

# ScrapVault\_(C191019,C191023,C 191035)

*by* MD Shahriar Siddique

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**ScrapVault – Which is a digital marketplace  
dedicated to buying and selling scrap materials.**

This Dissertation is Submitted in <sup>23</sup>Fulfillment  
of the Requirements for the Degree of

**Bachelor of Science (B.Sc.)**

in

**Computer Science and Engineering (CSE)**

by

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TO

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INTERNATIONAL ISLAMIC UNIVERSITY CHITTAGONG**

Spring 22

# DECLARATION

We hereby affirm the following statements regarding our thesis:

1. The project has been successfully completed as part of our undergraduate degree program at International Islamic University Chittagong.
2. The project work <sup>18</sup> does not contain any previously published or third-party content without proper citation.
3. The project work has not been previously <sup>18</sup> submitted for any other degree or diploma at any other university or institution.
4. We have appropriately acknowledged all significant sources of contribution in the project.

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## SUPERVISOR'S DECLARATION

I formally state that I have examined this project and claim it to be of sufficient quality and scope to be granted for the undergraduate degree of Bachelor of Science in Computer Science and Engineering.

---

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## DEDICATION

This project report is dedicated to us, our supervisor and our family. The team work was satisfactory and the family's support was incredibly Amazing. Our dedicated and most hard working Supervisor who has been a constant support throughout these months. In this document, the contributions are acknowledged too.

# ACKNOWLEDGMENT

To start with, All the praises to the Almighty Allah, for his mercy because of which we were able to finish our thesis despite having so many obstacles. Secondly, we would like to extend our gratitude to our supervisor, Mohammed Mahmudur Rahman for his continuous effort and guidelines from the very beginning of our research.

# ETHICAL STATEMENT

Hereby we state that, None of the unethical practices were used in the completion of our project work. The data we used for the research purpose are original. We carefully checked every citations we used here. The three writers of the work accept all the liabilities for any kind of violation of the thesis rule.

# ABSTRACT

ScrapVault is an innovative digital marketplace that aims to revolutionize the scrap trading industry by providing a dynamic platform to connect environmentally conscious individuals and businesses. The website has been designed with a user-centric approach, offering an intuitive interface for easy navigation and efficient discovery of a wide range of scrap materials, including metals, plastics, and paper.

The platform prioritizes security, offering a robust transactional framework to ensure peace of mind. Advanced geo-location features are integrated to help users locate nearby sources of scrap materials. ScrapVault is unique in its commitment to transparency, providing environmental impact metrics that allow users to track and quantify their contributions to sustainability.

In addition to its functional aspects, ScrapVault also focuses on building a community of like-minded individuals and businesses. This community not only supports recycling efforts but also cultivates a sense of responsibility towards the environment.

Overall, ScrapVault is a commendable project that contributes to the digital transformation of the scrap trading industry. By balancing economic considerations with a commitment to sustainability, community engagement, and environmental responsibility, ScrapVault has emerged as a trailblazing initiative towards a greener and more interconnected future.

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# ABBREVIATION

The following list provides descriptions of various symbols and abbreviations that will be utilized in the subsequent sections of the document.

35

**RF** : Random Forest

**KNN** : K-Nearest Neighbors

**MLP** : Multilayer Perceptron

**DT** : Decision Tree

**SVM** : Support Vector Machine

**CNN** : Convolutional Neural Network

# Chapter 1

## Introduction

### 1.1 Research Background

The emergence of scrap-selling websites signifies a transformative shift in commerce, driven by a heightened global awareness of environmental concerns related to resource extraction and waste generation. This project aims to explore, develop, and launch a scrap-selling website in response to the escalating demand for efficient and transparent platforms for trading scrap materials. The motivation behind this initiative is not solely technological; it embodies a firm commitment to fostering positive change. The overarching goal is to create a user-friendly, secure, and sustainable online platform where individuals, businesses, and industries can efficiently trade scrap materials, contributing to waste reduction and resource conservation.

The project envisions a future where discarded items are repurposed into valuable resources, reflecting a broader societal shift towards sustainable practices and a circular economy. By inviting participation and emphasizing collective action, the project seeks to make a substantial difference in how the world approaches the reuse and recycling of valuable resources, aligning with global initiatives for environmental responsibility and community engagement.

## 1.2 Problem Statement

The "ScrapVault" project is a groundbreaking digital marketplace that has been developed to address the limitations of traditional scrap trading methods. The existing approaches to scrap trading suffer from several deficiencies, including a lack of transparency, accessibility, and efficiency, which create significant obstacles to the smooth exchange of materials. The increasing volume of scrap materials due to urbanization and industrialization, coupled with the absence of streamlined digital platforms, exacerbates inefficiencies in the recycling process. Furthermore, the environmental impact of resource extraction and waste generation intensifies the need for a solution that prioritizes sustainability and responsible waste management.

The "ScrapVault" project aims to revolutionize the industry by establishing a user-friendly digital marketplace dedicated to scrap trading. Its primary objective is to rectify the shortcomings of current methods while making substantial contributions to waste reduction and resource conservation. The platform offers several features, including a transparent and efficient trading system, secure transactions, and a user-friendly interface. The platform leverages cutting-edge technology such as blockchain to ensure the security and transparency of transactions, which is a significant breakthrough in the industry.

"ScrapVault" emerges as a transformative solution in response to the pressing issues faced by traditional scrap trading methods. It fosters a more efficient, transparent, and environmentally conscious approach to scrap material exchange, making it an essential tool for businesses and individuals alike who aim to achieve their sustainability goals. The platform also focuses on sustainability by promoting responsible waste management practices and reducing the impact of resource extraction. The result is a streamlined and efficient process that benefits both sellers and buyers, while also contributing to a more sustainable future. individuals alike who aim to achieve their sustainability goals.

### 1.3 Motivation

The "Scrap Vault" initiative is an innovative project that aims to revolutionize the scrap trading industry and address environmental challenges. With the growing awareness of the negative impact of resource depletion and waste generation, it has become essential to explore new solutions that promote responsible waste management and environmental conservation. The "Scrap Vault" is a cutting-edge digital marketplace that seeks to transform the way we view waste materials, recognizing them as valuable resources that can be repurposed and recycled to create a more sustainable and circular economy. Conventional scrap trading methods can be complicated and opaque, which makes it difficult to access and trade scrap materials. The "Scrap Vault" uses state-of-the-art technology to offer a secure and user-friendly platform for individuals, businesses, and industries to trade scrap materials. The ultimate goal of this initiative is to significantly reduce waste, promote resource conservation, and contribute to a more sustainable and environmentally conscious society. By embracing the "Scrap Vault" project, we can work together towards a brighter future, where waste materials are no longer seen as a burden but as valuable resources that can benefit us all.

## 1.4 Objective Of The Project

The ScrapVault project is a visionary initiative that seeks to establish a digital marketplace that is both user-friendly and socially and environmentally responsible. With a comprehensive set of objectives aimed at streamlining scrap trading processes, reducing waste, and promoting sustainable practices, the project represents a major step forward in the development of a more sustainable and responsible digital ecosystem.

The key objectives are

- To Establish a User-Friendly Digital Marketplace
- To Promote Environmental Sustainability
- To Enhance Transparency in Scrap Trading
- To Ensure Secure Transaction Processes

## Chapter 2

# Literature Review

### 2.1 Introduction

Surrounding scrap trading and online platforms reveal persistent challenges that the "Scarp Vault" project seeks to address more efficiently and elegantly. While various digital platforms have emerged to facilitate scrap trading, gaps in the existing solutions necessitate innovative interventions. Current research suggests shortcomings in transparency and accessibility within traditional scrap trading methods, reflecting the need for modern, user-friendly platforms. Additionally, environmental concerns related to resource extraction and waste generation have heightened the importance of sustainable practices, aligning with the overarching goal of "Scarp Vault" to contribute to waste reduction and resource conservation. Existing literature also highlights the limitations of pricing models on some platforms, emphasizing the necessity for more inclusive solutions suitable for diverse geographic and economic contexts. Furthermore, safety concerns associated with online transactions in the scrap trading domain have been identified, underscoring the importance of secure transaction processes—a key objective of "Scarp Vault." The literature supports the notion that in the oversaturated market of major platforms, less developed areas and countries may be overlooked, making the comprehensive and community-focused approach of "Scarp Vault" particularly relevant. By aiming to provide a user-friendly interface, transparent transaction mechanisms, and localized trading capabilities, "Scarp Vault" aligns with findings that emphasize the significance of efficiency, security, and community engagement in the digitalization of scrap trading.

## 2.2 Scope of Project

1. A pivotal element within the project's scope revolves around the creation of comprehensive scrap listings. This involves empowering users to furnish detailed information about their scrap materials, including but not limited to type, quantity, and quality. The objective is to instill transparency in the trading process, enabling informed decision-making and fostering a more trustworthy environment within the digital marketplace.
2. Security is a top priority for "Scarp Vault". They have implemented strong measures to ensure the safety of their users. This includes integrating secure payment gateways and advanced data encryption to protect the confidentiality and integrity of transactions. As a result, users can have confidence in participating in the digital scrap trading ecosystem.
3. Environmental consciousness is woven into the fabric of the project's scope through the incorporation of features that enable users to track and visualize the environmental impact of their recycling efforts. By promoting sustainability and providing a tangible measure of the positive contribution to the environment, the project aims to instigate a sense of responsibility among users.
4. The project's geo-location integration aims to facilitate localized trading by connecting users with nearby buyers or sellers. This feature adds another layer to the project's scope, intending to minimize transportation costs, promote community engagement, and contribute to a more sustainable approach to scrap trading.
5. Recognizing the prevalence of mobile devices in today's dynamic world, the project ensures that the platform is not just accessible but optimized for mobile use. This strategic move empowers users to manage their scrap listings and transactions conveniently while on the move, aligning with contemporary trends in digital accessibility.

## 2.3 Literature Review

In the ever-changing dynamics of the scrap trading industry, the historical absence of dedicated online platforms has impeded its global progress, leading to enduring inefficiencies and a pronounced lack of transparency. Despite the transformative impact of the Internet in various sectors, the scrap trading industry remains ensnared in challenges, notably revolving around safety concerns, budget constraints, and transparency issues.

### Regional Dynamics and Challenges in Bangladesh

This narrative resonates strongly in countries like Bangladesh, where the untapped potential of sharing economy platforms poses challenges. Despite their presence, the transformative impact is yet to be fully realized, particularly in sectors like accommodation, where pricing structures and associated fees present significant obstacles in the Bangladeshi market. A bespoke solution is required to align with the unique economic context of Bangladesh.

Amidst these challenges, the "Scrap Vault" project emerges as a visionary response to the complexities within Bangladesh's scrap trading landscape. Drawing inspiration from successful sharing economy models and harnessing cutting-edge technology with a user-centric design, "Scrap Vault" aims to lead a comprehensive transformation. This initiative directly addresses safety, budget, and transparency concerns, not only meeting local needs but also aspiring to contribute to a broader paradigm shift in the global scrap trading landscape.

This narrative gains further depth through a synthesis of related studies, encompassing topics such as economic resilience in Dhaka's metal businesses[1], the influence of social ties on metal resource flows in Bangladesh's ship recycling industry[2], e-waste recycling practices[3], perspectives on the circular economy in ship demolition[4], the cycle assessment of steel in ship recycling[5], the impact of steel prices on ship demolition[6], secondhand product market development in Bangladesh[7], markets in ferrous scrap for steelmaking[8], price linkages in the copper futures, primary, and scrap markets[9], the decision-making process on production yield loss[10], and consumer behavior[11] in scrap metal scavenging and Scrap Prices, Waste, and Recycling Policy[12].

Expanding upon this comprehensive literature review, a wealth of additional references contributes nuanced insights to our understanding of the challenges and opportunities within the global scrap trading landscape. In Preparation and melting of scrap in aluminum recycling: A review[13], the focus is on the intricacies of preparing and melting scrap in the context of aluminum recycling. Scrap Tire Derived Fuel: Markets and Issues[14] sheds light on the markets and challenges associated with using scrap



tire-derived fuel. What do we know about metal recycling rates[15] explores the existing knowledge on metal recycling rates, offering valuable perspectives on sustainability.

Scrap-based steel production and recycling of steel[16] delves into the intricate processes of scrap-based steel production and its implications for steel recycling.

In An analysis of scrap futures markets for stimulating resource recovery[17], the examination of scrap futures markets provides insights into stimulating resource recovery. Iron and steel scrap[18] contributes to our understanding of the dynamics within the iron and steel scrap sector. An economic analysis of scrap tire pyrolysis, potential and new opportunities[19] explores the economic aspects of scrap tire pyrolysis, uncovering potential and new opportunities in this area. Your scrap, my scrap! The flow of scrap materials through international trade[20] International trade of scrap materials such as iron and steel[21] is viewed from a global perspective, highlighting the interconnectedness of countries.

Steel: price links between primary and scrap market[22] investigates the intricate price links between primary and scrap steel markets, shedding light on market dynamics.

Scrap metal scavenging: consumer market, consumer buying behavior and the environment[23] explores consumer behavior in the scrap metal scavenging sector, considering its impact on the environment. The US Copper-base Scrap Industry And Its By-products: An Overview[24] provides a comprehensive overview of the US copper-base scrap industry and its associated by-products. Finally, Global scrap trading outlook analysis for steel sustainability[25] contributes to the broader understanding of the outlook for global scrap trading, particularly focusing on sustainability in the steel industry.

This literature review offers a detailed exploration of the various challenges faced by the global scrap trading industry. It delves into the complexities of the industry's operations, including issues related to transportation, logistics, and quality control. The review also highlights the potential of innovative initiatives like "Scrap Vault," which can help address some of these challenges and lead to positive changes in the industry.

Moreover, the review underscores the importance of such initiatives, particularly in regions like Bangladesh, where the scrap trading industry faces unique challenges and requires tailored solutions. The review further emphasizes the growing global focus on enhancing efficiency, safety, and transparency in scrap trading practices. It highlights how advancements in technology and the adoption of best practices can help improve the overall sustainability and profitability of the industry while ensuring the safety of its workers and the environment.

## Chapter 3

# Methodology

### 3.1 Introduction

In the realm of software development, a methodology plays a crucial role as a systematic and structured approach that guides the planning, execution, and delivery of a project. It provides a set of principles, processes, and practices to ensure the efficient and successful development of software applications. Serving as the guiding framework orchestrating the intricate dance of project planning, execution, and delivery, the methodology essentially acts as the roadmap for shaping the entire development process, providing a systematic approach to navigate the complexities of bringing a software application to life. Agile has emerged as a prominent and widely adopted framework among various methodologies, owing to its adaptive and iterative nature. Agile methodology prioritizes flexibility, collaboration, and customer satisfaction, emphasizing incremental development and frequent iterations. This approach facilitates quick adaptation to changing requirements, fostering a dynamic and responsive development environment. In the context of the scrapVault project, the adoption of the Agile methodology signifies a commitment to delivering high-quality software collaboratively and adaptively. This ensures that the end product not only meets but exceeds the expectations of stakeholders and end-users. This introduction sets the stage for an exploration of Agile principles and practices within the specific context of the ScrapVault software development project in the forthcoming project report.

## 3.2 Necessity of Methodology

The significance of a methodology in project management cannot be overstated, as it provides a structured framework that organizes tasks, roles, and processes, ensuring clarity and consistency throughout the project lifecycle. This organized approach enhances efficiency by offering predefined workflows and best practices, minimizing the risk of errors, and streamlining team efforts. Methodologies also play a pivotal role in risk management, aiding teams in identifying potential challenges early on and implementing effective mitigation strategies.

Clear communication, adaptability, and a focus on continuous improvement are additional benefits that methodologies bring to the table. By providing a well-defined path, methodologies contribute to resource optimization, quality assurance, and ultimately, customer satisfaction. Whether following traditional project management methodologies or embracing agile approaches, having a methodology is essential for successful project outcomes, fostering a disciplined and organized approach to project execution.

The choice of Agile methodology is particularly compelling in the context of the scrapVault project. Agile's <sup>33</sup> emphasis on flexibility, collaboration, and iterative development aligns well with the dynamic nature of software development. The incremental and adaptive nature of Agile allows for quick adjustments to evolving project requirements, promoting a responsive development environment.

In addition to its adaptability, Agile <sup>38</sup> promotes close collaboration between development teams and stakeholders, ensuring that the end product not only meets but exceeds customer expectations. Agile's iterative cycles of development and continuous feedback loops contribute to a more efficient and customer-centric development process. Therefore, the decision to choose Agile for the scrapVault project is rooted in its ability to enhance flexibility, responsiveness, and overall project success in the ever-evolving landscape of software development.

### 3.3 Continuous Integration and Continuous Delivery (CI/CD)

For the "ScarpVault" project, the adoption of CI/CD is instrumental in achieving a seamless and reliable development pipeline. Developers working on various features and components can regularly commit their code changes to the version control system, triggering automated build and test processes through CI. This ensures that the codebase remains stable, and any issues are identified and addressed promptly.

The CD aspect of the process is critical for "ScarpVault" to deliver new features and updates to users efficiently. Once code changes pass the CI phase, the CD pipeline automates the deployment process, ensuring that the application is ready for release. This not only accelerates the delivery of valuable features but also minimizes the risk of errors associated with manual deployment procedures.

#### Continuous Integration (CI)

Continuous Integration (CI) is a software development practice that places a strong emphasis on integrating code changes frequently and automatically. The primary goal of CI is to ensure that the latest code changes are regularly merged into a shared repository, promoting collaboration and reducing integration issues that may arise when developers work in isolation. This practice helps to improve the quality of the codebase, reduce the time and effort required to release new features, and ultimately deliver a better product to customers.

As developers contribute to the project, CI servers automatically build and test the application, identifying any integration or unit testing failures early in the development process. This rapid feedback loop allows the team to catch and address issues promptly, ensuring the stability of the codebase and reducing the risk of critical bugs causing delays or loss of functionality. Developers can also receive immediate feedback on the impact of their code changes, which encourages them to make smaller and more frequent updates, reducing the likelihood of introducing errors into the codebase.

By automating the integration and testing process, CI helps teams to deliver higher-quality code more efficiently while fostering collaboration and communication among developers. This practice also encourages a culture of continuous improvement, as teams can quickly identify and address issues, leading to faster iteration and innovation. Overall, Continuous Integration plays a critical role in modern software development, enabling teams to deliver better products, faster, and with fewer errors.

### 29 Continuous Delivery (CD)

Continuous Delivery (CD) is a software development approach that automates the entire software release process. CD builds upon Continuous Integration (CI) by integrating automated testing and deployment. The goal of CD is to enable software teams to release new features and updates quickly and reliably.

With CD, the software release process is streamlined, reducing the likelihood of human errors. This is achieved through the automation of tasks such as code deployment, environment setup, and testing.

In the case of "ScarpVault," CD is implemented to ensure that the application can be reliably and consistently delivered to any environment, such as staging or production. The CD helps to create a deployment-ready version of the software at any given point, enabling the team to release new features or updates efficiently.

One of the key benefits of CD is that it enables software teams to deliver new features and updates to users more frequently. This is because the release process is automated, reducing the time and effort required to deploy new changes.

In summary, CD is a critical component of modern software development practices that automates the software release process, streamlines the deployment process, and helps software teams deliver new features and updates to users quickly and reliably.

## Chapter 4

### <sup>17</sup> Feasibility Study

A feasibility study encompasses an in-depth analysis that evaluates the practicality of an application, examining its financial viability, capacity to meet demand, and adaptability under mandatory circumstances. This study lays the groundwork for assessing essential ingredients and determining whether the proposed plan should proceed.

#### 4.1 Objectives of Feasibility Study

From the in-depth feasibility study conducted for our project, three pivotal dimensions have emerged, shaping the comprehensive evaluation of our plan. These three critical standards collectively contribute to a positive and holistic feasibility outlook for our project:

1. Technically Viability
2. Economically Likelihood
3. Operationally Feasibility/Organizationally Feasibility

##### 4.1.1 Technically Feasible

**Backend Development:**

**Java Spring Boot:**

Java Spring Boot is a widely used framework for constructing robust and scalable web applications. In the context of an e-commerce platform, Spring Boot simplifies backend development by employing the MVC architecture. Controllers handle incoming HTTP

requests, while service classes encapsulate business logic and repositories interact with the database using Spring Data JPA. Entities represent database tables, and DTOs facilitate data transfer between the backend and frontend. RESTful endpoints in controllers communicate with the frontend, and Swagger aids in API documentation. Spring Security enhances application security, caching improves performance, and logging with SLF4J ensures effective debugging. Unit and integration tests, along with dependency injection, contribute to the reliability and maintainability of the application. Overall, Spring Boot streamlines the development process, allowing developers to focus on implementing essential features for a successful e-commerce platform.

**Database:**

For storing crucial data in the e-commerce platform, a relational database system such as MySQL or PostgreSQL, or a NoSQL solution like MongoDB, can be employed. MySQL and PostgreSQL offer strong data consistency and reliability, making them suitable for handling structured data, while MongoDB, as a NoSQL database, provides flexibility for unstructured or semi-structured data. In the database schema, entities for products, categories, users, and orders can be defined. Products and categories may be structured with attributes like name, description, and price, while user entities encompass user-specific details like usernames, passwords, and contact information. Orders entities can store information related to customer orders, including order IDs, product quantities, and transaction details. Utilizing an appropriate database system and designing efficient entity relationships form the foundation for a robust and scalable e-commerce database, facilitating seamless data retrieval and management within the application.

**RESTful API:**

To establish effective communication between the frontend and backend of the e-commerce platform, a RESTful API architecture can be designed and implemented. This involves creating distinct endpoints to perform key actions within the system. For product management, endpoints can include functionalities for creating, retrieving, updating, and deleting products. Similarly, category management endpoints allow for the manipulation of product categories. User authentication can be facilitated through endpoints handling user registration, login, and user profile management. To support the e-commerce transaction flow, dedicated endpoints for processing and tracking orders should be implemented. Each endpoint adheres to RESTful principles, utilizing standard HTTP methods (GET, POST, PUT, DELETE) to represent different actions. Additionally, proper authentication mechanisms, such as token-based authentication, can be implemented to secure sensitive operations. By following RESTful principles and designing clear and intuitive endpoints, the API facilitates seamless communication between the



frontend and backend, enabling the e-commerce platform to perform essential actions efficiently.

#### **Authentication and Authorization:**

For robust security in the e-commerce application, it is imperative to implement user authentication and authorization mechanisms. A widely adopted solution for handling these security aspects is Spring Security. This framework seamlessly integrates with the Spring ecosystem and provides comprehensive tools for authentication, authorization, and protection against common security vulnerabilities. With Spring Security, developers can easily configure authentication providers, define user roles and permissions, and set up secure endpoints. Standard practices such as password hashing, session management, and CSRF protection can be effortlessly incorporated into the application. By leveraging Spring Security's capabilities, the e-commerce platform <sup>2</sup>can ensure that only authenticated users with the appropriate permissions can access sensitive resources or perform specific actions. This robust security infrastructure helps safeguard user data, transactions, and the overall integrity of the e-commerce system, contributing to a secure and trustworthy user experience.

#### **File Upload for Product Images:**

To enhance the visual appeal of the e-commerce platform, a feature enabling administrators to upload product images is crucial. This functionality not only enriches the user experience but also contributes to effective product representation. To implement this, administrators can utilize technologies such as Amazon S3 for storing and serving these images. Amazon S3 provides a scalable and reliable cloud storage solution, offering secure and durable object storage. By integrating the e-commerce platform with Amazon S3, administrators can seamlessly upload product images, and the platform can efficiently retrieve and serve these images to users. The use of cloud-based storage solutions like Amazon S3 ensures high availability, scalability, and efficient content delivery, enhancing the overall performance and user satisfaction of the e-commerce application. Additionally, proper access controls and permissions can be implemented on Amazon S3 to secure the uploaded images and maintain the integrity of the visual content.

#### **Frontend Development:**

##### **Frontend Framework:**

For building a responsive and dynamic user interface for the e-commerce platform, selecting a frontend framework is crucial. Among the popular choices, React, Angular, and Vue.js stand out for their capabilities in creating interactive and scalable applications. <sup>21</sup>React, developed by Facebook, is known for its component-based architecture, making



it efficient <sup>21</sup>for rendering dynamic content and managing state. Angular, maintained by Google, is a comprehensive framework offering two-way data binding and <sup>30</sup>a robust set of tools for building complex applications. Vue.js is a progressive JavaScript framework known <sup>57</sup>for its simplicity and ease of integration. The choice between these frameworks depends on factors such as project requirements, team expertise, and scalability needs.

Once a framework is selected, the user interface can be designed to facilitate seamless product browsing, category management, and user authentication. Leveraging the framework's components, developers can create a visually appealing and intuitive layout for users to explore products, navigate categories, and interact with the authentication system. Features like responsive design, smooth transitions, and real-time updates can be implemented to enhance the user experience. Additionally, integrating the chosen frontend framework with the backend RESTful APIs ensures efficient communication and data exchange between the frontend and backend components of the e-commerce application. Overall, the frontend framework serves as the foundation for a user-friendly and engaging interface, contributing to the success of the e-commerce platform.

#### API Integration:

When implementing API integration for the e-commerce platform, modern frontend frameworks and technologies such as AJAX (Asynchronous JavaScript and XML) play a crucial role in facilitating seamless communication with the backend APIs. AJAX, in conjunction with JavaScript, allows for asynchronous data retrieval from the server without requiring a page refresh. However, in contemporary web development, AJAX is often used as a concept, and frameworks like React, Angular, or Vue.js provide more robust and efficient ways to handle API communication.

For instance, in a React application, you might use the fetch API or third-party libraries like Axios to make HTTP requests to the backend APIs. Similarly, Angular employs services and the Angular HttpClient module to interact with APIs, while Vue.js integrates tools like Axios or the native fetch API.

These frameworks provide powerful features for handling asynchronous operations, managing the state, and updating the user interface based on the data received from the backend. Through well-defined endpoints in the backend API, the frontend can retrieve and send data seamlessly, enabling functionalities such as product browsing, category management, user authentication, and other dynamic interactions within the e-commerce application.

By leveraging these modern frontend frameworks and appropriate tools for API integration, <sup>41</sup>developers can ensure efficient communication between the frontend and backend

components, resulting in a responsive and dynamic user experience for the e-commerce platform.

#### **User Interface for Admin and Customers:**

Creating separate user interfaces for administrators and customers is essential to cater to their distinct needs and responsibilities. For administrators, prioritize features like a secure login, an intuitive dashboard for overseeing metrics, efficient product and category management tools, order processing capabilities, analytics for data-driven decisions, and user management functionalities. On the customer interface, emphasize user-friendly registration and authentication, an appealing product catalog with robust search and filtering options, seamless shopping cart and checkout processes, order history and tracking features, user profile management, and interactive feedback mechanisms. Both interfaces should prioritize responsive design to ensure a consistent and optimal user experience across various devices. Regular testing and feedback loops are critical to refining these interfaces and ensuring they meet the specific requirements of administrators and customers, enhancing the overall usability and effectiveness of the e-commerce platform.

#### **Additional Considerations:**

##### **Payment Integration:**

Integrating a secure and reliable payment gateway is critical to any e-commerce platform to facilitate seamless transactions. For this purpose, integrating popular payment gateways such as Bkash, Nagad, or Upai can offer users convenient and diverse payment options. Implementing a robust payment integration involves establishing secure connections, encrypting sensitive information, and adhering to industry standards for transaction security. Through the integration of these payment gateways, users can confidently make purchases, utilizing services like mobile banking and digital wallets. Additionally, ensure that the payment process is user-friendly, with clear instructions and confirmation messages. Regularly update the integration to comply with evolving security standards and provide a trustworthy and efficient payment experience for both customers and the e-commerce platform.

##### **Search Functionality:**

Incorporating an effective search functionality is pivotal for enhancing user experience on the e-commerce platform. The search feature should be prominently placed and user-friendly, allowing customers to easily find products. Utilize technologies such as Elasticsearch or integrate search functionalities provided by relational databases to enable fast and accurate product retrieval. Implement features like autocomplete suggestions,

filtering options, and sorting capabilities to refine search results. Additionally, consider incorporating natural language processing or fuzzy search algorithms to account for potential spelling errors or variations in user queries. Optimize the search algorithm for relevance, taking into account product names, descriptions, and other relevant attributes. Regularly assess and fine-tune the search functionality based on user feedback and search analytics, ensuring it remains a valuable tool for customers navigating the diverse range of products offered on the platform.

**Order Processing:**

Efficient order processing is a key aspect of the e-commerce platform's functionality. Begin by creating a user-friendly workflow for placing orders, ensuring a seamless experience from product selection to checkout. Implement secure payment gateways to facilitate smooth transactions. Upon order completion, send immediate and clear order confirmation notifications to customers, providing details such as order numbers and estimated delivery times. Develop robust backend workflows to handle order fulfillment, including inventory management and shipping logistics. Enable customers to track their orders in real-time through a dedicated order tracking system, offering insights into the current status and anticipated delivery dates. Regularly update customers on any changes to their orders, such as shipping updates or delays. This end-to-end order processing workflow contributes significantly to customer satisfaction and builds trust in the reliability of the e-commerce platform.

**Email Notifications:**

Implementing a comprehensive email notification system is crucial for keeping customers informed and engaged throughout the order process on the e-commerce platform. Configure the system to send immediate email notifications upon order confirmation, providing customers with a summary of their purchase, order details, and estimated delivery times. As the order progresses, send shipment updates, including tracking information and expected delivery dates. Additionally, use email notifications to communicate any changes to the order status, such as delays or successful delivery. Design these emails to be visually appealing, clear, and concise, ensuring they provide valuable information without overwhelming the recipient. By offering timely and relevant email notifications, the e-commerce platform enhances transparency, builds trust with customers, and contributes to an overall positive customer experience. Regularly assess and refine the content and frequency of email notifications based on customer feedback and preferences.

**Security:**

Ensuring robust security measures is paramount in the development of an e-commerce platform. Implementing secure coding practices involves adhering to industry standards

and frameworks, such as those provided by organizations like OWASP. Validating inputs from users is a fundamental step <sup>58</sup> to prevent common vulnerabilities like SQL injection and cross-site scripting. Apply proper data encryption techniques, especially for sensitive information such as user credentials and payment details. <sup>2</sup> Regularly update and patch software dependencies to address known vulnerabilities. Utilize tools like HTTPS, secure cookies, and content security policies to protect against various forms of attacks. Implement <sup>2</sup> role-based access control <sup>40</sup> to restrict unauthorized access to sensitive functionalities. Conduct thorough security audits and penetration testing to identify and address potential vulnerabilities proactively. By adopting a holistic security approach, the e-commerce platform can safeguard user data, build trust, <sup>2</sup> and maintain the integrity of the system in the face of evolving cyber threats. Regularly staying <sup>2</sup> informed about the latest security best practices and updating security measures accordingly is essential to stay ahead of potential risks.

**Scalability:**

Scalability is a critical consideration in designing the architecture of the e-commerce platform to accommodate potential growth in both user base and product offerings. Employ a modular and distributed architecture that allows for horizontal scaling, enabling the seamless addition of resources such as servers or containers to handle increased demand. Utilize cloud services, like AWS or Azure, to leverage elastic computing resources that can dynamically scale based on traffic patterns. Optimize database design, implement caching mechanisms, and employ content delivery <sup>26</sup> networks (CDNs) to ensure efficient data retrieval and minimize latency. Implement <sup>26</sup> load balancing to distribute incoming traffic evenly across multiple servers, preventing performance bottlenecks. Regularly monitor system performance and conduct stress testing to identify potential limitations and optimize as needed. A scalable e-commerce system ensures that the platform can gracefully handle growth, deliver a responsive user experience, and maintain reliability even during peak usage periods.

**Testing:**

Implementing rigorous testing processes, encompassing both unit testing and integration testing is indispensable for ensuring the reliability and stability of the e-commerce application. Unit testing involves testing individual components or functions in isolation to validate their correctness. By employing testing frameworks such as JUnit for Java-based applications, developers can systematically assess each unit's behavior under various scenarios. Integration testing, on the other hand, evaluates the interactions between different components to ensure seamless collaboration within the system. Automated testing tools and frameworks, such as Selenium for frontend testing, facilitate the

creation of comprehensive test suites. Continuous integration (CI) practices can be integrated into the development pipeline to automatically execute tests upon code changes, providing rapid feedback to developers. These testing practices not only identify and rectify bugs early in the development process but also contribute to the overall stability and reliability of the e-commerce application, ultimately enhancing its performance and user satisfaction.

**Deployment:**

Deploying the e-commerce application on a cloud platform, such as AWS, Azure, or Google Cloud, offers significant advantages in terms of scalability, reliability, and overall performance. Leveraging cloud services allows for dynamic scaling of resources based on demand, ensuring the platform can handle varying user loads efficiently. Cloud providers offer a range of services such as serverless computing, load balancing, and managed databases that streamline deployment and maintenance efforts. Additionally, deploying on a cloud platform enhances reliability by distributing the application across multiple data centers and regions, reducing the risk of downtime due to server failures or geographical outages. Continuous monitoring and automated scaling capabilities inherent in cloud environments contribute to improved system performance. Moreover, cloud platforms often provide security features, compliance certifications, and backup solutions, enhancing the overall resilience and security posture of the e-commerce application.

**Monitoring and Analytics:**

Establishing a robust monitoring and analytics infrastructure is crucial for the success of the e-commerce application. Implement monitoring tools that provide real-time insights into system performance, server health, and application responsiveness. Services like New Relic, Prometheus, or AWS CloudWatch can offer comprehensive visibility into various components of the system. Simultaneously, integrate analytics tools such as Google Analytics or Mixpanel to track user behavior, preferences, and interactions within the platform—these analytics help in understanding user journeys, identifying popular products, and optimizing the user experience. By setting up alerts for critical performance metrics, the development team can proactively address issues, ensuring minimal downtime and optimal system responsiveness. Regularly analyze both monitoring and analytics data to make informed decisions for system enhancements, feature improvements, and overall user satisfaction. This data-driven approach contributes to the continuous improvement and adaptability of the e-commerce application in response to evolving user needs and changing market dynamics.

**Legal and Compliance:**



Ensuring legal and regulatory compliance is paramount in the development and operation of the e-commerce application. Adhere to data protection laws, such as GDPR or CCPA, to safeguard customer information and privacy. Communicate terms of service, refund policies, and any applicable taxes to users. Implement secure payment gateways and adhere to PCI DSS standards to protect financial transactions. Additionally, comply with local and international e-commerce regulations, including consumer protection laws and electronic commerce directives. Stay informed about changes in legislation and promptly update the platform to align with new requirements. Regularly audit and assess compliance measures to mitigate legal risks and build trust with users. A proactive approach to legal and regulatory considerations not only ensures the integrity of the e-commerce platform but also establishes a foundation for sustainable and responsible business practices.

#### 4.1.2 Economically Feasible

The economic viability of an e-commerce platform hinges on a multifaceted approach that encompasses strategic planning, meticulous execution, and adaptive strategies. Thorough market research is foundational, enabling the identification of target audiences, market trends, and potential competitors. Crafting a well-defined revenue model that aligns with the products or services offered is essential, whether through product sales, subscription services, or transaction fees. Managing a balanced cost structure, including development, maintenance, marketing, and operational expenses, is crucial to sustaining profitability. Effective marketing and customer acquisition strategies, incorporating digital marketing, SEO, and social media presence, are key to driving traffic and sales. Scalability considerations are vital, anticipating and accommodating growth in user traffic and product offerings. Establishing partnerships, ensuring legal compliance, and staying attuned to economic trends further contribute to the economic viability of the e-commerce platform. Regularly reassessing and adapting business strategies based on market feedback and evolving economic conditions are integral to long-term success.

**Here are key economic considerations:**

##### **Market Research:**

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Conduct thorough market research to understand the demand for the products you plan to sell. Identify your target audience, analyze competitors, and assess market trends.

##### **Revenue Model:**

Conducting comprehensive market research is a foundational step in the development of a successful e-commerce platform. This process involves gaining a profound understanding of the demand for the intended products or services. Identifying the target audience is paramount, requiring a thorough examination of demographic, psychographic, and behavioral factors. Analyzing competitors in the market helps in gauging their strengths, weaknesses, and unique value propositions, providing valuable insights for differentiation. Additionally, assessing market trends, such as emerging technologies, changing consumer preferences, and industry innovations, aids in adapting the business model to meet evolving demands. Utilizing tools like surveys, focus groups, and data analytics enables the collection of meaningful data, which can inform strategic decisions, product offerings, and marketing strategies. This meticulous market research forms the groundwork for a well-informed and customer-centric approach, enhancing the likelihood of the e-commerce platform's success in a competitive landscape.

**Cost Structure:**

Identifying and analyzing the cost structure is crucial for establishing a sustainable e-commerce platform. Development costs encompass expenses related to software development, website design, and any technology required for the platform. Maintenance costs involve ongoing updates, bug fixes, and enhancements to ensure the platform's functionality and security. Hosting costs may vary depending on the chosen cloud provider or hosting service. Marketing expenses cover strategies to promote the platform, including digital marketing, advertising, and promotional campaigns. Payment processing fees are essential considerations, as they impact the overall revenue. Customer support costs, including personnel, software tools, and infrastructure, are vital for ensuring positive user experiences. A detailed understanding of the cost structure allows for effective budgeting, pricing strategies, and profit margin calculations. Regularly revisiting and optimizing the cost structure based on performance and growth metrics is essential to maintain economic viability and competitiveness in the dynamic e-commerce landscape.

**Profit Margins:**

Determining competitive and sustainable profit margins is a critical aspect of crafting a successful pricing strategy for the e-commerce platform. To ensure economic viability, it's imperative to factor in all costs, including development, maintenance, hosting, marketing, payment processing fees, and customer support. By understanding the total cost per product, businesses can set profit margins that not only cover expenses but also align with market expectations and remain competitive. Pricing strategies should consider a balance between offering value to customers and achieving profitability. Regularly evaluate and adjust pricing models based on market dynamics, competitor pricing, and customer feedback. Implementing dynamic pricing strategies, such as discounts,

promotions, and bundling, can further enhance the competitiveness of the e-commerce platform while maintaining healthy profit margins. Continuous monitoring of the market and adapting pricing strategies accordingly ensures that the platform remains economically viable and responsive to evolving market conditions.

#### **Marketing and Customer Acquisition:**

Allocating a dedicated budget for marketing and customer acquisition is essential for the success of an e-commerce venture. Successful customer acquisition often relies on a strategic combination of digital marketing, social media presence, and search engine optimization (SEO). Digital marketing campaigns, including pay-per-click (PPC) advertising, email marketing, and influencer collaborations, can effectively target and reach potential customers. Establishing a strong social media presence on platforms relevant to the target audience enhances brand visibility and engagement. Additionally, investing in SEO strategies ensures that the e-commerce platform ranks prominently in search engine results, driving organic traffic. Regularly analyze the performance of marketing channels, adjust strategies based on customer behavior and feedback, and optimize campaigns to maximize return on investment. A well-planned and executed marketing and customer acquisition strategy not only attracts new customers but also contributes to brand loyalty and sustained growth in the competitive e-commerce landscape.

#### **User Acquisition and Retention:**

Strategizing user acquisition and retention is pivotal for the sustained growth and success of the e-commerce platform. Attracting new customers can be achieved through targeted marketing campaigns, promotions, and user-friendly onboarding processes. Implementing loyalty programs and offering discounts or exclusive deals for repeat customers incentivizes retention. Exceptional customer service, characterized by responsiveness, problem resolution, and personalized interactions, plays a key role in fostering customer loyalty. Regularly engage with customers through newsletters, personalized recommendations, and feedback surveys to understand their preferences and expectations. Analyzing user behavior and purchasing patterns enables the customization of promotions and services, enhancing the overall user experience. By creating a seamless balance between attracting new users and fostering loyalty, the e-commerce platform can cultivate a thriving and enduring customer base, driving sustained success in the competitive market.

#### **Payment Processing:**

Evaluating the costs associated with payment processing is a crucial aspect of managing the overall financial health of an e-commerce platform. Transaction fees imposed by payment gateways can significantly impact profit margins. It's essential to carefully



analyze the fee structures of chosen payment gateways, considering both fixed fees per transaction and variable percentages of the transaction amount. Different payment methods, such as credit cards, digital wallets, or other regional payment options, may incur varying fees. By understanding these costs, businesses can implement pricing strategies that not only cover these fees but also maintain competitive product pricing in the market. Additionally, exploring partnerships or negotiating favorable terms with payment service providers can help optimize transaction costs. Regularly reviewing and reassessing payment processing costs in tandem with sales performance ensures that the e-commerce platform maintains a healthy balance between revenue generation and cost management.

**Scalability:**

Planning for scalability is fundamental to accommodating the anticipated growth in user traffic and product listings for an e-commerce platform. Adopting a cloud-based infrastructure, such as AWS, Azure, or Google Cloud, allows for efficient scaling without incurring a proportional increase in costs. <sup>9</sup> Utilize auto-scaling features to dynamically adjust computing resources based on demand, ensuring optimal performance during peak periods without over-provisioning during lulls. Implement a modular and distributed architecture <sup>55</sup> that allows for horizontal scaling, enabling the addition of servers or containers as needed. Leverage Content Delivery Networks (CDNs) to distribute content globally, reducing latency and enhancing user experience. Regularly conduct stress testing to identify potential bottlenecks and optimize the system architecture accordingly. By proactively addressing scalability concerns and aligning infrastructure choices with the anticipated growth trajectory, the e-commerce platform can seamlessly handle increased user traffic and product listings while maintaining efficiency and cost-effectiveness.

**Partnerships and Suppliers:**

Establishing strong relationships with reliable suppliers is a critical component of efficient supply chain management, directly influencing the overall economic viability of the e-commerce platform. Carefully select suppliers based on factors such as product quality, reliability, and the ability to meet demand fluctuations. Negotiating favorable terms, including pricing, bulk discounts, and flexible payment terms, can significantly impact the cost structure and profit margins. Regular communication and collaboration with suppliers foster transparency and responsiveness, ensuring <sup>8</sup> timely deliveries and minimizing stockouts. Implementing technology solutions, such as inventory management systems, that enable real-time tracking of stock levels and reorder points enhances supply chain efficiency. By building robust partnerships and optimizing supply chain processes, the e-commerce platform can enhance its economic viability, providing a competitive edge in

the dynamic market landscape. Regularly reassessing supplier relationships and adapting strategies based on market dynamics contribute to a resilient and responsive supply chain.

#### **Legal and Regulatory Compliance:**

Understanding and complying with legal and regulatory requirements is paramount for the sustainable operation of an e-commerce platform across various regions. Adhering to data protection laws, such as GDPR in the European Union or CCPA in California, ensures the secure handling of customer information, contributing to trust and credibility. Compliance with consumer protection laws is essential for transparent business practices, including accurate product descriptions, fair pricing, and clear terms of service. Understanding taxation regulations is crucial for the proper handling of sales taxes and ensuring compliance with regional tax laws. Regularly staying informed about updates and changes in regulations, both domestically and internationally, and promptly adapting the platform to align with new requirements, demonstrates a commitment to ethical business practices and legal compliance. Proactive engagement with legal counsel to navigate complex regulatory landscapes further safeguards the e-commerce platform from legal risks and contributes to its long-term success.

#### **Technological Infrastructure:**

Evaluating the ongoing costs associated with maintaining and upgrading technological infrastructure is crucial for the sustained performance and security of the e-commerce platform. Cloud hosting costs, including compute resources, storage, and data transfer, should be regularly assessed to ensure scalability and cost-efficiency. Budget for software updates and licensing fees to keep the platform running on the latest versions, benefiting from enhanced features, security patches, and performance optimizations. Implementing robust security measures, such as regular vulnerability assessments, encryption protocols, and intrusion detection systems, incurs ongoing expenses but is essential for safeguarding customer data and maintaining trust. Regularly reviewing and optimizing these costs allows for strategic budgeting, ensuring that the technological infrastructure remains resilient, up-to-date, and capable of adapting to evolving market demands while maintaining an optimal balance between performance and cost-effectiveness.

#### **Economic Trends:**

Vigilantly monitoring economic trends is crucial for anticipating and responding to shifts in consumer spending patterns, particularly in the dynamic landscape of e-commerce. External factors like economic downturns, changes in employment rates, or alterations in consumer behavior can significantly impact the success of an e-commerce platform. During economic fluctuations, consumer priorities and spending habits may transform,

necessitating agile strategies in marketing, pricing, and product offerings. Staying informed about economic indicators, market reports, and emerging trends enables the e-commerce platform to proactively adapt to evolving consumer needs, adjust pricing models, and tailor marketing campaigns. This adaptability not only helps navigate challenges posed by economic uncertainties but also positions the platform to capitalize on emerging opportunities in the ever-changing market. Regularly assessing economic trends provides valuable insights that empower strategic decision-making for sustained growth and resilience.

#### **Return on Investment (ROI):**

Monitoring and evaluating the Return on Investment (ROI) across various aspects of the business is critical for long-term success. Regularly assess the effectiveness of marketing campaigns, considering metrics such as customer acquisition costs, conversion rates, and customer lifetime value. Evaluate the ROI of technology investments, including software updates, security measures, and infrastructure enhancements, to ensure they align with business objectives and contribute to efficiency gains. Analyze overall business operations, including supply chain management and partnerships, to identify areas for improvement and optimization. By maintaining a continuous feedback loop and leveraging analytics tools, the e-commerce platform can make data-driven decisions, refine strategies, and maximize ROI across the entire business ecosystem. This iterative process fosters adaptability and positions the platform to thrive in a competitive market landscape.

#### **Adaptability:**

Adaptability is paramount in the dynamic landscape of the e-commerce industry. Being prepared to pivot and innovate in response to changing market conditions is essential for the long-term economic viability of the platform. E-commerce, influenced by technological advancements, consumer behaviors, and market trends, requires a proactive approach to stay relevant. Regularly assess customer feedback, monitor emerging technologies, and stay informed about industry trends to identify opportunities for improvement and innovation. Embrace flexibility in business strategies, product offerings, and marketing approaches. By cultivating a culture of adaptability, the e-commerce platform can not only navigate challenges effectively but also position itself to capitalize on new opportunities, ensuring sustained success in the ever-evolving e-commerce ecosystem.

### 4.1.3 Operationally Feasible

Operational feasibility refers to the practicality and viability of implementing a proposed system or project within the existing organizational structure and processes. In the context of an e-commerce platform, achieving operational feasibility involves ensuring that the platform can be effectively integrated into the day-to-day operations of the business. This includes evaluating the compatibility of the e-commerce system with existing business processes, personnel capabilities, and organizational workflows. Key considerations for operational feasibility include assessing the readiness of staff to adapt to new technologies, the ease of system integration with current tools and databases, and the impact on overall business efficiency. An operationally feasible e-commerce platform is one that seamlessly aligns with existing practices, minimizes disruptions, and enhances the overall operational efficiency of the business.

#### **System Functionality:**

System functionality is paramount in ensuring the effective operation of an e-commerce platform. The system should seamlessly meet the operational requirements of the business by facilitating core functions such as smooth product listing, intuitive order processing, and efficient inventory management. A well-designed product listing system allows administrators to easily add, edit, and manage product information, ensuring a comprehensive and attractive presentation to customers. Streamlined order processing features should enable users to make purchases with ease, providing a seamless and secure checkout process. Effective inventory management tools ensure accurate tracking of stock levels, reducing the risk of stockouts or overstock situations. The e-commerce system's functionality extends to providing a user-friendly interface for both administrators and customers, enhancing overall operational efficiency and contributing to a positive user experience. Regular testing and continuous improvement of system functionality are essential for adapting to changing business needs and ensuring the long-term success of the e-commerce platform.

#### **User-Friendliness:**

Designing a user-friendly interface is paramount for the success of an e-commerce platform, catering to both administrators and customers. For administrators, an intuitive and well-organized dashboard with clear navigation menus and easily accessible functionalities is crucial. This facilitates efficient management of products, categories, orders, and user data, reducing operational complexities and enhancing productivity. Similarly, for customers, the user interface should prioritize intuitive navigation, clear product categorization, and a straightforward checkout process. Implementing features like search

functionality, filters, and a visually appealing design contributes to a positive user experience. User-friendly interfaces not only enhance satisfaction but also reduce the learning curve for administrators and customers alike, fostering engagement and loyalty. Regular usability testing and feedback collection are essential for refining the interface and ensuring that it aligns with user expectations and operational needs.

#### Performance and Scalability:

Performance and scalability are critical aspects of an e-commerce platform's success. Rigorous testing should be conducted to evaluate the system's ability to handle a substantial number of concurrent users without compromising speed or functionality. Performance testing, including stress testing and load testing, helps identify potential bottlenecks and ensures that the platform can deliver a responsive and seamless experience during peak usage periods. Additionally, scalability assessments should be carried out to confirm that the platform can efficiently grow and adapt to increased user traffic and expanding product listings. Leveraging technologies like cloud hosting, load balancing, and efficient caching mechanisms can enhance scalability. Regular monitoring and optimization based on performance metrics contribute to maintaining a high-performing and scalable e-commerce platform that can reliably meet the demands of a growing user base.

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#### Integration with Existing Systems:

Integrating the e-commerce platform with existing systems, such as Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM), is a strategic move to streamline operations and enhance the flow of data across the organization. This integration enables seamless communication between different business functions, ensuring that data is consistent and up-to-date across all systems. For instance, integrating with an ERP system can improve inventory management, order processing, and overall business efficiency by synchronizing data between the e-commerce platform and the backend operations. Integration with CRM systems enhances customer engagement, allowing for a holistic view of customer interactions and preferences. This interoperability not only reduces manual data entry and the risk of errors but also fosters a more cohesive and efficient organizational workflow, contributing to enhanced productivity and a unified customer experience.

**Security Measures:** To ensure the integrity and confidentiality of the e-commerce platform, a comprehensive approach to security is paramount. Robust measures, including SSL encryption, should be implemented to safeguard customer data and transaction information, protecting them from potential unauthorized access or cyber threats. Utilizing secure payment gateways adds a layer of protection during financial transactions,



reassuring users about the safety of their sensitive information. <sup>13</sup> Compliance with data protection regulations, such as GDPR or CCPA, is essential, emphasizing responsible and lawful handling of customer data. Regular security audits, updates, and employee training further fortify the system against emerging threats. By prioritizing these security measures, the e-commerce platform not only ensures the trust of its user base but also aligns with industry best practices, promoting a secure and reliable online shopping experience.

**Inventory Management:**

Efficient inventory management is pivotal for the smooth operation of an e-commerce platform. Developing robust inventory management systems is essential to accurately track stock levels, automate reordering processes, and mitigate challenges like stock-outs or overstocking. Implementing real-time monitoring enables businesses to maintain optimal stock levels, preventing scenarios where products are either unavailable or excess inventory ties up capital. Automation of reordering processes, triggered by predefined stock thresholds, enhances operational efficiency and ensures that popular products remain in stock. Utilizing technology such as barcode scanning, RFID, or inventory management software contributes to accurate tracking and timely replenishment. By establishing efficient inventory management systems, the e-commerce platform can optimize its supply chain, improve order fulfillment, and enhance overall customer satisfaction by consistently providing the desired products on time.

**Order Fulfillment:**

Implementing effective order fulfillment processes is crucial for the overall success of an e-commerce platform. This involves optimizing order picking, packing, and shipping operations to ensure timely and accurate deliveries to customers. Leveraging technology such as order management systems and barcode scanning can enhance the efficiency of these processes, reducing errors and increasing order accuracy. Integration with logistics partners provides an opportunity to streamline shipping workflows, allowing for real-time tracking and efficient management of the delivery chain. Additionally, considering various shipping options, such as standard, express, or same-day delivery, allows the e-commerce platform to cater to diverse customer preferences. By prioritizing smooth order fulfillment, the platform not only meets customer expectations but also establishes a reputation for reliability and efficiency in the competitive e-commerce landscape. Regularly evaluating and optimizing these processes contributes to a seamless and positive customer experience.

**Customer Support:**

Establishing a robust customer support system is crucial for providing excellent service and building customer trust in an e-commerce platform. This involves implementing efficient mechanisms to handle customer inquiries, complaints, and returns. Integrating a customer support ticketing system enables the systematic tracking and resolution of customer issues, ensuring timely responses and effective communication. Additionally, incorporating chatbots with artificial intelligence can enhance the responsiveness of customer support by providing instant assistance for frequently asked questions or common concerns. Proactive communication, personalized interactions, and a user-friendly interface contribute to a positive customer experience. Regularly monitoring customer support performance metrics and gathering feedback allows for continuous improvement, ensuring that the e-commerce platform remains responsive to customer needs and maintains a high standard of service excellence.

## 4.2 Requirements Analysis:

Requirement analysis is a pivotal process in our project, involving the comprehensive collection of relevant data to construct an obligation model suited for the complexity of e-commerce. This iterative process encompasses a deep understanding of the domain, gathering and cataloging requirements, structuring the acquired information, resolving conflicts, prioritizing, and verification. Through a multi-faceted approach, we have gathered essential information for analysis, leveraging interviews with key individuals, direct observation of existing procedures, examination of brochures, and the utilization of information questionnaires. In this step, we aim to establish the relevance of the gathered information to our specific development process. The focus of our condition study centers around the "WEBSITE," with a keen emphasis on extracting insights that will guide the development of a robust and user-friendly e-commerce platform.

### System Functionality

The core system functionality of the E-Commerce Platform centers around three key pillars: product listing, order processing, and inventory management. A seamless product listing mechanism allows administrators to efficiently showcase, categorize, and update products, while customers can easily browse and select items for purchase. The order processing system ensures a smooth and secure checkout experience, providing users with a streamlined pathway to complete transactions. Concurrently, robust **inventory management systems** maintain **real-time tracking of stock levels**, automate **reordering processes**, and prevent potential issues such as stockouts or overstocking. These functionalities are presented through responsive and user-friendly interfaces tailored for both administrators and customers. Administrators benefit from intuitive dashboards and

management tools, simplifying tasks like product updates and order tracking. Customers experience an interface designed for easy navigation, clear product categorization, and a straightforward checkout process, enhancing overall user satisfaction. The entire system is built upon a secure and scalable architecture, prioritizing data protection, system reliability, and adaptability to accommodate potential future growth in users and products. This comprehensive approach ensures that the E-Commerce Platform not only meets the immediate needs of users but also lays a foundation for sustained success in the dynamic e-commerce landscape.

### Security Measures

<sup>45</sup> The E-Commerce Platform prioritizes robust security measures to safeguard user data, transactions, and overall system integrity. Firstly, SSL encryption is implemented to ensure the secure transmission of data between users and the platform. This encryption mechanism establishes a secure and encrypted connection, preventing unauthorized access to sensitive information. Secure payment gateways are integrated to facilitate safe financial transactions, ensuring that user payment details are handled with the highest level of security. Additionally, the platform adheres to strict compliance with data protection <sup>2</sup> regulations such as GDPR or CCPA. This commitment ensures that customer data is handled ethically, transparently, and following legal requirements, fostering trust and confidence among users. By combining <sup>2</sup> SSL encryption, secure payment gateways, and compliance with data protection regulations, the E-Commerce Platform establishes a robust security framework, providing users with a secure and trustworthy environment for their online transactions and interactions.

### Scalability

The E-Commerce Platform embraces a scalable architecture, leveraging a cloud-based infrastructure for dynamic scaling to efficiently accommodate fluctuations in user traffic and evolving product listings. By utilizing cloud services, such as AWS, Azure, or Google Cloud, the platform ensures flexibility and scalability <sup>2</sup> without the need for significant upfront investments in physical hardware. <sup>59</sup> This cloud-based approach allows for seamless horizontal scaling, enabling the addition of resources based on demand, ensuring optimal performance during peak usage periods without incurring unnecessary costs during periods of lower activity. Additionally, the platform undergoes regular performance testing to assess scalability and identify potential bottlenecks. Through proactive monitoring and optimization, the E-Commerce Platform is positioned to adapt and grow in tandem with user demands, providing a responsive and reliable shopping experience while maintaining cost-effectiveness and operational efficiency.

### Integration with Existing Systems



The E-Commerce Platform prioritizes seamless integration with existing <sup>53</sup>Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) systems to enhance operational efficiency. This integration enables a cohesive and synchronized flow of data between the e-commerce platform and internal business processes, streamlining various operational aspects. Integration with ERP systems facilitates efficient management of resources, such as inventory and order fulfillment, ensuring that the e-commerce platform aligns seamlessly with broader organizational workflows. On the customer-facing side, CRM integration contributes to personalized customer interactions by providing a consolidated view of customer data, purchase history, and preferences. This integrated approach not only reduces manual data entry, minimizes errors, and accelerates business processes but also fosters a more connected and responsive operational ecosystem, optimizing the overall efficiency and effectiveness of the E-Commerce Platform.

### User-Friendliness

User-friendliness is at the forefront of the design philosophy for the E-Commerce Platform, ensuring a positive experience for both administrators and customers. Administrators benefit from an intuitive and well-organized interface that facilitates efficient navigation through product management, order processing, and other administrative tasks. The dashboard provides clear access to essential functionalities, simplifying the process of product listing, inventory management, and order tracking. For customers, the platform <sup>8</sup>boasts a user-friendly interface designed for intuitive navigation, transparent product categorization, and a straightforward checkout process. Clear and concise functionalities are presented through an aesthetically pleasing and responsive design, allowing users to easily browse, select, and purchase products with minimal effort. By prioritizing user-centric design principles, the E-Commerce Platform ensures that both administrators and customers can engage with the platform seamlessly, fostering efficiency and enhancing overall satisfaction with the online shopping experience.

### Order Fulfillment

Order fulfillment is a critical aspect of the E-Commerce Platform, emphasizing efficiency and precision in the entire process. The system is designed to ensure effective order picking, packing, and shipping, streamlining operations to fulfill customer orders promptly and accurately. Leveraging technology and optimized workflows, the platform minimizes errors in order processing and enhances overall order accuracy. To further enhance operational efficiency, the E-Commerce Platform integrates with logistics partners. This integration facilitates seamless communication and coordination throughout the shipping process, allowing for real-time tracking, efficient handling of packages, and

timely deliveries. By combining effective order fulfillment practices with strategic partnerships, the platform aims to provide customers with a reliable and satisfying shopping experience while maintaining operational excellence.

### **Customer Support**

The E-Commerce Platform places a strong emphasis on customer support, recognizing its significance in delivering a positive user experience. The platform implements efficient customer support systems, incorporating features such as ticketing systems and chatbots. The ticketing system allows users to submit inquiries or concerns, providing a structured and trackable way to address and resolve issues promptly. Additionally, chatbots are employed to offer instant assistance and address frequently asked questions, enhancing the responsiveness of customer support. These customer-centric features aim to provide users with multiple channels for seeking assistance, ensuring that their queries are addressed in a timely and effective manner. By prioritizing robust customer support mechanisms, the E-Commerce Platform aims to foster customer satisfaction, build trust, and create a supportive environment for users engaging with the platform.

## **4.3 Technical Viability**

The technical viability of the E-Commerce Platform is underpinned by a carefully selected and integrated technology stack. Leveraging Java Spring Boot as the backend framework ensures efficient and scalable application development, while a choice between MySQL, PostgreSQL, or MongoDB for the database caters to diverse data storage needs. The use of RESTful APIs facilitates seamless communication between the frontend and backend, creating a standardized and scalable approach. Robust user authentication and authorization are achieved through Spring Security, ensuring the protection of sensitive information. Efficient file upload and storage for product images are ensured with the integration of Amazon S3. The platform's integration with selected payment gateways like Bkash, Nagad, or Upi ensures secure and diverse transaction options. Cloud-based infrastructure, with options like AWS, Azure, or Google Cloud, guarantees scalability and adaptability to varying levels of user demand. Altogether, these technical features contribute to the viability of the platform by fostering performance, security, and flexibility, meeting the evolving needs of an efficient and competitive e-commerce ecosystem.

### 4.3.1 Technology Stack

The technology stack chosen for the E-Commerce Platform has been meticulously crafted to provide a strong and stable foundation for development. With its scalability and security features, this chosen technology stack is capable of handling high levels of traffic and data storage, ensuring a seamless and secure shopping experience for customers. By leveraging the latest technologies and frameworks, the E-Commerce Platform is poised to support rapid development and innovation, delivering a cutting-edge shopping experience to customers.

#### Backend Framework (Java Spring Boot):

Java Spring Boot is a popular and powerful framework used for building robust and scalable applications in Java. It offers a wide range of features that simplify the development process, such as dependency injection, easy configuration, and built-in support for various databases and web technologies. Its lightweight design allows for faster application development and deployment, making it a top choice for developers who value efficiency and ease of use. Overall, Java Spring Boot is an excellent tool for building high-performance and reliable applications that can handle complex business logic and large-scale data processing.

#### Database (MySQL/PostgreSQL/MongoDB)

When it comes to choosing a database management system, the decision largely depends on the type of data you are working with and the specific needs of your project. There are several options available, including MySQL, PostgreSQL, and MongoDB, each with its strengths and weaknesses.

MySQL and PostgreSQL are both relational databases, which means they store data in tables with predefined relationships between them. This structure makes them well-suited for complex data that requires strict organization and consistency.

MongoDB, on the other hand, is a NoSQL database, which allows for more flexible data storage solutions. Instead of using tables, MongoDB uses a document-based model, allowing for easier scalability and faster data retrieval.

Ultimately, the choice between these database systems will depend on your specific needs and the type of data you are working with. It's important to carefully consider each option before deciding to ensure your data is stored and managed effectively.

### API Communication (RESTful APIs)

<sup>67</sup> RESTful APIs (Representational State Transfer Application Programming Interfaces) are designed to provide a consistent and scalable approach to data exchange between the frontend and backend of web applications. They enable developers to create web services that can be accessed by other applications or systems, making it easier to share data and integrate different parts of the application. The use of RESTful APIs facilitates a seamless communication process between the client and server, resulting in faster data transfer and improved user experience.

### Authentication (Spring Security)

Spring Security is a powerful and versatile framework that provides a robust and customizable security layer for user authentication and authorization. It offers a wide range of features such as protection against common web application vulnerabilities, integration with various authentication mechanisms, support for various security protocols, and much more, making it an ideal choice for securing modern web applications.

### Frontend Framework (Thymeleaf/React/Angular/Vue.js)

Selecting the perfect frontend framework for a project is a crucial decision that depends on the specific requirements of the project. If you need a server-side templating engine, Thymeleaf is an excellent choice. However, if you want to create highly interactive and dynamic user interfaces, React, Angular, and Vue.js are the most popular frameworks for achieving this. Each of these frameworks has its unique features and benefits, <sup>2</sup> so it's essential to carefully evaluate your project's needs before making a final decision.

**File Storage (Amazon S3 for product images)** Amazon S3 is a reliable and secure cloud storage service that provides businesses with a highly efficient and scalable solution for storing and serving product images. By leveraging Amazon S3's advanced features and capabilities, businesses can easily manage and access their image files across the platform. This ensures a seamless and consistent user experience, regardless of the device or platform being used. Whether it's for a small business or a large enterprise, Amazon S3 <sup>2</sup> provides a cost-effective and flexible solution for storing and serving product images.

### Payment Integration (BKash/Nagad/Upai)

By integrating with widely-used payment gateways such as BKash, Nagad, and Upai, you can provide your users with a seamless and secure payment experience. This not only ensures efficient transaction processing but also accommodates the diverse payment preferences of your customers. Whether they prefer to use mobile payment services or

other payment methods, integrating with these popular gateways can help you provide a more convenient and trustworthy payment experience for your users.

#### Scalability (Cloud-based infrastructure - AWS, Azure, or Google Cloud)

Adopting a cloud-based infrastructure, whether on AWS, Azure, or Google Cloud, ensures dynamic scalability, allowing the platform to adapt seamlessly to varying levels of user demand. This approach provides cost-effectiveness, reliability, and global accessibility.

By combining these technologies, the E-Commerce Platform aims to deliver a high-performing, secure, and scalable solution that meets the evolving needs of users and the demands of the competitive e-commerce landscape.

### 4.3.2 Key Technical Features

The e-commerce platform has been developed with a set of crucial technical features that are specifically designed to offer a smoother, more secure, and user-friendly online shopping experience. Some of the key technical features include advanced search and filtering options, secure payment gateways, responsive web design, and user-friendly navigation. These features work together seamlessly to help customers find what they are looking for quickly, make secure payments, and navigate through the site with ease. Additionally, the platform is built with the latest security protocols to ensure that customer data and payment information are kept safe and secure at all times.

#### Seamless RESTful API Communication

The platform has been designed to establish a seamless communication channel between the frontend and backend by leveraging the RESTful APIs. This technology brings a standardized approach to data exchange, allowing for efficient and effective communication between the two layers of the application. By implementing RESTful APIs, the platform facilitates the creation of dynamic and responsive user interfaces, enabling users to interact with the application more intuitively and interactively. Moreover, this technology ensures that any changes made to the frontend or backend do not disrupt the functionality of the other layer, resulting in a stable and reliable application.

#### Robust User Authentication and Authorization

The platform has a highly secure system for user authentication and authorization, powered by Spring Security. This system is designed to protect sensitive data and control access to various functionalities of the platform based on the roles assigned to users. For instance, a user with administrative privileges will have access to features



and data that a regular user may not have. This helps ensure that users can only access the areas of the platform that they are authorized to use, thus reducing the risk of unauthorized data breaches or system abuse.

### Efficient File Upload and Storage

Our product image handling system incorporates highly efficient file upload and storage mechanisms that ensure seamless management of images. By leveraging Amazon S3, we can provide a scalable, secure, and optimized storage solution that significantly enhances overall performance. This technology allows us to store and retrieve images quickly and efficiently, enabling our platform to deliver a smooth and reliable user experience. Additionally, the use of Amazon S3 ensures that our product images are stored in a highly secure and reliable manner, minimizing the risk of data loss or corruption. Overall, our image storage system is designed to provide our users with a seamless and efficient experience, while also ensuring that their valuable data is kept safe and secure..

### Integration with Selected Payment Gateways

Our platform strives to provide users with a seamless and secure payment experience. To achieve this, we have carefully selected and integrated with some of the most trusted payment gateways in the market, including BKash, Nagad, and Upai. These payment gateways offer a diverse range of transaction options that cater to the needs of our users.

We understand that security and confidentiality are of utmost importance when it comes to financial transactions. Therefore, we have implemented advanced security measures through this integration to ensure that all transactions carried out on our platform are conducted with the highest level of integrity and confidentiality. You can rest assured that your financial data and personal information are safe with us.

In summary, our platform offers you a secure and diverse range of transaction options, and we are committed to upholding the highest standards of security and confidentiality in all our financial transactions.

### Implementation of Search Functionality

The platform has taken a significant step towards providing an unparalleled user experience by introducing a robust search functionality. This feature allows users to effortlessly browse and discover products based on their preferences, leading to a more personalized and intuitive shopping experience. With just a few clicks, users can easily find what they are looking for, saving time and effort. The search functionality is designed to help users navigate through an extensive inventory of products with ease, making the shopping experience more satisfactory and enjoyable.

### Workflow Development for Order Processing and Tracking

Our platform is meticulously designed to deliver a hassle-free experience for our customers when it comes to placing and tracking orders. Our robust workflows ensure that every step in the order fulfillment process is well-defined and transparent. Once you place an order, you can easily track its progress from start to finish. Our system will keep you informed at every stage, from order confirmation to shipping, so that you always know the status of your order. We take pride in providing a systematic and efficient order-processing experience that aims to exceed your expectations and enhance your satisfaction. Our goal is to provide you with a level of service that sets us apart from the competition.

### Email Notifications

The platform has implemented an advanced feature of automated email notifications for important interactions, such as order confirmations and updates. This feature ensures that users are kept informed about their orders' current status and any updates related to them. It enables transparency in the system, allowing users to have a clear understanding of their orders, and provides a smooth communication channel between the platform and its users. With this feature, users can remain updated throughout the order processing, ensuring a hassle-free and satisfactory experience.

## 4.4 Product Features

The features of this system is -

1. **Admin:** Within the system, an Administrator role will be established, holding the highest level of access privileges. Serving as the superuser, the Administrator plays a pivotal role in overseeing and managing the entire system. This includes tasks such as adding or removing properties based on host requests. With comprehensive control over the system's features and functionality, the Administrator ensures its smooth operation. Additionally, the Administrator handles user account setup, role assignments, and permissions. System activity monitoring is another crucial responsibility to guarantee optimal performance. Configuration of the system to meet specific user and host requirements falls under the Administrator's purview, ensuring customization. Security maintenance is paramount, involving the implementation of protocols, continuous monitoring for any breaches, and the investigation of security incidents. The Administrator is also responsible for safeguarding data and maintaining privacy within the system. In the context of your project,

the Admin Panel empowers the Administrator to add products, manage product categories, delete orders, complete orders, and remove products or categories as needed. This role is indispensable for ensuring the efficient, secure, and seamless operation of the system.

2. **Admin Dashboard:** The central control hub within the system, the Admin Dashboard, serves as the nerve center for overseeing and managing various aspects of the platform. With a user-friendly interface, the Admin Dashboard provides real-time insights, tools, and functionalities that empower administrators to efficiently monitor, control, and customize the system. From this centralized point, administrators can perform tasks such as adding or removing products, managing product categories, deleting orders, completing orders, and handling other essential functions. The Admin Dashboard streamlines administrative workflows, offering a comprehensive view of system activities and enabling quick decision-making. Its intuitive design enhances the overall user experience, ensuring administrators have easy access to vital information and tools for maintaining the system's optimal performance and security.
3. **User Login and Registration:** The system incorporates a seamless and secure user authentication process through user login and registration functionalities. Users can register for an account by providing essential details, creating unique login credentials, and agreeing to terms and conditions. Upon successful registration, users gain access to the system, allowing them to log in using their designated credentials. The user login mechanism ensures a secure and personalized experience. Registered users can enter their credentials, typically a username and password, to gain authenticated access to their accounts and the system's features. Security measures such as encryption and secure protocols are implemented to safeguard user login information. The registration process is designed to be user-friendly, guiding individuals through the necessary steps to create an account efficiently. It involves inputting personal information, validating email addresses, and establishing a secure password. User data is stored securely, adhering to privacy regulations and ensuring the confidentiality of sensitive information. By incorporating user login and registration functionalities, the system enhances user engagement, allowing individuals to access personalized features, make secure transactions, and benefit from a tailored experience within the platform.
4. **Payment Gateway :** By implementing Cash on Delivery as the primary payment gateway, we aim to cater to a broader user base, accommodating those who may have reservations or preferences for cash transactions over digital payment



methods. This approach aligns with our commitment to providing a user-friendly and inclusive experience within the system.

## 4.5 Summary

In this chapter, we have conducted a thorough analysis to determine the feasibility of incorporating homework assignments in our educational program. The outcomes of this study will serve as the decisive factor in determining whether to move forward with the plan or not. If the results are positive, we will work collaboratively to formulate a comprehensive plan proposal.

<sup>74</sup> The primary goal of this feasibility study is to evaluate the benefits and drawbacks of introducing homework assignments. We have examined whether the introduction of homework assignments will help students develop their skills, gain knowledge, and improve their academic performance. Additionally, we have looked into the potential challenges that may arise from this change and identified ways to address them.

The study also aims to identify opportunities that may arise from incorporating homework assignments. For instance, homework assignments can help students develop time management and self-discipline skills, leading to better academic performance.

We have considered all factors that can realistically and effectively be addressed given the current circumstances. This includes evaluating the available resources, such as the availability of qualified teachers, the adequacy of technological infrastructure, and the support of parents and guardians.

In conclusion, the purpose of this feasibility study is to make an informed decision based on the merits and drawbacks of introducing homework assignments. Our goal is to ensure that any decision made is in the best interest of our students and the overall educational program.

## Chapter 5

# System Design

In this comprehensive exploration of the "System Design" for our groundbreaking application, Scrap Vault, we embark on a journey to redefine how industries approach the intricate task of managing and organizing scrap materials—a fundamental challenge resonating across diverse sectors. Recognizing the profound scope of this endeavor, our focus on meticulous system design is not just about efficiency but is a commitment to establishing a paradigm shift in the landscape of scrap material management.

The sensitivity of the information involved spans privacy, security, financial intricacies, and safety-related data. It is therefore imperative to forge a system that not only meets but exceeds the essential criteria, creating a robust foundation. In doing so, we not only guarantee a secure platform but elevate the overall user experience to foster trust, reliability, and innovation in the realm of scrap material management through Scrap Vault.

At the core of this design is the establishment of a formidable privacy policy, serving as a bulwark to safeguard user data. This ensures that data is utilized exclusively for the explicit purpose of managing and tracking scrap materials, assuring users that their information is handled with the utmost care and adherence to ethical standards.

The implementation of security measures becomes paramount, involving secure authentication mechanisms, cutting-edge data encryption, and impenetrable firewalls. These elements collectively fortify the system, shielding user data from any unauthorized access and reinforcing confidence in the security posture of Scrap Vault.

Given the financial transactions entwined with scrap material dealings, the system's reliability and security protocols must be of the highest order, ensuring the impervious handling of sensitive monetary data. Scalability stands as a cornerstone, allowing the

system not only to adeptly manage a substantial user base but to do so while upholding peak performance and reliability standards. As we embark on this transformative journey with Scrap Vault, our commitment extends beyond mere functionality—it is a dedication to delivering an avant-garde solution that not only meets the challenges but sets new benchmarks in the dynamic landscape of scrap material management for industries worldwide.

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## 5.1 Use Case Diagram

The **Use Case Diagram**, a pivotal facet of Unified Modeling Language (UML), serves as a dynamic tool in software engineering to articulate the intricate interactions between a system and its users or other interconnected systems. This diagram not only visualizes the functional prerequisites of a system but also provides a lucid and succinct means of conveying the intended functionality to stakeholders.

At its core, a use case diagram encapsulates the system within a box, casting the actors or stakeholders as stick figures. The interplay between these actors and the system is depicted through arrows, delineating the various tasks or processes that need execution. This representation holds significant importance for several reasons in the realm of software engineering.

Primarily, use case diagrams aid in the identification of diverse actors or stakeholders involved in a system, ensuring that their needs and requirements are thoroughly acknowledged. Additionally, they function as a preemptive measure by unveiling potential errors or issues within the system, allowing for rectification before deployment. Most crucially, these diagrams contribute to fostering a shared understanding among all stakeholders regarding the system's requirements and objectives, a pivotal element for the triumphant realization of any software development project.

In essence, the Use Case Diagram stands not only as a visual representation of system functionality but as a collaborative tool that harmonizes diverse perspectives, mitigates potential pitfalls, and ensures a cohesive vision among stakeholders throughout the software development journey.

## 5.2 Use Case Diagram of ScrapVault

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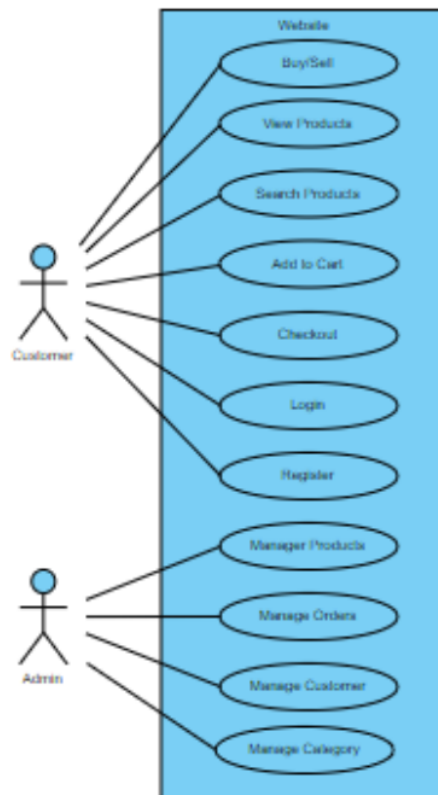


Fig. 5.1. Use Case Diagram

**Manage Product**

Admins can add, update, or remove products from the system. This includes providing details such as product name, description, quantity, buy price, and sell price.

**Manage Order**

Admins have the authority to view, process, and manage customer orders. This involves actions like approving orders, updating order status, and coordinating delivery.

**Manage Category**

Admins can create, modify, or delete product categories. This allows for effective organization and classification of products within the ScrapVault system.

**Buy/Sell**

Customers can initiate buying or selling actions, indicating their intention to purchase or offer scrap items. This includes specifying quantities and relevant details.

**View Product**

Customers can browse and view details of available products, including product names, descriptions, quantities, buy prices, and sell prices.

**Search Product**

Customers can search for specific products based on criteria such as product name or category. This enhances the user experience by facilitating quick access to desired items.

**34 Add to Cart**

Customers can add products to their shopping cart. This allows for convenient aggregation of desired items before proceeding to the checkout process.

**Login**

Customers need to log in to their accounts to access personalized features, view order history, and perform buying or selling activities.

**Registration**

New users, both customers and admins, must register by providing necessary information to create an account. This includes details like email, password, first name, last name, etc.

### 5.3 Database Schema

In the intricate landscape of system design, the database schema emerges as a cornerstone, wielding substantial influence in shaping the structural framework and organization of data. Functioning as a meticulous blueprint, the database schema delineates the intricate network of tables, columns, and relationships that collectively compose the database's foundation. This intricate map provides developers with a nuanced and logical model of the data, offering a fertile ground for crafting efficient queries and optimizing the nuanced intricacies of data storage.

The profound impact of a well-designed database schema extends beyond its immediate functionalities. It becomes a linchpin for upholding data integrity, strategically curbing redundancy, and streamlining the intricate processes of data access and manipulation. The careful orchestration and planning involved in the conception of a database schema impart a sense of coherence and order to the otherwise complex tapestry of system architecture.

This emphasis on meticulous detail and strategic foresight underscores the pivotal role of a robust and thoughtfully devised database schema. It stands as a testament to the commitment to precision and efficiency within the broader canvas of system design, where every element, no matter how intricate, plays a crucial role in the seamless orchestration of data management.

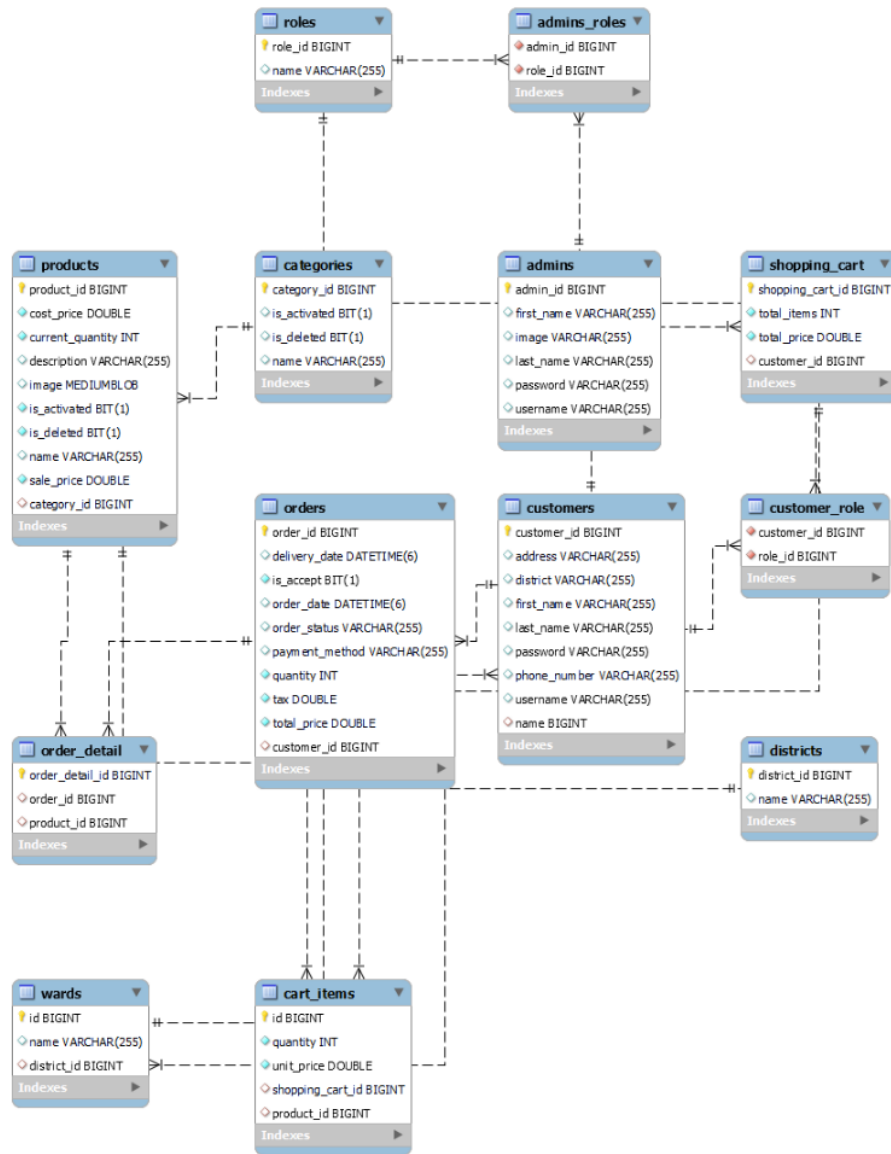


Fig. 5.2. Database Schema

Below is a brief description of the entities and their attributes in your Entity-Relationship Diagram (ERD) for the ScrapVault project:

**Entities:****Customer:**

The Customer entity is a crucial component of the ScrapVault system as it represents individuals who use the platform. Each customer is assigned a unique CustomerID which allows for easy identification and tracking of their activities on the platform. The entity contains several attributes that capture essential information about the customers, including their contact details such as email and phone number, name (first and last), and location details such as city and ward. This information helps to ensure that customers can be reached easily, and their location can be used to personalize their experience on the platform.

**Admin**

The Admin entity serves as a representation of individuals who have administrative privileges within the system. These users are identified by their first name, last name, email address, and a secure password that they use to gain access to the system. This entity is crucial in ensuring the smooth functioning of the system and maintaining the security of sensitive information.

**Category**

The Category entity is a fundamental component of the ScrapVault platform, representing the various product categories that are available for users to browse and purchase. Each category is distinguished by a unique Name attribute, which allows for easy identification and sorting of products. With the Category entity, users can easily navigate and explore the diverse range of products available on ScrapVault.

**Product**

The Product entity is a crucial aspect of ScrapVault's buying and selling system. It represents each unique item available for purchase and sale on the platform. The Product entity is defined by several attributes, including the product's name, description, quantity, buy price, and sell price. These attributes provide essential information to both buyers and sellers, allowing them to make informed decisions about transactions. For instance, the product's name and description allow buyers to identify the item they want to purchase, while the buy and sell prices enable them to compare prices and make cost-effective purchases. The quantity attribute ensures that buyers and sellers are aware of the available stock levels, preventing overselling, while also enabling sellers to



maintain appropriate inventory levels. Overall, the Product entity is a vital component of ScrapVault's marketplace, facilitating smooth transactions and ensuring customer satisfaction.

## **Order**

The Order entity is a fundamental component of the system that manages customer orders. It is designed to capture critical information that pertains to each order, including a unique OrderID that distinguishes it from other orders, the delivery date that specifies when the order is expected to be delivered to the customer, and the total price of the order, which reflects the sum of all items, taxes, and fees associated with the order. By providing these attributes, the Order entity facilitates the tracking, processing, and fulfillment of each customer order, ensuring that orders are delivered accurately, efficiently, and on time.

## **Relationships**

### **Customer-Order Relationship**

Whenever a customer places an order, it initiates a significant and essential link between the two entities, namely the Customer and Order. This relationship is pivotal in tracking and managing the orders placed by customers. The Order entity primarily represents all the orders placed by customers, providing a comprehensive overview of the entire ordering process.

### **Admin-Category Relationship**

Administrators are responsible for managing the product categories in the system. As such, they create and maintain a relationship between the Admin and Category entities. They can also add or modify the various categories available in the system, ensuring that they are up-to-date and relevant to the products being offered. This allows for a more organized and efficient system, making it easier for users to browse and find the products they are looking for.

### **Category-Product Relationship**

The process of categorizing products is essential in establishing a relationship between the products and their respective categories. By grouping similar products under a specific category, it becomes easier to understand and manage them. Every product is linked with a particular category that defines its characteristics, features and uses. This relationship between the product and category entities is crucial in organizing and presenting products to customers.

## 5.4 Entity-Relationship Diagram

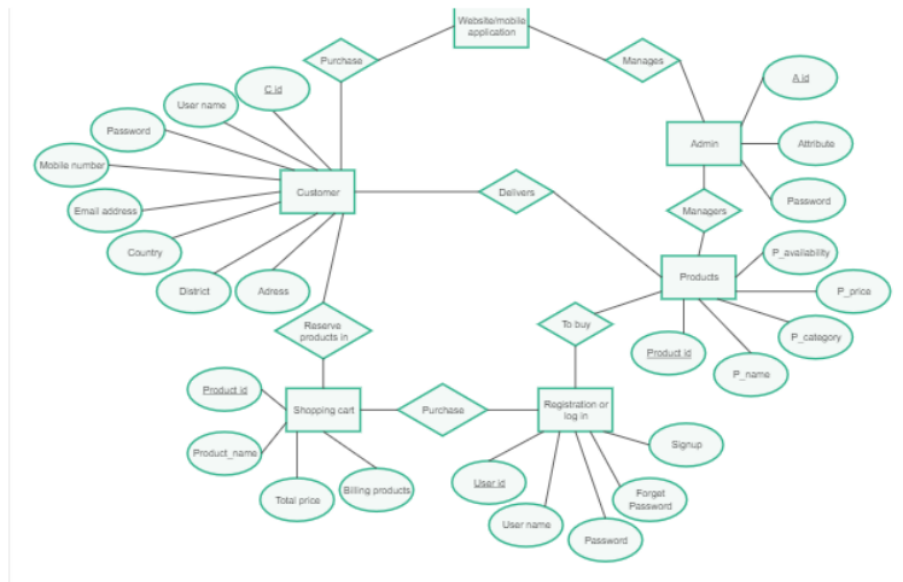


Fig. 5.3. Entity-Relationship Diagram

An Entity-Relationship Diagram (ERD) is a visual representation of the data model that depicts the relationships between entities in a database. It is a powerful tool used in database design to illustrate the structure and organization of data clearly and concisely. The main components of an ERD include:

- Entities:** Entities represent real-world objects or concepts in a database. They are usually nouns and serve as the primary building blocks of the data model.
- Attributes:** Attributes are properties or characteristics that describe the entities. They provide more detailed information about the entities and are often represented as ovals connected to the respective entities.
- Relationships:** Relationships indicate how entities are related to each other. They define the associations and connections between different entities in the database. Relationships are typically represented as lines connecting related entities.
- Cardinality:** Cardinality defines the numerical relationship between entities in a relationship. It specifies how many instances of one entity are associated with how many instances of another entity. Common cardinality types include one-to-one, one-to-many, and many-to-many.

- **Primary Key:** A primary key is a unique identifier for each record in an entity. It ensures that each record can be uniquely identified within the database.

ERDs are essential in the database design process as they help in:

- **Visualizing Relationships:** ERDs provide a visual representation of how different entities relate to each other, making it easier to understand the overall structure of the database.
- **Identifying Key Entities and Attributes:** Designers can identify key entities and attributes that need to be included in the database to meet the requirements of the system.
- **Ensuring Data Integrity:** By defining relationships and constraints, ERDs help ensure data integrity by preventing inconsistencies or errors in the database.
- **Facilitating Communication:** ERDs serve as a communication tool between stakeholders, including developers, designers, and non-technical individuals, helping convey the database structure effectively.

The Entity-Relationship (ER) Diagram for ScrapVault, a cutting-edge scrap-buying e-commerce system, provides an in-depth understanding of the intricate data relationships within the platform. This detailed overview explores the various components, relationships, and cardinalities, offering insights into the design and functionality of ScrapVault.

- **Entities and Attributes:** At the core of the ER Diagram are essential entities that define ScrapVault's functionality. Key entities include 'Customer,' 'Product,' 'Order,' 'Admin,' and more. These entities encompass specific attributes providing detailed information. For instance, the 'Customer' entity may include attributes like 'CustomerID,' 'Name,' 'Address,' and 'Email,' while the 'Product' entity may have attributes such as 'ProductID,' 'ProductName,' 'Category,' and 'Price.'
- **Relationships and Cardinality:** The ER Diagram illustrates relationships between entities, showcasing how they interact and influence one another. For example, the relationship between 'Customer' and 'Order' can be depicted as one-to-many, signifying that a single customer can place multiple orders, but each order is linked to only one customer. Similarly, the 'Product' entity may have a many-to-one relationship with 'Order,' indicating that multiple products can be part of a single order.

- **Normalization and Integrity Constraints:** Normalization principles play a vital role in efficient data storage and minimizing redundancy. In ScrapVault, normalization involves organizing attributes into different entities to eliminate data anomalies. For instance, a 'Payment' entity may be introduced to store financial transaction information, avoiding redundancy in the 'Order' entity. Integrity constraints ensure the accuracy and consistency of data, such as the requirement that an 'Order' cannot exist without a corresponding 'Customer.'
- **Extended Features and Future Scalability:** Looking ahead, the ER Diagram can be extended to accommodate additional features and entities. Entities like 'Supplier,' 'ProductCategory,' or 'Feedback' can be introduced to enhance the system's capabilities. Future scalability considerations are embedded in the design, allowing seamless integration of new features without compromising existing data relationships.

In conclusion, the ER Diagram for ScrapVault serves as a comprehensive visual representation of the data relationships, providing a roadmap for developers and stakeholders. Its meticulous design, consideration of entities, relationships, cardinality, normalization, and integrity constraints position it as a dynamic blueprint for the evolving ScrapVault ecosystem. This detailed overview ensures a profound understanding of the system's design and facilitates effective data management.

## 5.5 Data Flow Diagram

**1** A data flow diagram (DFD) maps out the sequence of information, actors, and steps within a process or system. It uses a set of defined symbols that each represent the people and processes needed to correctly transmit data within a system.

A DFD can be as simple or as complex as the system it represents, but the easiest way to make one is with a Data Flow Diagram tool.

Data flow diagrams are most often used to visually represent the flow of data within a business information system. As shown in the data flow diagram example below, these diagrams illustrate how data enters a system, how a system processes it, and finally, where it goes. **1** As its name indicates, a data flow diagram focuses on data and information. This makes it different from a workflow diagram or flowchart, which is a broader type of visualization that can represent any other process or system within a company.

One way to identify the difference between a flowchart and a data flow diagram is to look at how the arrows are used. The arrows in a flowchart represent an order of events, while the arrows in a data flow diagram represent the flow of data and information.

### 5.5.1 **1** Symbols for data flow diagrams

There's a set of standardized symbols used to illustrate the components of a DFD. These symbols for a data flow diagram make it easier for your team to read and understand your visualization.

- **External entity**

External entities are actors, sources, sinks, or terminators. They're the components that exist outside the system, responsible for sending or receiving data. In other words, they're the sources and destinations of the system's inputs and outputs.

- **Process**

Processes represent activities or transformations that occur within the system. Each process is depicted as a circle or oval and is labeled with a verb phrase to describe the action taking place.

- **Data store**

**39** Data stores represent where data is stored within the system. They are depicted as rectangles with the data store's name inside. Data stores can include databases, files, or any other storage mechanism. **11**

### 9 • Data flow

Data flows represent the movement of data between processes, external entities, and data stores. They are depicted as arrows and are labeled to describe the data being transported. Data flows illustrate the flow of information within the system.

### 1 5.5.2 Data flow diagram levels

Data flow diagrams are layered. Each layer of the diagram gets deeper and more intricate as it focuses on a particular piece of the system or data. The levels in a data flow diagram are usually represented from Level 0 to Level 2, and some exceptionally intricate systems may need the diagram to dive as deep as Level 3. The level of detail you want to examine will determine how deep the diagram needs to go.

#### • Data flow diagram Level 0

Level 0 is usually the context level of a data flow diagram. It is unfocused and doesn't generally zero in on a particular system part. Instead, at Level 0, a simple data flow diagram will provide a basic overview of the system, placing it into context and displaying a single, high-level process.

#### • Data flow diagram Level 1

Level 1 of the diagram is where things become more detailed, and the map becomes far more focused. Level 1 highlights the main functions within the process or the system. Level 1 of a data flow diagram is where specific sections of the Level 0 overview start to get broken down and explained.

#### • Data flow diagram Level 2

Level 2 simply goes another step deeper as it starts to map out and analyze specific sections of the Level 1 diagram. The deeper the levels go, the more text-based the diagram becomes. This is why many systems designers prefer not to go deeper than Level 2. However, for some complex and complicated systems, it may be necessary to go another level or two deeper.

## 5.6 Data Flow Diagram of ScrapVault

Processes

ScrapVaultSystem

Represents the overall ScrapVault system, serving as the central process that connects Admin, Customer, and other system components. It acts as a hub for processing and managing activities initiated by Admin and Customer.

**Admin**

Represents the administrative process within the ScrapVault system. Admin is responsible for managing various aspects of the system, such as categories, products, orders, or any other administrative functions. However, the specific activities are not detailed in the current code.

**Customer**

Represents the customer process within the ScrapVault system. Customers interact with the system to perform activities like selecting products, managing shopping carts, placing orders, etc. The specific customer activities are not detailed in the current code.

**Data Stores****Product**

Represents a data store that stores information about products within the ScrapVault system. Products are likely to have attributes such as names, IDs, descriptions, prices, etc. The Product data store is connected to the ScrapVaultSystem, indicating that it is part of the system's data management.

**Data Flows****Admin – ScrapVaultSystem**

Represents the data flow from the Admin process to the ScrapVaultSystem, indicating that Admin interacts with and provides information to the system.

**Customer – ScrapVaultSystem**

Represents the data flow from the Customer process to the ScrapVaultSystem, indicating that customers interact with and provide information to the system.

**Product – ScrapVaultSystem**

Represents <sup>24</sup>the data flow from the Product data store to the ScrapVaultSystem, indicating that product information is part of the overall system data.

This diagram provides a high-level overview of the processes and data flow within the ScrapVault system.



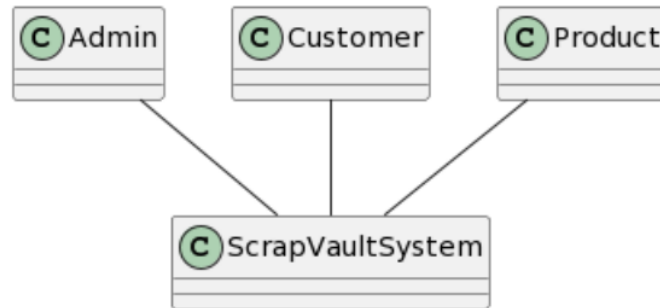


Fig. 5.4. Context Diagram

### 5.6.1 Level-0 DFD

The context diagram you provided is a high-level representation of the ScrapVault system. Here's a description of the main components and their interactions:

#### System:

Represents the overall ScrapVault system. Includes high-level processes: Admin: Responsible for managing categories, products, orders, and scrap. Customer: Manages the shopping cart and places orders. ShoppingCart: Manages the customer's shopping cart. OrderApproval: Manages the approval of orders. Processes:

#### Admin

The Admin module includes a set of processes that enable the management of product categories, products, customer orders, and scrap items. With the Admin module, authorized personnel can easily add, update, or delete product categories and products as well as manage customer orders and scrap items. This helps ensure that the product catalog is accurate and up-to-date and that customer orders are processed efficiently. Additionally, the scrap management feature helps keep track of items that are no longer useful or relevant, improving overall inventory management.

#### Customer

When it comes to managing your shopping cart, you as a customer have the freedom to add, update, or remove items according to your preferences. This means you can easily modify your cart to include or exclude items based on your needs. Also, when you are ready to checkout, submitting your order is a breeze. Our platform ensures a quick and hassle-free process, so you can complete your purchase with ease and confidence.

#### Data Stores



Our system has four main data stores that help us manage our business operations. Let me explain each one in detail:

1. **Category:** This data store represents the storage of product categories. It includes information about the different types of products we offer and how they are classified based on their features, characteristics, and intended use.
2. **Product:** This data store represents the storage of products. It includes information about each product we sell, such as its name, description, price, availability, and other relevant details.
3. **Order:** This data store represents the storage of customer orders. It includes information about each order placed by our customers, such as the products ordered, quantity, delivery address, payment method, and order status.
4. **Scrap:** This data store represents the storage of scrap items. It includes information about any products that are considered unusable, damaged, or defective and cannot be sold to customers. We keep track of these items to analyze the reasons for waste and take measures to minimize it in the future.

### **Data Flows**

The following text describes the data flow between different components in the ScrapVault system.

- **System - Category:** This data flow manages categories.
- **System - Product:** This data flow manages products.
- **System - Order:** This data flow manages orders.
- **System - Scrap:** This data flow manages scrap items.

Additionally, the following data flows manage interactions between the ShoppingCart and OrderApproval components

- **Customer - ShoppingCart:** This data flow manages the shopping cart.
- **ShoppingCart - OrderApproval:** This data flow manages order submissions.

This context diagram offers a high-level overview of the ScrapVault system's key components and their interactions.

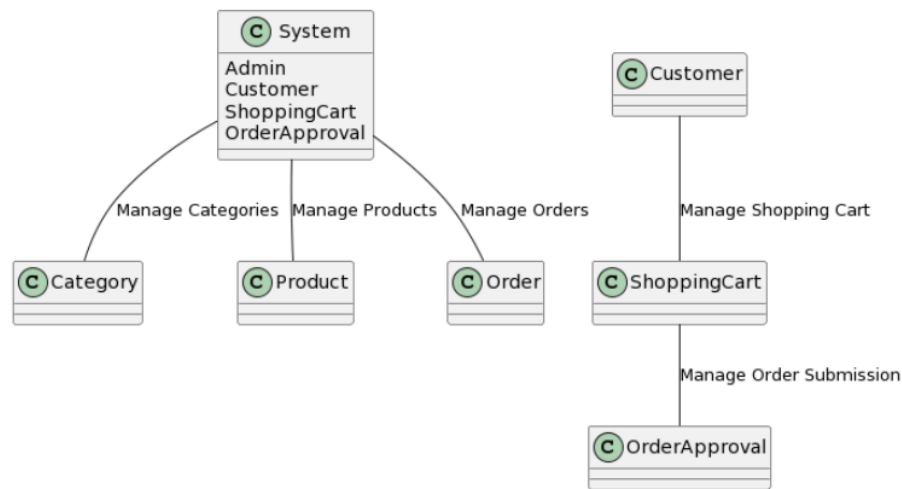


Fig. 5.5. Level-0 DFD

### 5.6.2 Level-1 DFD

The following is a description of the Level 1 Data Flow Diagram (DFD) of ScrapVault.

#### System

The ScrapVault system is a comprehensive e-commerce platform that encompasses various processes to facilitate efficient and streamlined operations. The Admin process is responsible for managing the system's overall functionality, while the Customer process enables users to create and manage their accounts and view products. The ShoppingCart process allows customers to add desired products to their carts, and the OrderApproval process ensures that orders are verified and approved before being processed. Together, these processes work seamlessly to provide a seamless online shopping experience for customers.

#### Admin

The admin is an essential subprocess of the system that enables the efficient management of product categories and products. With the `SetCategory()` function, the admin can easily create, modify, and delete product categories as per the business requirements. Similarly, with the `SetProduct()` function, the admin can streamline managing products by adding, editing, or removing them from the inventory. These functions empower the admin to keep the product catalog organized and up-to-date, ultimately leading to improved business performance.

#### Customer

Customer is a subprocess of the system that performs the following activities: Select-Product() allows customers to choose products, UpdateCart() enables customers to update or delete items in their shopping cart, and PlaceOrder() allows customers to place orders. The subprocess ShoppingCart is also part of the system.

### Data Stores

The Category data store acts as a central repository for managing product categories, and storing essential information such as category names, IDs, and descriptions. This data store enables administrators to efficiently set and update product categories, ensuring a well-organized classification of products. The Product data store complements this by storing details about individual products, including names, IDs, prices, and descriptions. Admins utilize this store to manage product information, while customers access it when selecting products. The Order data store plays a crucial role in handling customer orders and storing pertinent information such as order IDs, customer details, and product-specific data. Both the Customer and OrderApproval processes interact with the Order data store, with customers utilizing it during the order placement process, and the OrderApproval process accessing it to approve orders. Together, these data stores contribute to the effective functioning of the ScrapVault platform, facilitating seamless management of categories, products, and customer orders.

### Data Flows

The data flows in the ScrapVault system <sup>2</sup> play a crucial role in facilitating communication and information exchange between different components. Here's a description of the key data flows identified in your diagram:

#### Between System and Components

System - Admin: Manages Categories, Orders, and Products.

This data flow represents the communication between the overall ScrapVault system and the Admin component. It allows the system to manage categories, orders, and products through the Admin process.

System - Customer: Manages Shopping and Orders.

This data flow enables communication between the ScrapVault system and the Customer component. It supports the management of shopping activities and customer orders through the Customer process.

System - ShoppingCart: Manages Cart and Order Submission.

This data flow facilitates communication between the ScrapVault system and the ShoppingCart component. It is crucial for managing the shopping cart and the submission of orders through the ShoppingCart process.

System - OrderApproval: Approve Orders.

This data flow represents the communication between the ScrapVault system and the OrderApproval component, allowing for the approval of orders.

#### **Between Admin and Data Stores**

Admin - Category: Set Category.

This data flow enables the Admin process to set or update information in the Category data store, allowing for the management of product categories.

Admin - Product: Set Product.

This data flow facilitates communication between the Admin process and the Product data store, allowing the admin to set or update product information.

#### **Between Customer and Data Stores**

Customer - ShoppingCart: Select Product.

This data flow supports the selection of products by customers, allowing them to access information from the Product data store through the ShoppingCart process.

Customer - ShoppingCart: Update/Delete from Cart.

This data flow enables customers to update or delete items from their shopping cart, interacting with the ShoppingCart process and the ShoppingCart data store.

Customer - ShoppingCart: Place Order.

This data flow allows customers to place orders by interacting with the ShoppingCart process and updating information in the Order data store.

#### **Between ShoppingCart and OrderApproval**

ShoppingCart - OrderApproval: Submit Order.

This data flow facilitates the submission of orders from the ShoppingCart process to the OrderApproval process, ensuring a seamless process for order approval.

#### **Between Data Stores**

Category - Order: Set Category.

This data flow represents the connection between the Category and Order data stores, ensuring that the category information is associated with customer orders.

Product - Order: Set Product.

This data flow connects the Product and Order data stores, allowing product information to be associated with customer orders.

These data flows collectively depict the dynamic interactions and information exchange within the ScrapVault system, supporting effective management of categories, products, and customer orders.

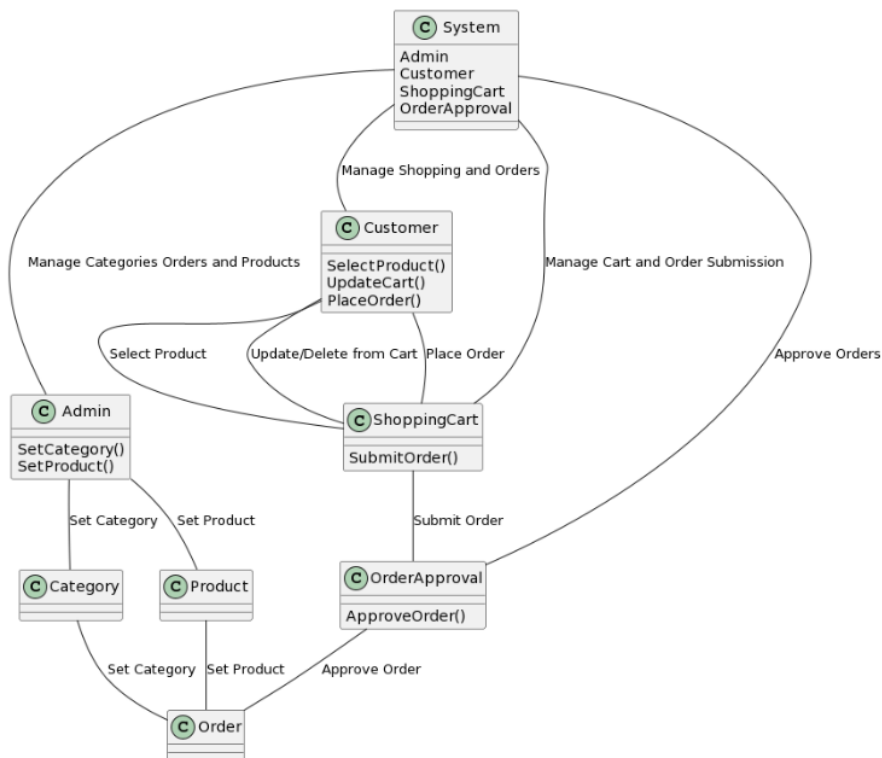


Fig. 5.6. Level-1 DFD

## Chapter 6

# Design and Implementation

<sup>10</sup> The design phase of software development deals with transforming the customer requirements as described in the SRS documents into a form implementable using a programming language. The software design process can be divided into the following three levels or phases of design:

- Interface Design
- Architectural Design
- Detailed Design

"Scrap Vault" is an e-commerce platform where users can sell their scrap. Outline the main features, such as user registration, scrap listing, transaction management, and communication between customers and admins.

### 6.1 Interface Design

#### 1. Admin Module Interface:

##### Dashboard:

The dashboard should offer a comprehensive overview of the essential metrics that are crucial for assessing the overall performance of your system. These metrics may include the total number of users, the number of active transactions, and recent activities. Additionally, the dashboard should feature quick links to common tasks like managing users, scrap item management, and transaction monitoring, which can help you efficiently manage the system and ensure its smooth functioning.

**User Management:**

As an admin, you can effortlessly manage user accounts. This includes adding new users, editing existing ones, and deleting accounts if needed. Additionally, you can search and filter user accounts based on certain criteria for a more efficient management process. When viewing user accounts, you will be provided with their name, contact information, and roles, ensuring that you have all the necessary details at your fingertips.

**Scrap Item Management:**

The system should provide a hassle-free way for administrators to handle scrap items. It should allow them to effortlessly add new items to the inventory, update any necessary details, as well as remove items when necessary. In addition, the system should allow for each item to be categorized and include accurate pricing information, making it easier to track and manage inventory levels.

**2. Customer Module Interface:****User Registration/Login:**

It's important to ensure that the registration and login forms on your website or application are designed in a way that is simple and easy to understand for all users. The forms should be intuitive, with clear and concise instructions to guide users through the process. Additionally, it's crucial to include options for password recovery, such as security questions or email verification, to ensure that users can regain access to their accounts in case they forget their password or encounter any other issues. By implementing these features, you can create a user-friendly and secure login experience for your users.

**Scrap Listing:**

Our platform now offers a user-friendly feature that enables customers to easily list their scrap items for sale. To get started, customers simply need to fill out a form with detailed information about their items, including the type, quantity, and pricing. This information will help potential buyers make informed decisions about their purchases.

We understand the importance of making the selling process as seamless as possible, which is why we've made it our mission to provide a safe, fair, and user-friendly platform for all customers.

**3. Library Module Interface:****Communication Hub:**

Facilitate seamless communication between customers and administrators by implementing a robust messaging system that enables the exchange of messages along

with file attachments. The system should also provide real-time notifications for new messages, ensuring that no message goes unnoticed and timely resolutions can be achieved. By incorporating these features, the communication process becomes more efficient and streamlined, leading to a better user experience and heightened satisfaction.

## 6.2 Architectural Design

The system architecture for your "Scrap Vault" project <sup>36</sup> involves designing the overall structure and organization of the system, including its components, modules, and their interactions.

### High-Level System Architecture:

#### 1. Frontend:

To deliver a user-friendly experience, it's essential to develop a web-based frontend that caters to both admins and customers. Using HTML, CSS, and JavaScript, you can create an intuitive and responsive UI that adapts to different devices. To make the development process more comfortable, you may consider using a popular JavaScript framework like React or Angular. With a responsive design, users can access the frontend from any device, ensuring that they can interact with your platform without any issues.

#### 2. Backend:

To establish a highly reliable and adaptable backend framework, I would suggest using Spring Boot. It is a popular Java-based framework that provides an excellent foundation for building web applications. Additionally, I recommend dividing the backend into three distinct modules: Admin, Customer, and Library. The Admin Module will handle all administrative functions, Customer Module will cater to customer-related operations, and Library Module will manage all book-related tasks. By separating the backend into these three modules, you can ensure that the application is more organized, easier to maintain, and more efficient overall.

#### 3. Database:

To manage relational databases, I would recommend utilizing MySQL. To store relevant data encompassing users, scrap items, transactions, and communication, a comprehensive database schema should be designed. This schema will serve as the backbone for the system, ensuring efficient storage and retrieval of information.



#### 4. **Middleware/Service Layer:**

To streamline the communication between the frontend and backend, it is highly advisable to implement a middleware or service layer that is specifically responsible for managing the business logic. This middleware or service layer acts as a mediator and facilitates the smooth transfer of data between the frontend and backend. To manage HTTP requests and ensure the seamless flow of data, Spring MVC can be used as a reliable and efficient tool. Its robust framework is perfect for handling complex web applications and can greatly simplify the development process.

#### 5. **RESTful API:**

To ensure seamless communication between the frontend and backend, it is essential to have a robust set of RESTful APIs in place. These APIs should be designed in a way that facilitates smooth data exchange between the two ends. For this purpose, APIs with clear and consistent endpoints should be developed to enable CRUD (Create, Read, Update, Delete) operations on various entities such as users, scrap items, transactions, and more. This approach will not only simplify the development process but also enhance the overall user experience.

#### 6. **Authentication and Authorization:**

To ensure the security of your application, it is essential to implement Spring Security for user authentication and authorization. By defining specific roles such as admin and customer, you can control which parts of the system users can access. Additionally, assigning permissions to these roles will enable you to regulate the actions users can perform within the system. This approach provides a comprehensive solution that ensures only authorized users can access restricted areas and perform authorized actions.

#### 7. **Communication Module:**

In order to facilitate seamless communication between customers and admins, it is essential to create a robust communication module. This module should be designed to enable real-time interactions, allowing customers to quickly and easily get in touch with admins whenever they need assistance. To ensure that all communication is secure, it is recommended to utilize advanced technologies such as WebSocket, which provides a reliable, bidirectional communication channel. By implementing strong security measures, such as encryption and authentication protocols, the module can prevent unauthorized access and protect sensitive information exchanged during communication.

#### 8. **External Libraries and APIs:**

To enhance the functionality of your software application, you may need to integrate external libraries or APIs. For instance, you may want to incorporate payment gateways or geolocation services to enable your users to make transactions or find nearby locations. By integrating such external tools, you can provide seamless and efficient services to your users, making your application more valuable and user-friendly.

## 6.3 Module Design

The "Scrap Vault" project is a comprehensive application that consists of three main modules - Admin, Customer, and Library. The Admin module is designed to manage and monitor the overall system, while the Customer module enables users to request scrap pickups. The Library module is responsible for storing and managing the data related to scrap types, pricing, and the pickup schedule. Together, these three modules work seamlessly to ensure a smooth and efficient scrap management process.

### Admin Module:

#### 1. AdminController:

This is an overview of the HTTP requests related to admin functionalities, which are used to manage various aspects of an e-commerce platform. The endpoints are as follows:

- /admin/users: This endpoint is used to manage users, including creating and deleting user accounts, as well as updating user information.
- /admin/category: This endpoint is used to manage product categories, including creating, updating, and deleting categories.
- /admin/product: This endpoint is used to manage product information, including the name, category, buy price, sell price, description, and quantity of each product. This endpoint allows administrators to add, update, and delete products as needed.
- /admin/order: This endpoint is used to manage product orders, including accepting or deleting orders. Using this endpoint, administrators can view and manage customer orders, update order statuses, and cancel orders as needed.
- /admin/transactions: This endpoint is used to view and monitor all transactions that occur on the platform. This includes viewing orders, payments, refunds, and other transactions related to the platform. Using this endpoint, administrators can monitor the financial health of the platform and detect any potential issues that may arise.

The AdminService is used to perform operations related to these endpoints. This service interacts with the platform's database to retrieve and update information as needed and ensures that all operations are performed safely and securely.

- #### 2. AdminService:
- The primary responsibility of an Admin is to implement the business logic for various administrative operations. This involves communicating with the Admin Repository to ensure seamless database interactions and working closely with other team members to ensure that all administrative tasks are carried

out efficiently and effectively. The work requires a deep understanding of the business processes involved and the ability to write high-quality, maintainable code.

3. **AdminRepository:** The adminRepository plays a critical role in managing and maintaining database operations related to admin entities. It is responsible for performing a wide range of **CRUD (Create, Read, Update, and Delete) operations** on the data in the database, ensuring the accuracy, relevance, and consistency of the data at all times. This includes tasks such as creating new admin records, retrieving existing ones, updating or modifying them, and deleting them when necessary. By performing these tasks seamlessly and efficiently, the adminRepository helps ensure the smooth functioning of the system and the integrity of the admin-related data.

#### Customer Module:

1. **CustomerController:**

The CustomerController plays a crucial role in managing customer-related functionalities. They act as a mediator between the user and the CustomerService, responsible for handling HTTP requests related to customer operations.

The CustomerController comprises two endpoints: /customer/product and /customer/transactions. The former endpoint allows the user to edit, remove, buy, and sell products. The latter endpoint enables the user to view their transaction history. By utilizing these endpoints, the user can perform essential operations related to their purchase and transaction history.

2. **CustomerService:**

As a part of the Customer Services team, your primary responsibilities would include implementing the business logic for customer operations. In addition to that, you will also be responsible for communicating with the CustomerRepository for database interactions. This would require you to have a strong understanding of the underlying database architecture and the ability to write efficient and optimized queries. Your role would be crucial in ensuring smooth and seamless customer experiences, and you will be working closely with other teams to ensure that the customer operations are aligned with the broader business objectives.

3. **CustomerRepository**

CustomerRepository is responsible for managing customer-related data in the database. This includes creating, reading, updating, and deleting customer records.

As a member of this team, you will be responsible for performing CRUD (Create, Read, Update, Delete) operations on customer-related entities in the database. You will ensure that customer data is accurate, up-to-date, and secure. Your work will be crucial to maintaining the integrity of our customer database and ensuring a positive customer experience.

#### Library Module:

##### 1. **LibraryService:**

This module encompasses a range of responsibilities that are crucial for efficient and effective communication and transaction management for both the admin and the customer. As part of these responsibilities, you will be required to implement complex business logic to ensure that all transactions and communications are handled seamlessly. Additionally, providing excellent customer service is a key aspect of this role, as it involves dealing with customer queries and concerns in a timely and professional manner. To ensure that all data is stored and retrieved accurately, you will also be responsible for communicating with the `LibraryRepository` for all database interactions.

##### 2. **LibraryRepository**

As a member of the `LibraryRepository` team, your primary responsibility is to manage the database operations related to the library. This involves creating, reading, updating, and deleting the entities stored in the database. You also need to ensure that the data is stored in a well-organized and secure manner. Your role is crucial in maintaining the integrity of the library database and ensuring that it remains accessible to all library staff.

#### Shared Components

- **Authentication and Authorization**

To ensure secure user authentication and authorization, it is recommended to implement Spring Security in your application. This will provide a robust framework to manage user access control and permissions. Spring Security allows you to define roles such as `ROLEADMIN` and `ROLECUSTOMER`, which can be assigned to users based on their responsibilities and access levels. Additionally, you can granularly define permissions that determine what actions a user can perform within the application. With these features in place, you can have confidence that your application is secure and that users can only access the functionality that they are authorized to use.

- **Database Schema**

The database schema is a critical component of any software application that handles user data. In this case, the schema includes four main tables: users, scrapitems, transactions, and communications.

The users table stores information about all the users of the application, including both admins and customers. This information includes their name, email address, password, and any other relevant details.

The scrapitems table manages all the details related to the scrap items that customers list on the platform. This includes information about the item's condition, price, and any images associated with it.

The transactions table records all the transaction details, such as the date and time of the transaction, the amount paid, and any other relevant information. This table is crucial to ensure that the transactions are processed correctly and that all parties are aware of what has happened.

Finally, the communications table handles all the communication between the customers and admins. This includes messages, chat logs, and any other relevant information about the communication. This table ensures that all parties are kept up to date and that any issues or concerns are addressed promptly.

## Chapter 7

# Website Testing

### 7.1 <sup>4</sup> Testing

Software Testing is a method to assess the functionality of the software program. The process checks whether the actual software matches the expected requirements and ensures the software is bug-free. The purpose of software testing is to identify the errors, faults, or missing requirements in contrast to actual requirements. It mainly aims at measuring the specification, functionality, and performance of a software program or application.

Software testing can be divided into two steps:

- **Verification:**

It refers to the set of tasks that ensure that the software correctly implements a specific function. It means “Are we building the product right?”.

- **Validation:**

It refers to a different set of tasks that ensure that the software that has been built is traceable to customer requirements. It means “Are we building the right product?”.

## 7.2 <sup>3</sup> Different Types Of Software Testing

The categorization of software testing is a part of diverse testing activities, such as test strategy, test deliverables, a defined test objective, etc. Software testing is the execution of the software to find defects. The purpose of having a testing type is to confirm the AUT (Application Under Test).

To start testing, we should have a requirement, application-ready, and necessary resources available. To maintain accountability, we should assign a respective module to different test engineers.

The software testing is mainly divided into two parts, which are as follows:

- Manual Testing
- Automation Testing

### 7.2.1 <sup>3</sup> Manual Testing

Testing any software or an application according to the client's needs without using any automation tool is known as manual testing.

In other words, we can say that it is a procedure of verification and validation. Manual testing is used to verify the behavior of an application or software in contradiction of requirements specification.

We do not require any precise knowledge of any testing tool to execute the manual test cases. We can easily prepare the test document while performing manual testing on any application. Classification of Manual Testing

In software testing, manual testing can be further classified into three different types of testing, which are as follows:

- White Box Testing
- Black Box Testing
- Grey Box Testing



### 7.3 Testing result

Interface Name	Data Field	Input Values
Login	Username	admin
	Password	admin

TABLE 7.1: Test Case 1

#### Result

The login attempt was unsuccessful. It appears that the username or password you entered does not match the corresponding details on our records. To ensure that your account remains secure, we recommend verifying that you have entered your login credentials correctly and that your caps lock key is off.

Interface Name	Data Field	Input Values
Sign up	Username	admin
	Password	admin
	Email	

TABLE 7.2: Test Case 2

#### Result

Unfortunately, the registration process could not be completed as the email field was left empty. Providing a valid email address is necessary to proceed with the registration. Please enter a valid email address to successfully complete the registration process.

Interface Name	Data Field	Input Values
Sign up	Username	admin
	Password	abc11
	Email	

TABLE 7.3: Test Case 3

#### Result

The registration process could not be completed successfully. The reason is, that the password you provided did not meet our security requirements. To ensure the safety of your account, we require a password that contains at least 6 characters. Please update your password and try again.

Interface Name	Data Field	Input Values
ProductName	CatagoryName	Metal
	ProductName	Iron
	Description	
	Quantity	20
	BuyPrice	100
	SellPrice	150

TABLE 7.4: Test Case 4

**Result**

The product upload was unsuccessful because the product description field was left blank or contained null values. Please provide a valid product description and try again.

Interface Name	Data Field	Input Values
ProductName	CatagoryName	
	ProductName	Iron
	Description	This is a Scrap
	Quantity	20
	BuyPrice	100
	SellPrice	150

TABLE 7.5: Test Case 4

**Result**

The product upload has not been successful. This is because the product category field was left blank or it contained null values. To proceed with the upload, please ensure that you provide a valid product description and category. We apologize for any inconvenience this may have caused and appreciate your cooperation.

Interface Name	Data Field	Input Values
ProductName	CatagoryName	Metal
	ProductName	Iron
	Description	This is a Scrap
	Quantity	20
	BuyPrice	100
	SellPrice	150

TABLE 7.6: <sup>51</sup>Test Case 4**Result**

The product has been successfully added to the database and is now available for purchase.

## Chapter 8

# Discussion and Conclusion

### 8.1 Discussion

Bangladesh's rich history of scrap dealings, notably the acquisition of old ships for scrap, highlights the significance of managing and leveraging recyclable materials [2]. Daily scrap generation throughout the country underscores the existing market potential for individuals and smaller businesses. Traditionally, these entities have engaged with larger companies in the scrap industry. However, accessibility and inclusivity challenges persist within this framework.

#### 8.1.1 Project's Role in Addressing the Issue:

"Scrap Vault" emerges as a transformative solution, positioning itself as a modern, digital platform bridging the gap between sellers and buyers in the scrap ecosystem. The project's primary objective is to streamline and democratize the scrap management process, enabling a more extensive range of participants to actively contribute to recycling and material reuse. By facilitating direct interactions between sellers and buyers, the platform seeks to create a dynamic and inclusive scrap economy.

#### 8.1.2 Technological Solutions:

At the core of "Scrap Vault" lies a sophisticated technological foundation, incorporating cutting-edge solutions such as Spring Boot, MySQL, and Git. This deliberate technological choice is a testament to the project's commitment to creating a scalable, efficient,

and future-ready platform. Leveraging these technologies ensures that the complexities of scrap transactions are seamlessly managed, offering users a contemporary and user-friendly experience.

### **8.1.3 User Engagement**

"Scrap Vault" actively encourages user engagement by providing an intuitive and accessible interface for listing and selling scrap items. The platform aims to empower individuals and smaller entities by simplifying the process of selling scrap, thus contributing to economic opportunities. By making scrap transactions more convenient and accessible, the project seeks to foster increased participation from a diverse demographic.

### **8.1.4 Communication Enhancement:**

A pivotal feature introduced in the project is the Library module, which acts as a communication hub. Real-time communication capabilities enhance the overall user experience by facilitating direct interactions between customers and administrators. This feature ensures that queries are addressed promptly, and transactions are managed efficiently, reinforcing the platform's commitment to user satisfaction.

## **8.2 Conclusion**

In essence, "Scrap Vault" emerges as a beacon of progress in the contemporary landscape of scrap management within Bangladesh. This project signifies a transformative leap, embracing technology to forge direct connections between individuals and potential buyers. The resultant platform not only augments user accessibility and inclusivity but also catalyzes a paradigm shift in how the nation engages with its scrap resources.

Bangladesh, grappling with the dual challenges and opportunities entwined with scrap generation, finds in "Scrap Vault" a pioneering solution. The platform's role extends beyond a transactional medium; it becomes an enabler of economic empowerment. By empowering individuals to seamlessly list and sell scrap items, "Scrap Vault" democratizes economic participation and, in doing so, amplifies its impact across diverse strata of society.

Crucially, "Scrap Vault" resonates with environmental stewardship imperatives, aligning with global sustainability goals. Its emphasis on promoting the reuse of materials not

only contributes to mitigating environmental impact but also places it at the forefront of initiatives that champion a circular economy.

The success trajectory of "Scrap Vault" hinges on the widespread adoption of its user-friendly platform and the establishment of fruitful collaborations with stakeholders in the scrap industry. The project, poised at the nexus of technology, commerce, and environmental consciousness, has the potential to redefine Bangladesh's approach to scrap management. Its influence reaches beyond mere efficiency, extending into the realms of accessibility, inclusivity, and environmental responsibility.

In the onward journey, "Scrap Vault" carries the promise of reshaping the very fabric of scrap management practices in Bangladesh. By fostering a more efficient, accessible, and environmentally responsible scrap economy, the project stands <sup>8</sup> as a testament to the transformative power of technology and innovation in addressing complex societal challenges.

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