HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

School of Information and communications technology

Software Design Document

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AIMS

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Vũ Việt Anh – 20215261

*Hanoi,* *<month, year>*

*<All notations inside the angle bracket are not part of this document, for its purpose is for extra instruction. When using this document, please erase all these notations and/or replace them with corresponding content as instructed>*

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# Introduction

*<The following subsections of the Software Design Document (SDD) document should provide an overview of the entire SDD.>*

## Objective

This document provides an analysis and modeling of the use cases for the AIMS – An Internet Media Store software. The document outlines the purpose and features of the system, as well as the constraints the system must meet to respond to external stimuli.

This document is intended for stakeholders and software developers.

## Scope

AIMS is a cross-platform system that operates 24/7, allowing new users to quickly get familiar with it. The system is capable of serving multiple customers simultaneously without significant performance degradation.

The AIMS system allows product managers to add, view, edit, and delete products. Each product must have information such as the product name, type, value, current price, and special information depending on the product type (e.g., books, CDs, DVDs). Product managers are allowed to change the product price up to 2 times per day, and the product price must be within 30% to 150% of the product's value.

Administrators are allowed to manage all the users of the systems, comprising product managers, and manage products.

The AIMS system stores the history of adding, editing, and deleting products and notifies administrators of invalid actions.

Customers can search and view product listings, sort products by price, or add products to the shopping cart. The shopping cart displays product information, pricing, and shipping fees. Customers can choose between standard or express shipping options.

To successfully place an order, customers need to update shipping information and make a payment. The payment method is through credit cards, and the system supports payments in the local currency (VND). After successful payment, the system displays a transaction code and stores the order information.

Administrators have the right to approve or reject orders. An order can be canceled after payment, and the money will be refunded to the customer.

In the simulation system, customers do not need to create an account to place an order. The system uses virtual credit cards for payment and provides APIs to manage virtual credit cards.

## Definitions, Acronyms, and Abbreviations

* **AIMS**: Automated Inventory Management System.
* **UC**: Use Case.
* **VNPay**: Third-party payment gateway for processing transactions.
* **Rush order:** refers to a request for expedited processing of an order, meaning the order needs to be completed and delivered faster than usual.

## References

|  |  |
| --- | --- |
| [1] | Centers for Medicare & Medicaid Services, "System Design Document Template," [Online]. Available: https://www.cms.gov/Research-Statistics-Data-and-Systems/CMS-Information-Technology/XLC/Downloads/SystemDesignDocument.docx. |

# Overall Description

<*This section describes the principles and strategies to be used as guidelines when designing and implementing the system.>*

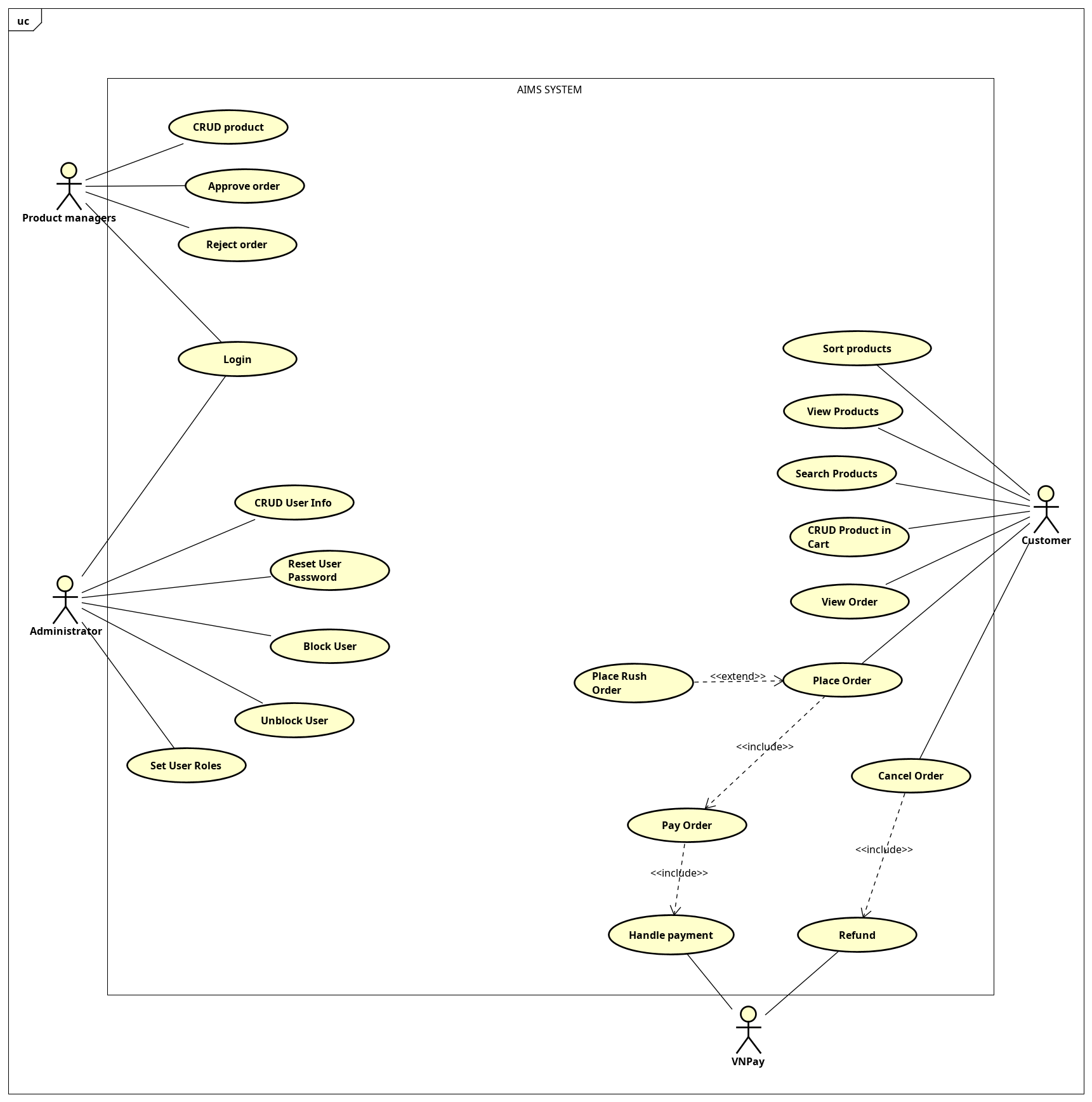
## General Overview

The AIMS system is designed to operate as a cross-platform system running 24/7, with a primary focus on usability and scalability. The system architecture allows for multiple concurrent users without a noticeable impact on performance. It serves both administrators and customers, providing interfaces for managing products, handling transactions, and processing payments.

The core functionalities include:

* **Product Management**: Product managers can add, view, edit, and delete products. Each product has detailed information, including specific attributes like name, type, value, and special characteristics depending on the product category (books, CDs, DVDs). Prices can be updated up to twice per day and must remain within 30% to 150% of the product's value.
* **Customer Interaction**: Customers can search for products, sort them by price, and manage a shopping cart. They can select between standard and express shipping options and complete transactions through credit card payments.
* **Order Management**: Administrators can approve, reject, or cancel orders, with a full audit trail of product changes. Order cancellations trigger automatic refunds.

Key architectural goals include ease of use, robust concurrency handling, and integration with virtual credit card APIs for simulation purposes.



## Assumptions/Constraints/Risks

### Assumptions

 The system operates in a mixed hardware environment (e.g., mobile platforms).

 Users have basic internet access and devices capable of handling online shopping.

 All transactions will be processed using credit cards in the local currency (VND).

 The system assumes stable internet connections for transactions to succeed without errors.

 Future functionalities might be required to handle international payments, but this is not within the current scope.

### Constraints

 **Hardware/Software Environment**: The system must be compatible with multiple platforms (web and mobile) and operate within modern web browsers.

 **End-user Environment**: Users must be able to quickly navigate the system, requiring a simple, intuitive user interface.

 **Resource Availability**: System resources (e.g., database, processing power) must handle simultaneous multiple users without degradation in performance.

 **Standards Compliance**: The system must adhere to relevant security standards (e.g., PCI DSS for payment processing).

 **Interoperability**: APIs for handling virtual credit card payments must be compatible with existing systems and easily extensible.

 **Data Security**: Secure storage of transaction and user data is paramount, following encryption standards and data protection regulations.

 **Performance Requirements**: The system must provide a smooth experience with quick loading times and responsive interfaces, even under heavy traffic.

 **Network Communications**: Efficient handling of network traffic is necessary, especially during payment processing and order updates.

###  ****Verification and Validation****: Regular testing is required to ensure the system functions as expected across all supported platforms and under different user loads.

### Risks

*<Describe any risks associated with the system design and proposed mitigation strategies.>*

 **Payment Gateway Failures**: The system’s reliance on external payment services may cause downtime or transaction failures. Mitigation: Implementing fallback mechanisms and user notifications during payment issues.

 **High Traffic Impact**: During peak usage times, system performance may degrade. Mitigation: Ensure the system is scalable, using load balancing and caching where necessary.

 **Data Breaches**: Unauthorized access to sensitive data is a risk. Mitigation: Strong encryption and regular security audits will help mitigate this risk.

 **Pricing Errors**: Incorrect price adjustments beyond allowed limits may occur. Mitigation: Implement checks and notifications for product managers to prevent such errors.

# System Architecture and Architecture Design

This section describes the overall architecture and design steps for the system, outlining the principles and strategies used in the implementation.

## Architectural Patterns

The chosen architectural pattern for this system is **MVC (Model-View-Controller)**.

* **Model**: This layer is responsible for managing the data and business logic of the system. It communicates with the database and processes any data-related operations.
* **View**: The view layer is responsible for presenting the data to the user in a specific format. It handles the UI and user interactions without holding any business logic.
* **Controller**: The controller acts as an intermediary between the model and view layers. It listens to user inputs, processes requests, and sends responses back to the view.

**Reason for Choosing MVC**:

* **Separation of concerns**: MVC separates the logic of the system, allowing independent development of UI, business logic, and data management.
* **Scalability**: With the separation of components, the system can be scaled efficiently.
* **Maintainability**: Modularized structure makes it easier to update or modify the system as requirements evolve.
* **Reusability**: Components within MVC can be reused across different parts of the application or even in other projects.

## Interaction Diagrams

### Sequence Diagrams

#### UC Place Order

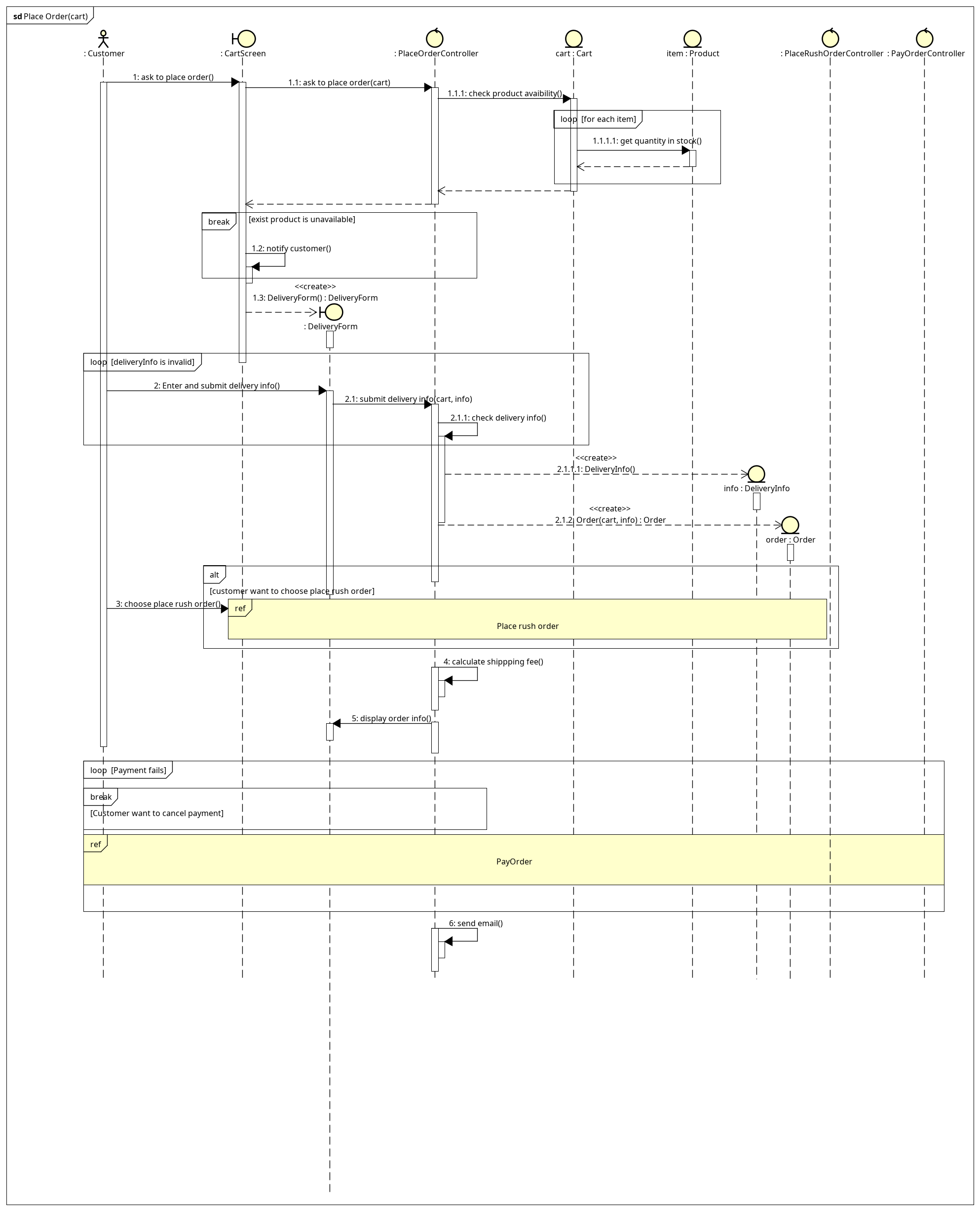


Figure : Place order

#### UC Pay Order

A diagram of a diagram

Description automatically generated

Figure : UC Pay Order

#### UC Place Rush Order

A diagram of a project

Description automatically generated

Figure : UC Place Rush Order

## Analysis Class Diagrams

#### UC Place Order

A diagram of a diagram

Description automatically generated with medium confidence

Figure : Analysic Class Diagram for UC Place Order

#### UC Pay Order

A diagram of a company

Description automatically generated

Figure : Analysic Class Diagram for UC Pay Order

#### UC Place Rush Order

A diagram of a company

Description automatically generated

Figure : Analysic Class Diagram for UC Place Rush Order

## Unified Analysis Class Diagram

A diagram of a computer flowchart

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Figure : Unified Analysis Class Diagram

## Security Software Architecture

*<Describe the software components and configuration supporting the security and privacy of the system. Specify the architecture for (1) authentication to validate user identity before allowing access to the system;(2) authorization of users to perform functional activity once logged into the system, (3) encryption protocol to support the business risks and the nature of information, and (4) logging and auditing design, if required.>*

# Detailed Design

## User Interface Design

*<Suppose that you design a Graphical User Interface (GUI)>*

### Screen Configuration Standardization

### Screen Transition Diagrams

### Screen Specifications

*<Screen images should be included in the screen specifications>*

## Data Modeling

### Conceptual Data Modeling

*<E-R Diagram image and description of entities and relationships>*

### Database Design

#### Database Management System

*<Specify what is the decision of Database Management System (DBMS) and give some description of the DBMS>*

#### Database Diagram

<

* *Show the process to design database from E-R diagram*
* *Show the diagram of DB design*

*>*

#### Database Detail Design

<

*Give a detail design of each element in the DB diagram. For instance, in a Relational DBMS, give a detail design for each Table and their constraints, illustrated in below table (PK: Primary Key, FK: Foreign Key).*

Table . Example of table design

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *#* | *PK* | *FK* | *Column name* | *Data type* | *Default value* | *Mandatory* | *Description* |
| 1 | x |  | ProductID |  |  |  |  |
| 2 |  | x | CategoryID |  |  |  |  |

*You may add indexing, trigger, view, etc.*

*Give the database script*>

## Non-Database Management System Files

*<Provide the detailed description of all non-DBMS files if any and include a narrative description of the usage of each file that identifies if the file is used for input, output, or both, and if the file is a temporary file. Also provide an indication of which modules read and write the file and include file structures (refer to the data dictionary). As appropriate, the file structure information should include the following:*

*• Record structures, record keys or indexes, and data elements referenced within the records*

*• Record length (fixed or maximum variable length) and blocking factors*

*• Access method (e.g., index sequential, virtual sequential, random access, etc.)*

*• Estimate of the file size or volume of data within the file, including overhead resulting from file access methods*

*• Definition of the update frequency of the file (If the file is part of an online transaction-based system, provide the estimated number of transactions per unit of time, and the statistical mean, mode, and distribution of those transactions.)*

*• Backup and recovery specifications>*

## Class Design

### General Class Diagram

<General class diagram which shows the whole class diagram of the software. This diagram may have packages, subsystems and classes. Classes in this diagram may not have all attributes and operations>

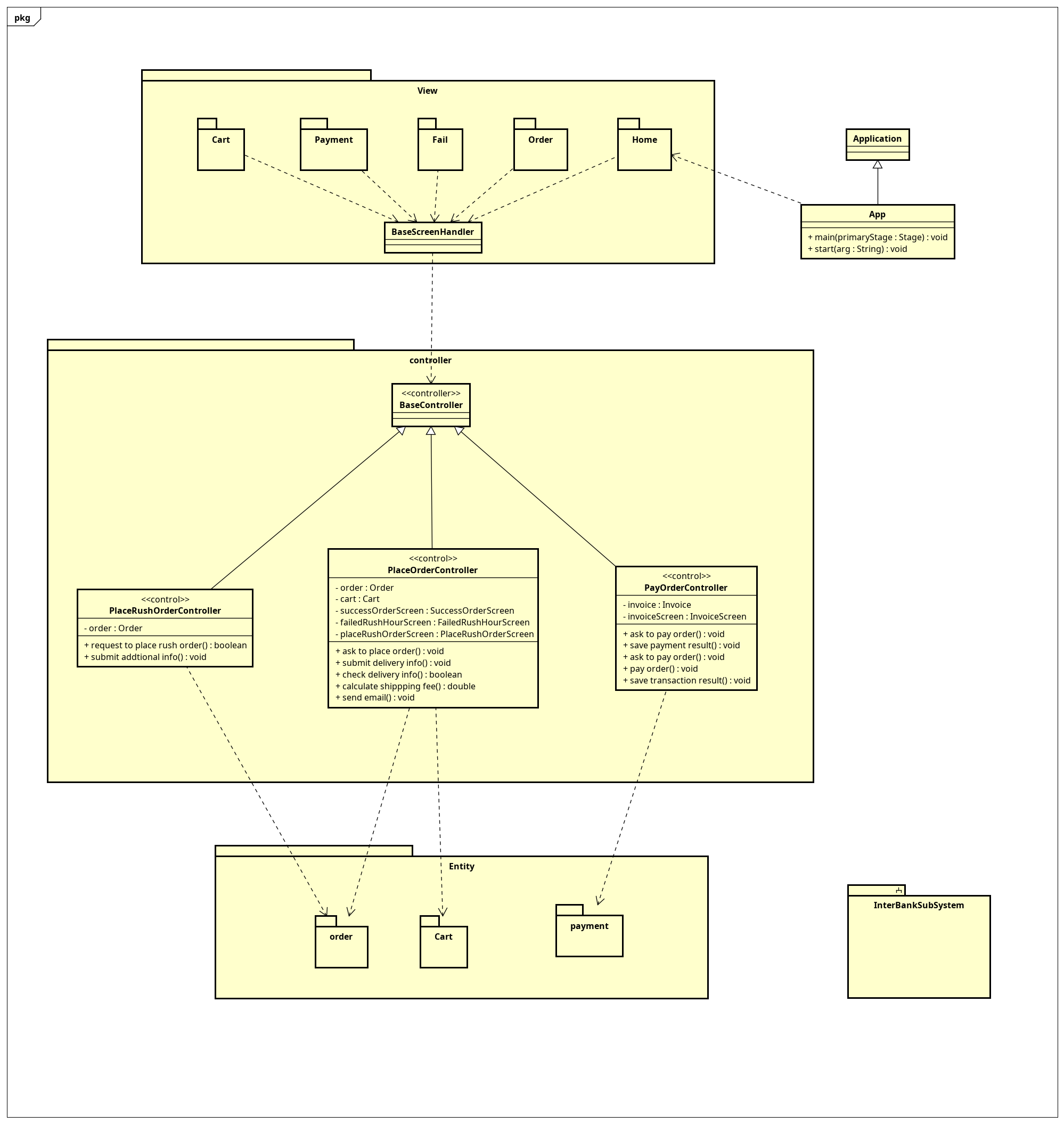


Figure : General Class Diagram

### Class Diagrams

#### Class Diagram for Package view.cart

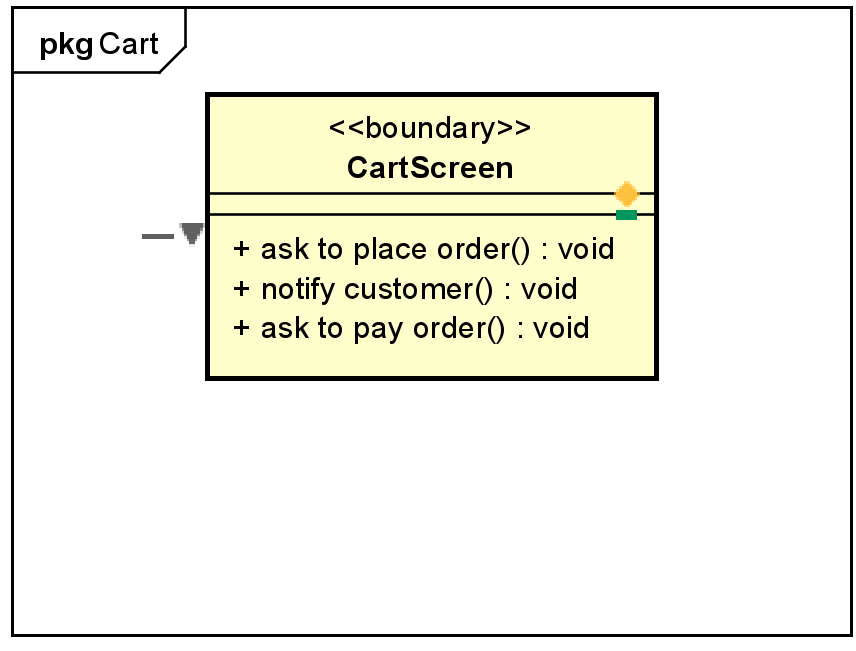


Figure : Class diagram for package view.cart

#### Class Diagram for Package view.fail

A screenshot of a computer

Description automatically generated

Figure : Class Diagram for Package view.fail

#### Class Diagram for Package view.order

A screenshot of a computer

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Figure : Class Diagram for Package view.order

#### Class Diagram for Package view.payment

A close-up of a computer screen

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Figure : Class Diagram for Package view.payment

#### Class Diagram for Package controller

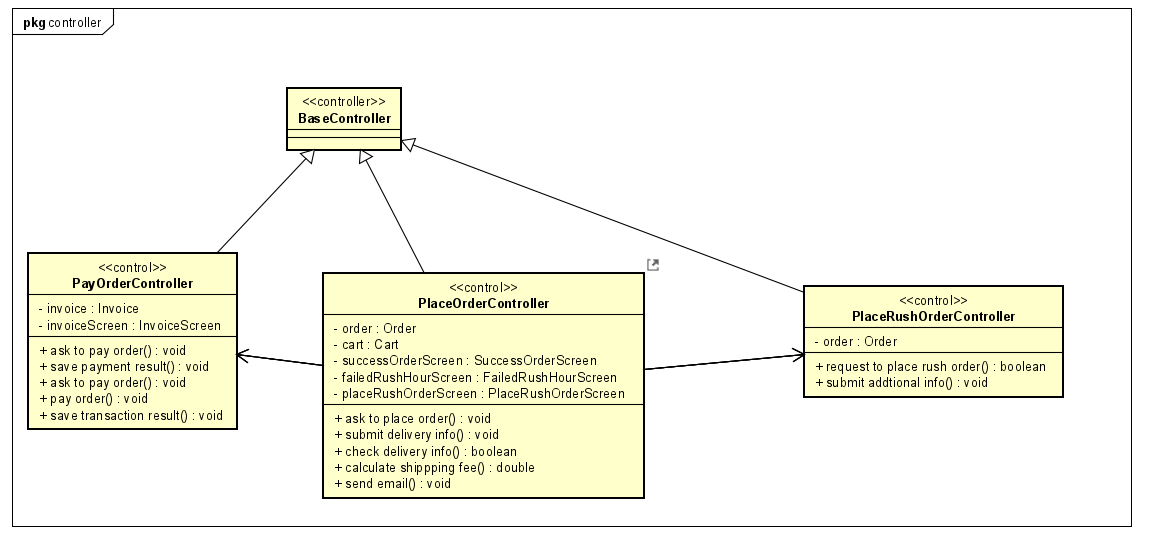


Figure : Class Diagram for Package controller

#### Class Diagram for Package entity.cart

A screenshot of a computer

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Figure : Class Diagram for Package entity.cart

#### Class Diagram for Package entity.order

A screenshot of a computer

Description automatically generated

Figure : Class Diagram for Package entity.order

#### Class Diagram for Package entity.payment

A diagram of a transaction

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Figure : Class Diagram for Package entity.payment

…

### Class Design

<Detail design for each class>

#### Class “PayOrderController”

A screenshot of a computer screen

Description automatically generated

Figure : Class "PayOrderController"

**Table 2. Attribute design**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *#* | *Name* | *Data type* | *Default value* | *Description* |
| 1 | invoice | Invoice | null | Represents the invoice for the order. |
| 2 | invoiceScreen | InvoiceScreen | null | Screen interface for displaying invoice details |

**Table 3. Operation design**

|  |  |  |  |
| --- | --- | --- | --- |
| *#* | *Name* | *Return type* | *Description (purpose)* |
| 1 | askToPayOrder() | void | Prompts the user to pay the order, typically via the InvoiceScreen. |
| 2 | payOrder() | void | Initiates the payment process for the order. |
| 3 | saveTransactionResult() | void | Saves the result of the payment transaction to the system. |

*Parameter*:

* askToPayOrder(): Không có
* payOrder(): Không có
* saveTransactionResult(): Không có

*Exception*:

* PaymentException if there is an error during the payment process.
* InvoiceNotFoundException if the invoice cannot be found during the transaction.

**Method**

* askToPayOrder(): This method uses invoiceScreen to prompt the user to initiate payment for the invoice.
* payOrder(): Uses invoice to complete the payment process.
* saveTransactionResult(): Stores the outcome of the payment, potentially interacting with other components such as a database.

#### Class “PlaceOrderController”

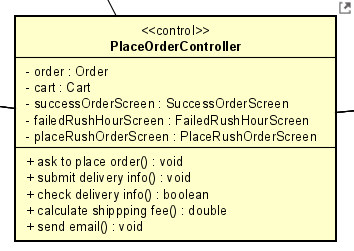


Figure : Class "PlaceOrderController"

**Table 2. Attribute design**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *#* | *Name* | *Data type* | *Default value* | *Description* |
| 1 | order | Order | N/A | Represents the order that needs to be processed. |
| 2 | cart | Cart | N/A | The shopping cart associated with the order. |
| 3 | successOrderScreen | SuccessOrderScreen | N/A | Screen displayed upon successful order placement. |
| 4 | failedRushHourScreen | FailedRushHourScreen | N/A | Screen displayed if order fails due to rush hour traffic. |
| 5 | placeRushOrderScreen | PlaceRushOrderScreen | N/A | Screen for placing rush orders. |

**Table 3. Operation design**

|  |  |  |  |
| --- | --- | --- | --- |
| *#* | *Name* | *Return type* | *Description (purpose)* |
| 1 | askToPlaceOrder() | void | Initiates the process of placing an order. |
| 2 | submitDeliveryInfo() | void | Submits delivery information for the order. |
| 3 | checkDeliveryInfo() | boolean | Checks if the delivery information is valid. |
| 4 | calculateShippingFee() | double | Calculates the shipping fee for the order based on delivery info. |
| 5 | sendEmail() | void | Sends a confirmation email after the order has been placed. |

*Parameter*:

* askToPlaceOrder(): Không có
* submitDeliveryInfo(): Không có

checkDeliveryInfo(): Không có

calculateShippingFee(): Không có

sendEmail(): Không có

*Exception*:

* PaymentException if there is an error during the payment process.
* InvoiceNotFoundException if the invoice cannot be found during the transaction.

**Method**

* askToPayOrder(): This method uses invoiceScreen to prompt the user to initiate payment for the invoice.
* payOrder(): Uses invoice to complete the payment process.
* saveTransactionResult(): Stores the outcome of the payment, potentially interacting with other components such as a database.

# Design Considerations

***<Describe issues which need to be addressed or resolved before attempting to devise a complete design solution. Remember that, you have to refactor your source code to strictly follow the final design>***

## Goals and Guidelines

*<Describe any goals, guidelines, principles, or priorities which dominate or embody the design of the system and its software.*

*Examples of such goals might be: an emphasis on speed versus memory use; or working, looking, or “feeling” like an existing product.*

*Guidelines include coding guidelines and conventions.*

*For each such goal or guideline, describe the reason for its desirability unless it is implicitly obvious.*

*Describe any design policies and/or tactics that do not have sweeping architectural implications (meaning they would not significantly affect the overall organization of the system and its high-level structures), but which nonetheless affect the details of the interface and/or implementation of various aspects of the system (e.g., choice of which specific product to use)*>

## Architectural Strategies

*<Describe any design decisions and/or strategies that affect the overall organization of the system and its higher-level structures. These strategies should provide insight into the key abstractions and mechanisms used in the system architecture. Describe the reasoning employed for each decision and/or strategy (possibly referring to previously stated design goals and principles) and how any design goals or priorities were balanced or traded-off.*

*Examples of design decisions might concern (but are not limited to) things like the following:*

*• Use of a particular type of product (programming language, database, library, commercial off-the-shelf (COTS) product, etc.)*

*• Reuse of existing software components to implement various parts/features of the system*

*• Future plans for extending or enhancing the software*

*• User interface paradigms (or system input and output models)*

*• Hardware and/or software interface paradigms*

*• Error detection and recovery*

*• Memory management policies*

*• External databases and/or data storage management and persistence*

*• Distributed data or control over a network*

*• Generalized approaches to control*

*• Concurrency and synchronization*

*• Communication mechanisms*

*• Management of other resources*

>

## Coupling and Cohesion

*<Evaluate your design and describe which levels of coupling and cohesion that your design is at. Give proofs for your assumptions. Explain if there is any special design or exceptions>*

*<You may show the previous design from which you made improvements to get better levels of coupling and cohesion. You should clarify how and why you did these improvements>*

## Design Principles

*<Does your design follow the SOLID principles if there are new requirements/changing requirements in the future? Give proofs for your assumptions. Explain if there is any special design or exceptions>*

*<You may show the previous design from which you made improvements to get a better design, which follows SOLID principles in spite of additional requirements. You should clarify how and why you did these improvements>*

## Design Patterns

*<Do you use any design patterns for your design? If yes, describe detailly why you use those design patterns? Describe in detail on the solutions and how to implement each design pattern>*