המכללה האקדמית
להנדסה בתל אביב
אפקה

# Clickcart

A Cross Platform e-commerce App

## Final Project in Computer Science

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|---|---|
| Project Name: | Clickcart (cross platform ecommerce system) |
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| Submission Date: | 07/07/2024 |

## Table of Contents

# Executive Summary

ClickCart is an innovative eCommerce platform designed to provide a seamless shopping experience for users and powerful management tools for administrators. Developed using modern technologies such as Flutter for the frontend, Node.js for the backend, and MongoDB for the database, ClickCart offers a robust, scalable, and secure solution for online retail businesses.

**Project Overview:**

ClickCart's primary goal is to deliver an intuitive and efficient shopping experience. The platform features comprehensive user authentication, a detailed product catalog with advanced search and filtering options, and a dynamic shopping cart. The checkout process is secure and supports multiple payment options, including credit card transactions via Stripe and cryptocurrency payments through Coinbase Commerce. Users can track their orders in real-time, enhancing their overall shopping experience.

For administrators, ClickCart provides a robust admin panel equipped with tools for inventory management, order processing, and in-depth analytics. This allows businesses to efficiently manage their operations and make data-driven decisions. The platform also supports cross-platform push notifications via OneSignal, ensuring timely communication with users.

**Key Features:**

- User Experience: Seamless authentication, comprehensive product catalog, real-time shopping cart, secure checkout, and order tracking.
- Admin Capabilities: Efficient inventory management, streamlined order processing, user management, and advanced analytics.
- Security and Performance: End-to-end encryption, optimized performance, and scalable architecture.

## Adaptations and Changes:

Throughout its development, ClickCart has undergone several adaptations to enhance its functionality and user experience. Notable changes include moving from MetaMask to Coinbase Commerce for cryptocurrency payments, transitioning from Redux to Provider for state management, and integrating OneSignal for push notifications.

## Future Development:

Proposals for future development include enhanced personalization through machine learning, advanced analytics and reporting tools, multi-language and multi-currency support, mobile app enhancements, expanded payment options, and improved customer support.

## Conclusion:

ClickCart stands out as a comprehensive and effective eCommerce platform, capable of adapting to the evolving demands of the online retail landscape. Its robust features, combined with strong security and performance attributes, make it a reliable choice for businesses looking to establish or enhance their online presence.

# Introduction

In today's digital age, the e-commerce industry continues to grow exponentially, driven by the convenience and efficiency it offers to both businesses and consumers. Our final project, "Clickcart," aims to contribute to this ever-evolving landscape by developing a robust, user-friendly e-commerce platform. Utilizing modern technologies, Clickcart is designed to provide a seamless experience for both administrators managing the store and customers browsing and purchasing products.

Clickcart leverages the power of the Flutter framework for creating responsive and visually appealing client-side applications for both admin management and customer use. The server side is built with Node.js, ensuring a scalable and efficient backend infrastructure. For data management, we have chosen MongoDB, a flexible NoSQL database, to handle the diverse and dynamic data requirements of an e-commerce platform. Additionally, Clickcart implements secure payment processing through the Stripe API for credit card transactions and Coinbase Commerce for cryptocurrency payments, catering to a wide range of customer preferences. Our project is focused on delivering a comprehensive solution that addresses the needs of a modern online retail business, from inventory management to secure transactions and customer satisfaction.

# Targets, Goals & Measures

## Targets

- **Platform Stability and Reliability**: Ensure that Clickcart operates smoothly under various load conditions and handles transactions without errors.
- **User Experience**: Provide an intuitive and responsive user interface for both administrators and customers.
- **Security**: Implement robust security measures to protect user data and transaction information.
- **Scalability**: Design the platform to support future growth in terms of users, products, and transactions.
- **Integration Capabilities**: Enable easy integration with third-party services such as payment gateways, shipping providers, and marketing tools.
- **Payment Flexibility**: Implement secure and reliable payment processing options for both credit card transactions via Stripe API and cryptocurrency payments via Coinbase Commerce.

## Goals

- **Complete Development and Deployment**: Develop and deploy a fully functional e-commerce platform by the project deadline.
- **Admin Management System**: Create a comprehensive admin management system for inventory management, order processing, and customer service.
- **Customer Application**: Develop a customer-facing application with features such as product browsing, shopping cart, and order tracking.
- **Database Efficiency**: Optimize MongoDB for fast data retrieval and minimal downtime.
- **Real-Time Updates**: Implement real-time updates for inventory and order statuses using WebSockets or similar technology.

- **Secure Payment Processing**: Integrate Stripe API for credit card transactions and Coinbase Commerce for cryptocurrency payments, ensuring secure and smooth payment experiences.

## Measures

**Performance Metrics**:

- **Load Testing**: Perform load testing to ensure the platform can handle peak traffic without performance degradation.
- **Response Time**: Measure the average response time for various operations (e.g., product search, checkout process) to ensure it meets user expectations.

**User Satisfaction**:

- **Feedback Surveys**: Collect feedback from beta testers to identify areas for improvement in user experience.
- **User Retention**: Track user retention rates to gauge the effectiveness of the platform in maintaining user engagement.

**Security Metrics**:

- **Penetration Testing**: Conduct regular penetration testing to identify and fix security vulnerabilities.
- **Data Breach Incidents**: Monitor and aim for zero data breach incidents throughout the testing phase.

**Scalability Metrics**:

- **Horizontal Scaling**: Test the platform's ability to scale horizontally by adding more servers and ensuring consistent performance.
- **Database Scaling**: Assess MongoDB's performance with increasing amounts of data to ensure it can handle growth.

**Integration Success**:

- **API Integration Tests**: Verify the successful integration of third-party APIs for payments, shipping, and other services.
- **Transaction Success Rate**: Monitor the success rate of transactions processed through integrated payment gateways.

**Payment Processing Metrics**:

- **Transaction Time**: Measure the average time taken to process transactions via Stripe and Coinbase Commerce.
- **Payment Failure Rate**: Track the rate of failed transactions and aim to minimize it through rigorous testing and optimization.
- **User Feedback on Payments**: Collect user feedback specifically related to the payment process to identify and address any pain points.

# Literature review

### Introduction

The development of an e-commerce platform like "Clickcart" involves numerous technological decisions that impact its performance, security, and user experience. Two crucial areas of focus are the integration of blockchain technology and the selection of an appropriate mobile cross-platform framework. This literature review combines insights from two articles: "The impact of blockchain on e-commerce: A framework for salient research topics" by Horst Treiblmaier and Christian Sillaber, and "A Comparison Study Between Mobile Cross-Platform Frameworks: Flutter vs. React Native" by Pelle Grönlund. These studies provide valuable guidance on leveraging blockchain for enhanced security and trust, and on choosing between Flutter and React Native for mobile app development.

### Blockchain Integration in E-Commerce

Blockchain technology offers significant potential to enhance e-commerce platforms by providing a decentralized, immutable ledger for transactions and data management. Treiblmaier and Sillaber's framework highlights the advantages of blockchain in improving product traceability, data provenance, and transaction transparency[1]. For "Clickcart", integrating blockchain can ensure that product information and transaction records are tamper-proof, enhancing customer trust and satisfaction.

The combination of blockchain with technologies like IoT, big data analytics, and AI can further optimize e-commerce operations. Smart contracts, for instance, can automate payment and delivery processes, reducing the need for intermediaries and streamlining operations[1]. However, implementing blockchain also raises legal and compliance issues, such as data protection and the need for KYC and AML procedures when using cryptocurrencies for payments. "Clickcart" must navigate these challenges to fully leverage blockchain's benefits.

### Cross-Platform Frameworks: Flutter vs. React Native

Choosing the right cross-platform framework for mobile application development is critical for ensuring a seamless user experience across different devices. Grönlund's comparison of Flutter and React Native provides insights into their performance, usability, and integration capabilities[2].

Flutter, developed by Google, uses Dart and offers a comprehensive set of pre-designed widgets, enabling a faster development cycle and consistent design across platforms. React Native, developed by Facebook, leverages JavaScript and benefits from a vast ecosystem of libraries and tools, offering high flexibility[2]. The study found that Flutter generally consumes less memory but has higher CPU spikes immediately after user interactions, while React Native's performance varies depending on the specific use case.

For "Clickcart", the choice between Flutter and React Native could significantly impact development speed and maintainability. Flutter's efficiency and rapid development cycle are advantageous, particularly for ensuring a consistent and responsive user experience. React Native's extensive library support and flexibility may also be beneficial, depending on the specific needs and developer expertise.

### Conclusion

Integrating blockchain technology into "Clickcart" can enhance security, transparency, and operational efficiency, though it requires careful attention to legal and compliance challenges. Meanwhile, the choice of a mobile cross-platform framework between Flutter and React Native should consider factors like performance, development speed, and flexibility. Flutter offers rapid development and consistent design, while React Native provides flexibility and extensive library support. By addressing these key areas, "Clickcart" can leverage cutting-edge technologies to create a robust, secure, and user-friendly e-commerce platform[1][2].

References

[1] The impact of blockchain on e-commerce: A framework for salient research topics. Link

[2] A comparison study between mobile cross-platform frameworks: Flutter vs. React Native, Karlstad University, Sweden. Link

# Competitors & Existing technologies

### Competitors

The e-commerce market is highly competitive, with several established players offering robust platforms. Here are some key competitors and their features:

1. **Shopify**:
   - **Strengths**: User-friendly interface, extensive app ecosystem, reliable customer support.
   - **Weaknesses**: Subscription fees, transaction costs, limited customization.
2. **Magento**:
   - **Strengths**: Powerful customization, scalability, wide range of extensions.
   - **Weaknesses**: Complex setup, resource-intensive maintenance.
3. **WooCommerce**:
   - **Strengths**: Cost-effective, extensive customization, integrates seamlessly with WordPress.
   - **Weaknesses**: Performance issues with large catalogs, relies on WordPress.
4. **BigCommerce**:
   - **Strengths**: Feature-rich, strong SEO capabilities, multi-channel selling.
   - **Weaknesses**: Higher pricing structure, limited customization compared to open-source platforms.

## Existing Technologies

### Framework Comparison

| Feature | Flutter | React Native | Ionic | Xamarin |
|---|---|---|---|---|
| Programming Language | Dart | JavaScript | JavaScript/TypeScript | C# |
| Performance | High | Moderate | Moderate | High |
| Development Speed | Fast | Moderate | Fast | Moderate |

| | | | | |
|---|---|---|---|---|
| UI Consistency | High | Moderate | Low | High |
| Community Support | Growing | Large | Moderate | Moderate |
| Learning Curve | Moderate | Low | Low | High |
| Access to Native Features | Comprehensive | Comprehensive | Limited | Comprehensive |
| Integration with Web | Limited | Limited | Excellent | Limited |

**Choice**: **Flutter** for its high performance, fast development speed, and comprehensive UI consistency, which are crucial for ensuring a seamless user experience on "Clickcart".

## Database Comparison

| Feature | MongoDB | Firebase | MySQL | PostgreSQL |
|---|---|---|---|---|
| Type | NoSQL | NoSQL | SQL | SQL |
| Scalability | High | High | Moderate | High |
| Real-time Capabilities | Limited | Excellent | Limited | Limited |
| Flexibility | High | Moderate | High | High |
| Setup Complexity | Moderate | Low | Moderate | Moderate |
| Cost | Variable | Usage-based | Variable | Variable |
| Community Support | Large | Large | Large | Growing |
| Data Consistency | Eventual | Eventual | Strong | Strong |

**Choice**: **MongoDB** for its high scalability, flexibility, and strong support for complex queries, which are essential for managing diverse and dynamic data in "Clickcart".

## Competitor Analysis Table

| Feature | Shopify | Magento | WooCommerce | BigCommerce | Clickcart |
|---|---|---|---|---|---|
| User Interface (Weight: 0.2) | 4 | 3 | 3 | 4 | 4 |
| Customization (Weight: 0.3) | 3 | 5 | 4 | 3 | 4 |
| Cost (Weight: 0.2) | 2 | 3 | 5 | 2 | 4 |

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| Support<br>(Weight: 0.1) | 5 | 3 | 4 | 4 | 3 |
| Scalability<br>(Weight: 0.2) | 4 | 5 | 3 | 5 | 5 |
| Weighted Score | 3.6 | 3.9 | 3.9 | 3.6 | 4.2 |

### Summary

**Clickcart** leverages Flutter for its high performance, development speed, and consistent UI, and MongoDB for its scalability and flexibility. Compared to competitors, Clickcart scores highly in customization, cost, and scalability, providing a balanced and robust platform for modern e-commerce needs.

# System Requirements

## Functional Requirements:

### User Management

- Registration and login functionality for customers and administrators.
- Role-based access control to distinguish between admin and customer functionalities.
- Profile management for users, including updating personal information and password management.

### Product Management

- Admin interface to add, edit, and delete products.
- Categorization and tagging of products for easy navigation.
- Inventory management to track stock levels and notify admins of low stock.

### Shopping Cart

- Add, update, and remove items from the shopping cart.
- Display item details, quantities, and total price in the cart.
- Persistent cart to retain items across sessions.

### Order Processing

- Secure checkout process integrating Stripe API for credit card payments and Coinbase Commerce for cryptocurrency payments.
- Order confirmation and receipt generation.
- Order tracking functionality for customers.

### Payment Processing

- Integration with Stripe API for handling credit card transactions.
- Integration with Coinbase Commerce for cryptocurrency payments.
- Handling payment errors and providing appropriate feedback to users.

### Search and Navigation

- Search functionality with filtering options (e.g., by category, price, rating).
- Navigation menu for accessing different product categories and account-related pages.
- Product recommendations based on user behavior and preferences.

### Real-Time Updates

- Real-time inventory updates using WebSockets or similar technology.
- Notifications for admins about low stock or new orders.
- Real-time order status updates for customers.

### Reporting and Analytics

- Admin dashboard with key metrics (e.g., sales, traffic, inventory levels).
- Reports on sales performance, customer behavior, and product popularity.
- Data export functionality for further analysis.

## Nonfunctional Requirements:

1. **Performance**
   - Fast response times for all user interactions.
   - Capable of handling at least 1,000 concurrent users without performance degradation.
   - Efficient database queries to ensure quick data retrieval.
2. **Scalability**
   - Design to support horizontal scaling by adding more servers.
   - Ability to handle increasing amounts of data and user load without significant changes to the system architecture.
3. **Security**
   - Secure user authentication and authorization mechanisms.
   - Encryption of sensitive data, such as passwords and payment information.
   - Regular security audits and penetration testing.
4. **Reliability**
   - High availability with minimal downtime.
   - Robust error handling and logging for diagnosing issues.
   - Backup and recovery procedures for critical data.
5. **Usability**
   - Intuitive and user-friendly interfaces for both admin and customer applications.
   - Consistent and responsive design across different devices and screen sizes.
   - Accessible design that adheres to web accessibility standards.
6. **Maintainability**
   - Modular code structure to facilitate easy maintenance and updates.
   - Comprehensive documentation for both developers and end-users.
   - Automated testing and continuous integration/continuous deployment (CI/CD) pipeline.
7. **Compatibility**
   - Cross-platform compatibility for the Flutter client application.

- Compatibility with major web browsers for the web-based admin interface.
- Seamless integration with third-party services such as payment gateways and shipping providers.

8. **Compliance**
   - Adherence to relevant data protection regulations, such as GDPR.
   - Compliance with industry standards for e-commerce and payment processing.

# Alternatives

## System:

1. **Pre-built E-commerce Platforms**
   - **Shopify**: Offers a comprehensive, hosted e-commerce solution with a wide range of features and integrations. It simplifies the setup process but comes with subscription fees and transaction costs.
   - **WooCommerce**: A plugin for WordPress that allows for extensive customization and control. It is cost-effective and suitable for those familiar with WordPress but requires more effort to manage and scale.
2. **Open-source E-commerce Solutions**
   - **Magento**: Provides a highly customizable and scalable platform suitable for large enterprises. It requires significant technical expertise and resources for setup and maintenance.
   - **OpenCart**: A user-friendly, open-source platform that offers a range of extensions and themes. It is less complex than Magento but may lack some advanced features.

## System implementation:

### Monolithic Architecture

- **Advantages**: Simpler to develop and deploy initially, with all components integrated into a single system.
- **Disadvantages**: Can become unwieldy and difficult to manage as the application grows, leading to potential scalability and maintenance issues.

### Microservices Architecture

- **Advantages**: Allows for independent development, deployment, and scaling of individual services. Enhances maintainability and flexibility.
- **Disadvantages**: More complex to implement and manage, requiring robust inter-service communication and orchestration.

## Technological:

### Frontend Frameworks

- **React**: A popular JavaScript library for building user interfaces. It offers a component-based architecture and strong community support. React Native can be used for mobile applications.
- **Angular**: A comprehensive framework for building dynamic web applications. It provides a robust set of tools and features for enterprise-level applications.
- **Vue.js**: A progressive JavaScript framework that is easy to integrate with other projects. It offers a balance between simplicity and flexibility.

### Backend Frameworks

- **Django**: A high-level Python web framework that encourages rapid development and clean, pragmatic design. It includes built-in features for authentication, ORM, and more.
- **Ruby on Rails**: A server-side web application framework written in Ruby. It follows the convention over configuration principle and is known for its simplicity and speed of development.

- **Spring Boot**: A Java-based framework that simplifies the development of production-ready applications. It is highly scalable and suitable for complex, large-scale applications.

**Databases**

- **PostgreSQL**: An open-source relational database management system known for its robustness and compliance with SQL standards. It is suitable for complex queries and transactions.
- **MySQL**: A widely-used open-source relational database management system. It is known for its speed and reliability but may lack some advanced features of PostgreSQL.
- **Firebase**: A NoSQL cloud database that provides real-time data synchronization. It is easy to set up and use, particularly for mobile and web applications.

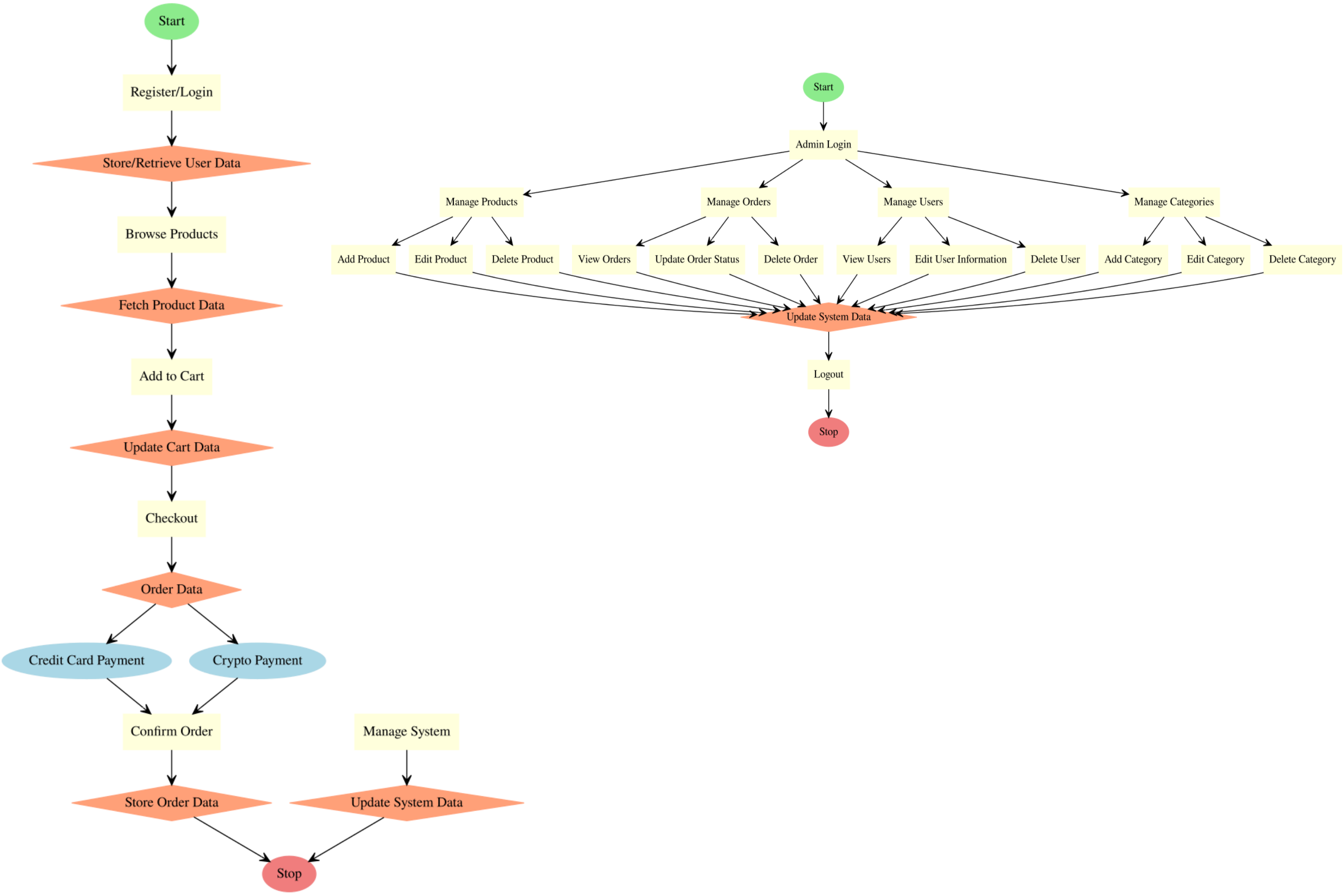
## Hardware & Architectural:

1. **On-Premises Servers**
   - **Advantages**: Complete control over hardware and software configurations, potentially lower long-term costs for large-scale operations.
   - **Disadvantages**: High initial setup costs, ongoing maintenance, and scalability challenges.
2. **Cloud-based Infrastructure**
   - **AWS (Amazon Web Services)**: Offers a wide range of cloud services, including computing, storage, and databases. It provides scalability, reliability, and global reach but can be costly.
   - **Google Cloud Platform (GCP)**: Provides robust cloud services with strong support for machine learning and data analytics. It offers competitive pricing and integration with Google services.
   - **Microsoft Azure**: A comprehensive cloud platform with a broad set of services and enterprise-level support. It integrates well with Microsoft products and services.
3. **Hybrid Cloud Solutions**

- **Advantages**: Combines the benefits of on-premises and cloud infrastructure, allowing for greater flexibility, scalability, and cost management.
- **Disadvantages**: Increased complexity in managing and integrating different environments, potential security and compliance challenges.

# Analysis & Visualization:

## Flow Diagram:



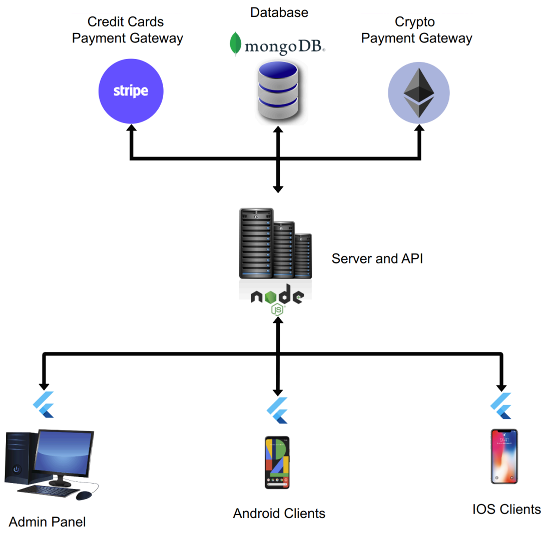
## E-Commerce Client Flow Diagram

The first flow diagram illustrates the e-commerce client-side process from the start to the completion of a transaction. The flow begins with the user registering or logging into the system. Upon successful authentication, the user can browse available products. Once products are fetched from the database, the user can add desired items to their cart. The system updates the cart data and allows the user to proceed to the checkout process. At checkout, the system prepares the order data, and the user can choose to pay via credit card (processed by Stripe) or cryptocurrency (processed by Coinbase Commerce). Upon successful payment, the order is confirmed, and the order data is stored in the database. The process concludes with the user receiving confirmation and the system storing the final order details.

## Admin Flow Diagram

The second flow diagram details the admin panel activities within the e-commerce system. Starting with the admin logging in, the admin can manage various aspects of the system, including products, orders, users, and categories. For product management, the admin can add, edit, or delete products. Similarly, order management includes viewing orders, updating order statuses, and deleting orders. User management involves viewing user details, editing user information, and deleting users. Category management allows the admin to add, edit, or delete categories. After making any changes, the system data is updated accordingly. Finally, the admin can log out, completing the admin workflow. This diagram highlights the comprehensive administrative capabilities provided to manage the e-commerce platform efficiently.

## Architecture:



### Admin Panel

- A Flutter-based interface used by administrators to manage products, orders, and users on the e-commerce platform.

### Android Clients

- Flutter applications that allow Android users to browse products, make purchases, and manage their accounts.

### iOS Clients

- Flutter applications that provide iOS users with the ability to browse, purchase products, and manage their accounts.

**Server and API (Node.js)**

- The backend server that handles business logic, processes requests from clients and the admin panel, and interacts with the database and payment gateways.

**Database (MongoDB)**

- The NoSQL database that stores all the platform's data, including user information, product details, orders, and more.

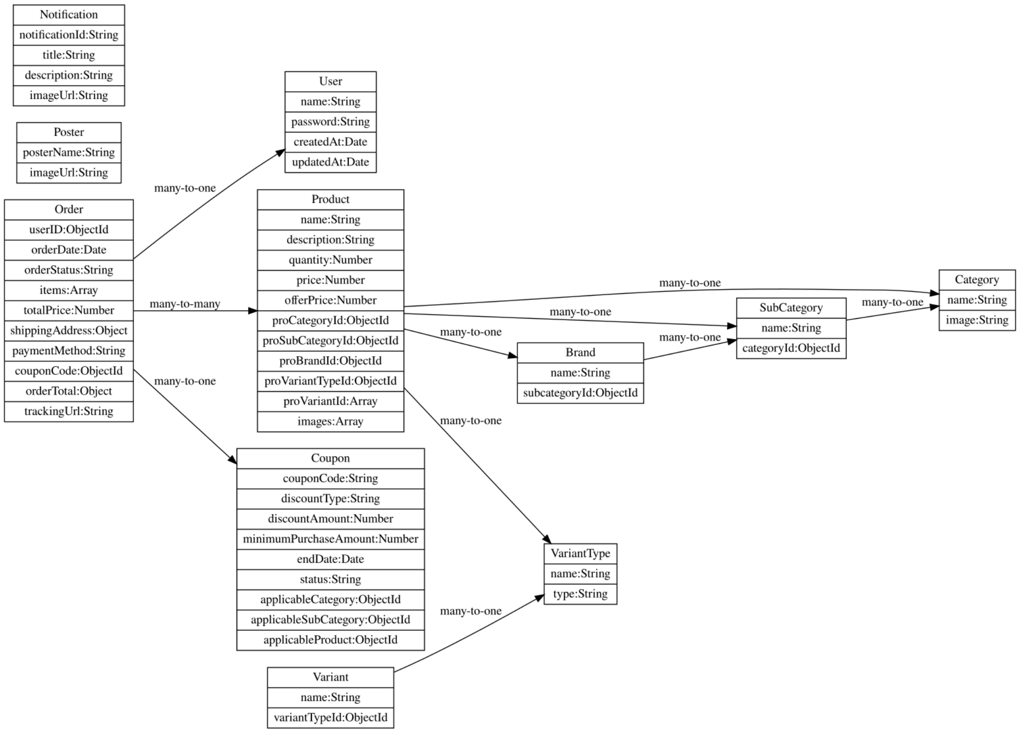
**Credit Cards Payment Gateway (Stripe)**

- The service used to process credit card payments securely from customers.

**Crypto Payment Gateway (Ethereum)**

- The service that facilitates cryptocurrency payments using the Coinbase Commerce wallet for Ethereum transactions.

## ERD Diagram:



## User:

- name: The name of the user.
- password: The password for the user account.
- createdAt: The date and time when the user account was created.
- updatedAt: The date and time when the user account was last updated.

## Product:

- name: The name of the product.
- description: A description of the product.
- quantity: The quantity of the product available in stock.
- price: The price of the product.
- offerPrice: The discounted price of the product, if any.
- proCategoryId: The ID of the category to which the product belongs.
- proSubCategoryId: The ID of the subcategory to which the product belongs.
- proBrandId: The ID of the brand to which the product belongs.
- proVariantTypeId: The ID of the variant type of the product.
- proVariantId: An array of variant IDs for the product.
- images: An array of images for the product, each containing an image number and a url.

## Order:

- userID: The ID of the user who placed the order.
- orderDate: The date and time when the order was placed.
- orderStatus: The current status of the order (e.g., pending, processing, shipped, delivered, cancelled).
- items: An array of items in the order, each containing productID, productName, quantity, price, and variant.
- totalPrice: The total price of the order.
- shippingAddress: The shipping address for the order, containing phone, street, city, state, postalCode, and country.
- paymentMethod: The payment method used for the order (e.g., cod, prepaid).
- couponCode: The ID of the coupon applied to the order, if any.
- orderTotal: An object containing subtotal, discount, and total for the order.
- trackingUrl: The tracking URL for the order shipment.

## Category:

- name: The name of the subcategory.
- categoryId: The ID of the parent category to which the subcategory belongs.

### Sub-Category:

- name: The name of the subcategory.
- categoryId: The ID of the parent category to which the subcategory belongs.

### Brand:

- name: The name of the brand.
- subcategoryId: The ID of the subcategory to which the brand belongs.

### Variant:

- name: The name of the variant.
- variantTypeId: The ID of the variant type to which the variant belongs.

### Variant-type:

- name: The name of the variant type.
- type: The type of the variant (e.g., size, color).

### Coupon:

- couponCode: The code of the coupon.
- discountType: The type of discount (e.g., fixed, percentage).
- discountAmount: The amount of discount.
- minimumPurchaseAmount: The minimum purchase amount required to apply the coupon.
- endDate: The expiration date of the coupon.
- status: The status of the coupon (e.g., active, inactive).
- applicableCategory: The ID of the category to which the coupon is applicable.
- applicableSubCategory: The ID of the subcategory to which the coupon is applicable.
- applicableProduct: The ID of the product to which the coupon is applicable.

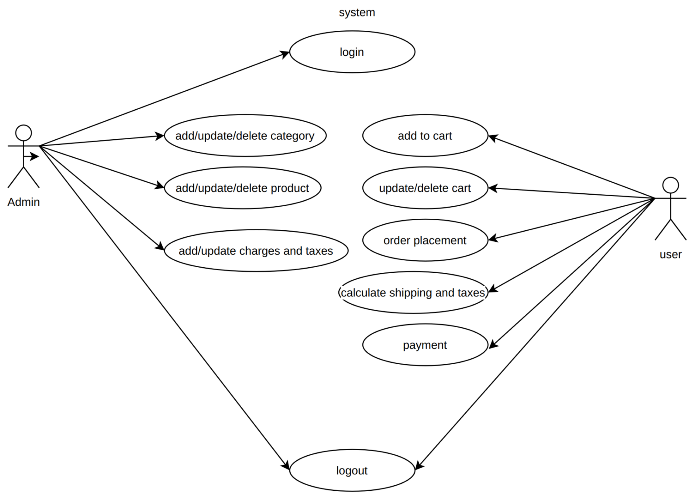
### Poster:

- posterName: The name of the poster.
- imageUrl: The image URL of the poster.

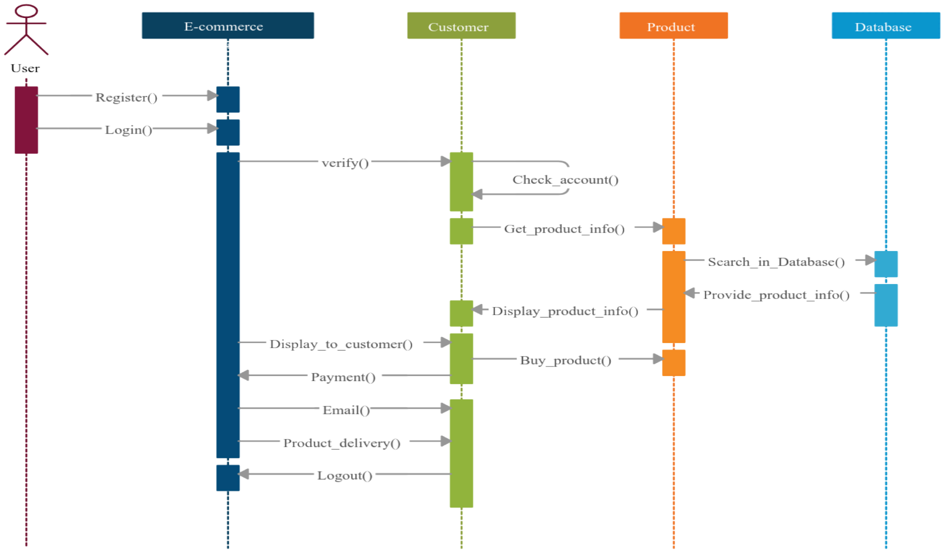
### Notification:

- notificationId: The ID of the notification.
- title: The title of the notification.
- description: The description of the notification.
- imageUrl: The image URL of the notification.

# Use Case:


system
login
add/update/delete category
add/update/delete product
add/update charges and taxes
add to cart
update/delete cart
order placement
calculate shipping and taxes
payment
logout
Admin
user

# Sequence Diagrams:



# Risks Management

### Data Security and Privacy

- **Risk**: Unauthorized access to sensitive user information, including personal details and payment data.
- **Mitigation**: Implement strong encryption, secure authentication methods, regular security audits, and compliance with data protection regulations such as GDPR.

### System Downtime and Availability

- **Risk**: Server downtime or performance issues affecting user experience and business operations.
- **Mitigation**: Use cloud services with high availability, implement load balancing, perform regular maintenance, and have a robust disaster recovery plan.

### Payment Processing Failures

- **Risk**: Issues with payment gateways leading to transaction failures or delays.
- **Mitigation**: Integrate multiple payment gateways (Stripe and Coinbase Commerce) to provide alternatives, monitor transaction processes, and implement real-time alerts for payment issues.

### Scalability and Performance Bottlenecks

- **Risk**: Inability to handle increased traffic or data load, leading to slow performance and user dissatisfaction.
- **Mitigation**: Design the system with scalability in mind, use performance monitoring tools, conduct regular load testing, and optimize database queries and server responses.

# Engineering Challenges

# Technical Challenges:

**Integration of Multiple Technologies**:

- Ensuring seamless integration between the client-side (Flutter), server-side (Node.js), database (MongoDB), and payment gateways (Stripe and Coinbase Commerce) can be complex. Each technology has its own set of protocols, APIs, and potential compatibility issues that need to be resolved.

**Real-Time Updates**:

- Implementing real-time updates for inventory, order statuses, and notifications requires efficient use of WebSockets or similar technology. Ensuring low latency and high reliability in real-time communication is a significant technical challenge.

**Cross-Platform Compatibility**:

- Developing a consistent and responsive user experience across multiple platforms (iOS, Android, and web) using Flutter requires careful handling of platform-specific nuances and testing on different devices and operating systems.

## System Design Challenges:

**Scalability**:

- Designing the system to handle future growth in terms of users, products, and transactions is critical. The architecture must support horizontal scaling, efficient load balancing, and the ability to handle spikes in traffic without performance degradation.

**Security and Compliance**:

- Implementing robust security measures to protect against data breaches, ensuring secure payment processing, and maintaining compliance with regulations like GDPR require careful planning and ongoing vigilance.

**Reliability and Fault Tolerance**:

- Ensuring the system remains operational and performs well under various conditions, including server failures or network issues, necessitates the implementation of redundancy, failover mechanisms, and comprehensive monitoring and alerting systems.

## Data-Related Challenges:

**Data Consistency and Integrity**:

- Maintaining data consistency and integrity across various operations, such as adding products, processing orders, and updating inventory, is crucial. This involves implementing transaction management and ensuring data synchronization between the server and database.

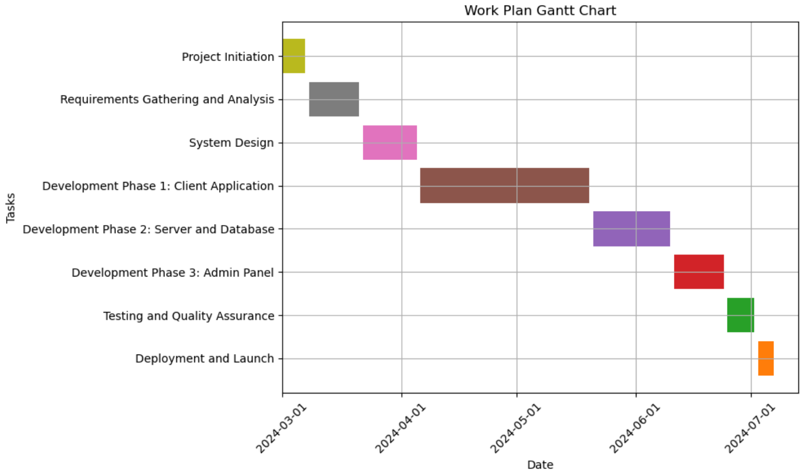
**Efficient Data Storage and Retrieval**:

- Optimizing MongoDB for fast data retrieval and minimal downtime, especially with large datasets, requires effective indexing strategies, query optimization, and database maintenance practices.

**Data Analytics and Reporting**:

- Providing meaningful analytics and reports for administrators involves processing and analyzing large volumes of data. Implementing efficient data aggregation, storage of historical data, and real-time reporting capabilities present significant challenges.

# Work Plan



# Software Testing and Evaluation

## Software Requirements:

To run the system, the following requirements are needed:

1. Node.js with the following packages:
   - **express** (for the server-side logic)
   - **mongoose** (for MongoDB interactions)
   - **cors** (for handling Cross-Origin Resource Sharing)
   - **dotenv** (for managing environment variables)
   - **jsonwebtoken** (for handling JSON Web Tokens)
   - **bcryptjs** (for password hashing)
   - **nodemon** (for development purposes)

2. Flutter with the following dependencies:
   - **http (for making HTTP requests and crypto payments)**
   - **provider (for state management)**
   - **flutter_secure_storage (for secure data storage)**
   - **stripe_payment (for integrating Stripe payments)**
   - **shared_preferences (for storing user preferences)**

3. Database:

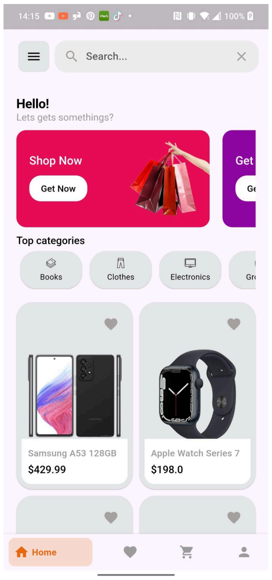
- **MongoDB** (NoSQL database)

4. Development Tools:

- **Visual Studio Code** (recommended IDE)
- **Postman** (for API testing)
- **Docker** (for containerization, if needed)

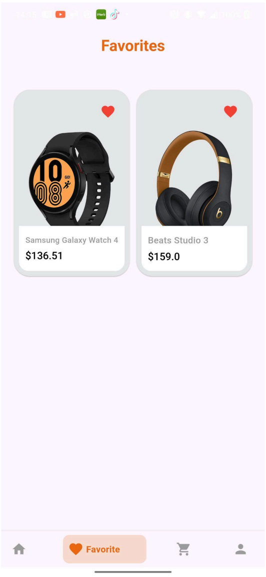
# Software Testing

## Client App



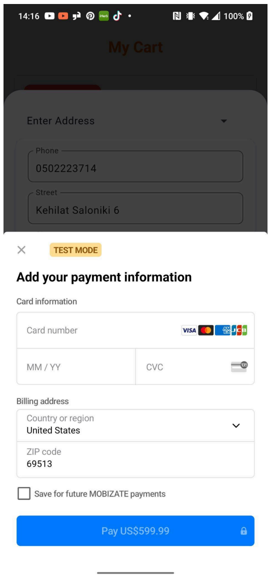
Samsung A53 128GB
$429.99

Apple Watch Series 7
$198.0



Samsung Galaxy Watch 4
$136.51

Beats Studio 3
$159.0



Enter Address

Phone: 0502223714

Street: Kehilat Saloniki 6

Add your payment information

Card information

Card number

MM / YY

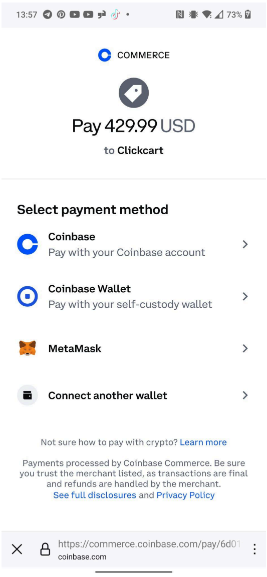
Billing address

Country or region: United States

ZIP code: 69513

□ Save for future MOBIZATE payments

Pay US$599.99



Pay 429.99 USD

to Clickcart

Select payment method

Coinbase
Pay with your Coinbase account

Coinbase Wallet
Pay with your self-custody wallet

MetaMask

Connect another wallet

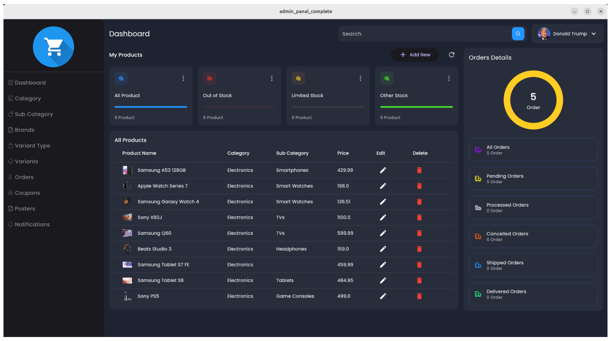
Not sure how to pay with crypto? Learn more

Payments processed by Coinbase Commerce. Be sure you trust the merchant listed, as transactions are final and refunds are handled by the merchant.
See full disclosures and Privacy Policy

https://commerce.coinbase.com/pay/6d01
coinbase.com

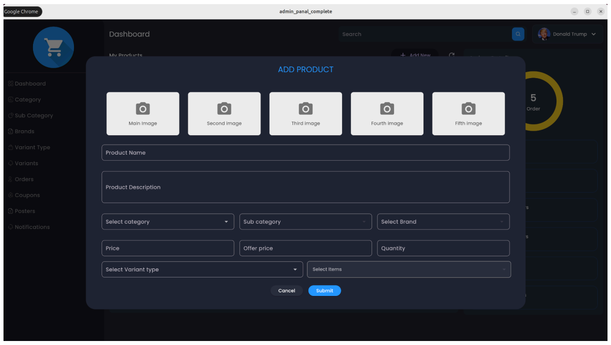
The images show Clickcart app functionalities, requiring comprehensive testing. User Interface Testing ensures visual appeal and functionality across devices, checking element alignment and button operations like "Get Now" and "Favorite." Functional Testing verifies features such as search, navigation, and cart management. Usability Testing focuses on ease of use, navigation, and accessibility of product details and prices. Payment Gateway Testing checks the secure processing of payment methods, including credit cards and cryptocurrencies like Coinbase. Localization Testing verifies support for different languages and regional settings. Performance Testing ensures responsiveness and load times under various conditions, ensuring a smooth, user-friendly experience.

# Admin Panel



All Products

| Product Name | Category | Sub Category | Price | Edit | Delete |
|---|---|---|---|---|---|
| Samsung A53 128GB | Electronics | Smartphones | 429.99 | ✎ | 🗑 |
| Apple Watch Series 7 | Electronics | Smart Watches | 198.0 | ✎ | 🗑 |
| Samsung Galaxy Watch 4 | Electronics | Smart Watches | 136.51 | ✎ | 🗑 |
| Sony X80J | Electronics | TVs | 1100.0 | ✎ | 🗑 |
| Samsung Q60 | Electronics | TVs | 599.99 | ✎ | 🗑 |
| Beats Studio 3 | Electronics | Headphones | 159.0 | ✎ | 🗑 |
| Samsung Tablet S7 FE | Electronics |  | 459.99 | ✎ | 🗑 |
| Samsung Tablet S8 | Electronics | Tablets | 484.95 | ✎ | 🗑 |
| Sony PS5 | Electronics | Game Consoles | 499.0 | ✎ | 🗑 |



ADD PRODUCT

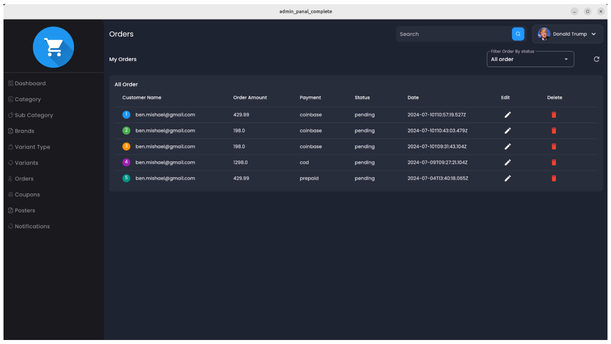
Product Name

Product Description

Select category | Sub category | Select Brand

Price | Offer price | Quantity

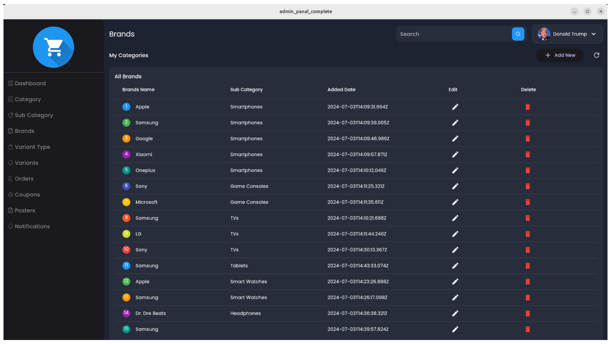
Select Variant type | Select Items



Filter Order By status: All order

All Order

| Customer Name | Order Amount | Payment | Status | Date | Edit | Delete |
|---|---|---|---|---|---|---|
| 1 ben.mishael@gmail.com | 429.99 | coinbase | pending | 2024-07-10T10:57:19.527Z | ✎ | 🗑 |
| 2 ben.mishael@gmail.com | 198.0 | coinbase | pending | 2024-07-10T10:43:03.479Z | ✎ | 🗑 |
| 3 ben.mishael@gmail.com | 198.0 | coinbase | pending | 2024-07-10T09:31:43.104Z | ✎ | 🗑 |
| 4 ben.mishael@gmail.com | 1298.0 | cod | pending | 2024-07-09T09:27:21.104Z | ✎ | 🗑 |
| 5 ben.mishael@gmail.com | 429.99 | prepaid | pending | 2024-07-04T13:40:18.065Z | ✎ | 🗑 |



All Brands

| Brands Name | Sub Category | Added Date | Edit | Delete |
|---|---|---|---|---|
| 1 Apple | Smartphones | 2024-07-03T14:09:31.664Z | ✎ | 🗑 |
| 2 Samsung | Smartphones | 2024-07-03T14:09:39.005Z | ✎ | 🗑 |
| 3 Google | Smartphones | 2024-07-03T14:09:46.986Z | ✎ | 🗑 |
| 4 Xiaomi | Smartphones | 2024-07-03T14:09:57.871Z | ✎ | 🗑 |
| 5 Oneplus | Smartphones | 2024-07-03T14:10:12.046Z | ✎ | 🗑 |
| 6 Sony | Game Consoles | 2024-07-03T14:11:25.321Z | ✎ | 🗑 |
| 7 Microsoft | Game Consoles | 2024-07-03T14:11:35.611Z | ✎ | 🗑 |
| 8 Samsung | TVs | 2024-07-03T14:10:21.688Z | ✎ | 🗑 |
| 9 LG | TVs | 2024-07-03T14:11:44.246Z | ✎ | 🗑 |
| 10 Sony | TVs | 2024-07-03T14:30:13.367Z | ✎ | 🗑 |
| 11 Samsung | Tablets | 2024-07-03T14:43:33.074Z | ✎ | 🗑 |
| 12 Apple | Smart Watches | 2024-07-03T14:23:26.888Z | ✎ | 🗑 |
| 13 Samsung | Smart Watches | 2024-07-03T14:26:17.098Z | ✎ | 🗑 |
| 14 Dr. Dre Beats | Headphones | 2024-07-03T14:36:38.321Z | ✎ | 🗑 |
| 15 Samsung |  | 2024-07-03T14:39:57.824Z | ✎ | 🗑 |

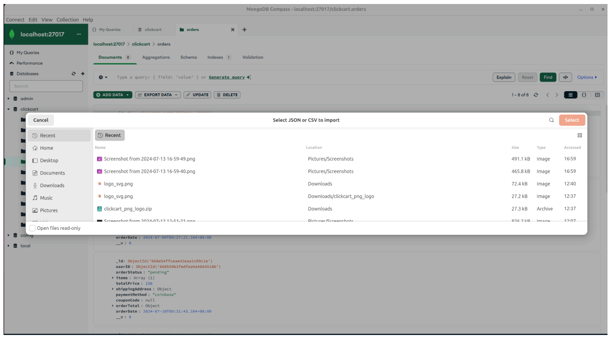
The images depict the admin panel for the Clickcart app, necessitating comprehensive software testing. User Interface Testing ensures that the UI elements are properly aligned, labeled, and functional. Functional Testing verifies that features like adding new products, editing product details, managing orders, and updating brand information work correctly. Usability Testing checks the intuitiveness of navigation and the ease of performing administrative tasks. Performance Testing ensures the admin panel responds well under various conditions, including handling multiple products and orders. This thorough testing approach guarantees the admin panel operates smoothly, providing an efficient and user-friendly experience for managing the e-commerce platform.

# Node.js Backend API

The Online Store API is a backend service designed to manage eCommerce operations, including product, order, and customer management. It provides RESTful endpoints for CRUD operations on products, orders, customers, and more, ensuring efficient inventory and payment processing. The API is built with Node.js and Express.js, uses MongoDB for data storage, and integrates with Stripe and Coinbase for payment processing. It also supports push notifications via OneSignal. This

API is essential for testing various eCommerce functionalities, ensuring robust and reliable performance in a production environment.

## Database

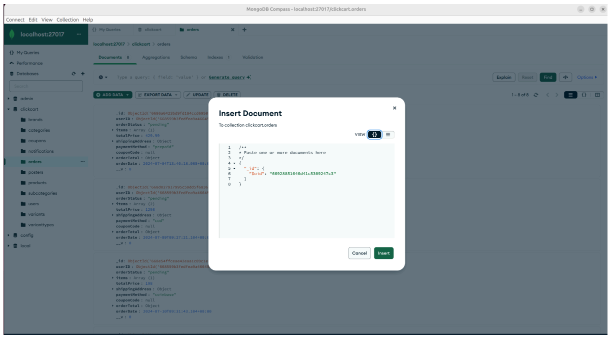


Select JSON or CSV to import

| Name | Location | Size | Type | Accessed |
|---|---|---|---|---|
| Screenshot from 2024-07-13 16-59-49.png | Pictures/Screenshots | 491.1 kB | Image | 16:59 |
| Screenshot from 2024-07-13 16-59-40.png | Pictures/Screenshots | 465.8 kB | Image | 16:59 |
| logo_svg.png | Downloads | 72.4 kB | Image | 12:40 |
| logo_svg.png | Downloads/clickcart_png_logo | 27.2 kB | Image | 12:37 |
| clickcart_png_logo.zip | Downloads | 27.3 kB | Archive | 12:37 |

□ Open files read-only

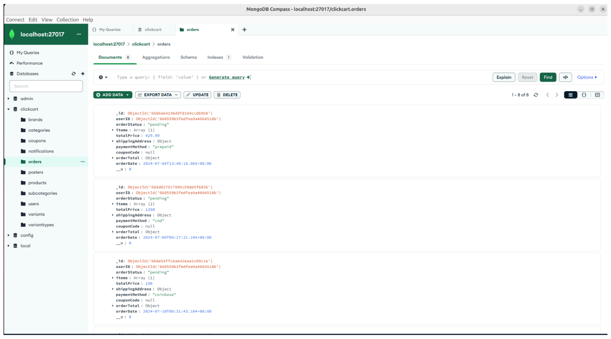
```
orderDate : 2024-07-09T09:27:21.104+00:00
__v : 0

_id: ObjectId('668e54ffceae42eaa1c89c1e')
userID : ObjectId('668559b3fedfea9a4664518b')
orderStatus : "pending"
items : Array (1)
totalPrice : 198
shippingAddress : Object
paymentMethod : "coinbase"
couponCode : null
orderTotal : Object
orderDate : 2024-07-10T09:31:43.104+00:00
__v : 0
```



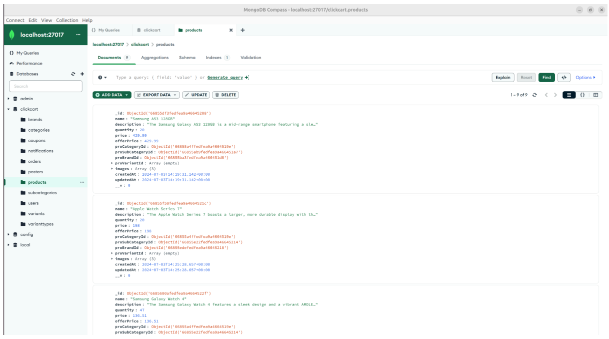
Insert Document

To collection clickcart.orders

```
/**
* Paste one or more documents here
*/
{
  "_id": {
    "$oid": "66928851646d41c5309247c3"
  }
}
```



```
_id: ObjectId('6686a6423bd9fd184ccd6950')
userID : ObjectId('668559b3fedfea9a4664518b')
orderStatus : "pending"
items : Array (1)
totalPrice : 429.99
shippingAddress : Object
paymentMethod : "prepaid"
couponCode : null
orderTotal : Object
orderDate : 2024-07-04T13:40:18.065+00:00
__v : 0

_id: ObjectId('668d027917995c59dd5f6836')
userID : ObjectId('668559b3fedfea9a4664518b')
orderStatus : "pending"
items : Array (2)
totalPrice : 1298
shippingAddress : Object
paymentMethod : "cod"
couponCode : null
orderTotal : Object
orderDate : 2024-07-09T09:27:21.104+00:00
__v : 0

_id: ObjectId('668e54ffceae42eaa1c89c1e')
userID : ObjectId('668559b3fedfea9a4664518b')
orderStatus : "pending"
items : Array (1)
totalPrice : 198
shippingAddress : Object
paymentMethod : "coinbase"
couponCode : null
orderTotal : Object
orderDate : 2024-07-10T09:31:43.104+00:00
__v : 0
```



```
_id: ObjectId('66855df3fedfea9a46645208')
name : "Samsung A53 128GB"
description : "The Samsung Galaxy A53 128GB is a mid-range smartphone featuring a sle…"
quantity : 20
price : 429.99
offerPrice : 429.99
proCategoryId : ObjectId('66855a4ffedfea9a4664519e')
proSubCategoryId : ObjectId('66855ab9fedfea9a466451a7')
proBrandId : ObjectId('66855ba3fedfea9a466451d8')
proVariantId : Array (empty)
images : Array (3)
createdAt : 2024-07-03T14:19:31.142+00:00
updatedAt : 2024-07-03T14:19:31.142+00:00
__v : 0

_id: ObjectId('66855f58fedfea9a4664521c')
name : "Apple Watch Series 7"
description : "The Apple Watch Series 7 boasts a larger, more durable display with th…"
quantity : 20
price : 198
offerPrice : 198
proCategoryId : ObjectId('66855a4ffedfea9a4664519e')
proSubCategoryId : ObjectId('66855e22fedfea9a46645214')
proBrandId : ObjectId('66855edefedfea9a46645218')
proVariantId : Array (empty)
images : Array (3)
createdAt : 2024-07-03T14:25:28.657+00:00
updatedAt : 2024-07-03T14:25:28.657+00:00
__v : 0

_id: ObjectId('6685600afedfea9a4664522f')
name : "Samsung Galaxy Watch 4"
description : "The Samsung Galaxy Watch 4 features a sleek design and a vibrant AMOLE…"
quantity : 47
price : 136.51
offerPrice : 136.51
proCategoryId : ObjectId('66855a4ffedfea9a4664519e')
proSubCategoryId : ObjectId('66855e22fedfea9a46645214')
```

The images depict MongoDB Compass, highlighting product and order data management for the Clickcart app. Thorough software testing is essential here. User Interface Testing ensures data is correctly displayed and interfaces are user-friendly. Functional Testing verifies operations like adding, updating, and deleting product and order documents. Usability Testing checks for ease of navigation and clarity of information. Performance Testing ensures efficient handling of large datasets and responsiveness. This comprehensive testing approach guarantees the MongoDB database performs reliably, maintaining accurate and up-to-date product and order information for Clickcart.

# Evaluation

## Functional Requirements:

- User and Product Management
  - Seamless user authentication with email and social login integration.
  - Comprehensive product catalog with intuitive search and advanced filtering options.
- Order and Payment Processing
  - Seamless user authentication with email and social login integration.
  - Comprehensive product catalog with intuitive search and advanced filtering options.

## Nonfunctional Requirements:

- Performance and Security
  - Optimized for fast loading and smooth performance across devices.
  - End-to-end encryption for all sensitive data and secure handling of payment information.
- Scalability and Usability
  - Scalable architecture to handle increasing numbers of users and transactions.
  - Intuitive and user-friendly interfaces for both the client app and admin panel.

# Discussion and conclusions

The ClickCart project represents a robust and comprehensive eCommerce platform designed to deliver a seamless shopping experience for users and efficient management tools for administrators. Built with modern technologies such as Flutter for the frontend, Node.js for the backend, and MongoDB for the database, ClickCart leverages the strengths of these frameworks to provide a high-performance, scalable, and secure solution.

## Discussion:

The functional requirements of ClickCart are well-defined and cater to both user and admin needs. The platform offers seamless user authentication, a comprehensive product catalog, and a dynamic shopping cart, ensuring a smooth and intuitive user experience. The integration of secure payment gateways like Stripe and Coinbase Commerce enhances the checkout process, providing users with multiple payment options. Additionally, the admin panel is equipped with robust tools for inventory management, order processing, and analytics, enabling administrators to efficiently manage the platform.

From a non-functional perspective, ClickCart excels in performance, security, scalability, and usability. The platform is optimized for fast loading times and smooth performance across various devices, ensuring a positive user experience. Security is a top priority, with end-to-end encryption for sensitive data and secure payment processing. The scalable architecture allows ClickCart to handle increasing numbers of users and transactions, making it suitable for growing businesses. The user-friendly interfaces for both the client app and admin panel further enhance the platform's usability.

## Conclusions:

In conclusion, ClickCart is a well-rounded eCommerce platform that successfully addresses the needs of both users and administrators. Its robust functional capabilities, combined with strong non-functional attributes, make it a reliable and efficient solution for online shopping and management. The use of modern technologies ensures that ClickCart remains scalable, secure, and performant, capable of adapting to the evolving demands of the eCommerce landscape. Overall, ClickCart stands out as a comprehensive and effective platform for businesses looking to establish or enhance their online presence.

# Proposals for Future development

**1. Enhanced Personalization**

- Implement machine learning algorithms to provide personalized product recommendations based on user behavior and preferences.

- Introduce personalized marketing campaigns and notifications to increase user engagement and retention.

**2. Advanced Analytics and Reporting**

- Develop more sophisticated analytics tools for administrators, including real-time dashboards and predictive analytics.

- Integrate advanced reporting features to help businesses make data-driven decisions and optimize their operations.

**3. Multi-Language and Multi-Currency Support**

- Add support for multiple languages to cater to a global audience.

- Implement multi-currency functionality to allow users to view prices and make payments in their preferred currency.

**4. Mobile App Enhancements**

- Introduce native mobile app features such as offline access, push notifications, and enhanced performance optimizations.

- Develop a Progressive Web App (PWA) version to provide a seamless experience across web and mobile platforms.

**5. Expanded Payment Options**

- Integrate additional payment gateways to offer more payment options, including regional and alternative payment methods.

- Implement a digital wallet feature to allow users to store and manage their payment information securely.

**6. Improved Customer Support**

- Develop an integrated customer support system with live chat, ticketing, and automated responses to common queries.

- Implement AI-driven chatbots to provide instant support and improve customer satisfaction.

## Adaptations Changes

| The change | In Which Part | When | Suggested by | Meaning |
|---|---|---|---|---|
| Crypto Payment Gateway | Backend & Frontend | During testing | Us, after failing to integrate with Metamask Testnet on Android phones | We decided to use Coinbase Commerce instead to implement crypto payments. |

## List of Sources

1. The impact of blockchain on e-commerce: A framework for salient research topics. Link

2. A comparison study between mobile cross-platform frameworks: Flutter vs. React Native, Karlstad University, Sweden. Link

3. A performance comparison of NoSQL and SQL databases for different scales of ecommerce systems, Link

4. An analysis of price, service and commission rate decisions in online sales made through E-commerce platforms, Link