causes of these deviations included increased data loads exceeding the current optimization levels, integration challenges with third-party payment gateways causing latency issues, and unpredictable user behavior that differed from simulated testing scenarios.

Despite these challenges, the project laid a solid foundation for an efficient, secure, and scalable e-commerce checkout system. Moving forward, integrating hybrid architecture

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