AI4STYLE
Software Architecture Document

Version 1.1

Revision History

Date	Version	Description	Author
27/11/2025	1.0	First version, defined all needed components in system	All team's members
07/12/2025	1.1	Complete section 5, 6	All team's members

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SAD-A4S	

Software Architecture Document

1. Introduction

The purpose of this Software Architecture Document is to describe the high level structure of the AI4STYLE e-commerce fashion system. It provides an architectural overview of the system, including the major components, their responsibilities, and the interactions between them. This document serves as a reference for developers, testers, project managers, and other stakeholders to ensure that the system's implementation aligns with the intended design principles, quality requirements, and technological constraints.

The scope of this document includes architectural decisions related to the system's functional modules, such as product browsing, authentication, ordering, payment, administration dashboard and AI-based features such as Chatbot and Virtual Try-On (VITON). It also defines design constraints derived from the project's schedule, technologies, and non-functional requirements.

This document includes the following sections:

- Purpose and scope of the system's architecture.
- Architectural goals and constraints.
- High-level architectural views.
- Key design decisions and trade-offs.
- Technology stack and external dependencies

This Software Architecture Document is intended to provide a consistent and stable foundation for development throughout all phases of the project.

2. Architectural Goals and Constraints

Architectural Goals:

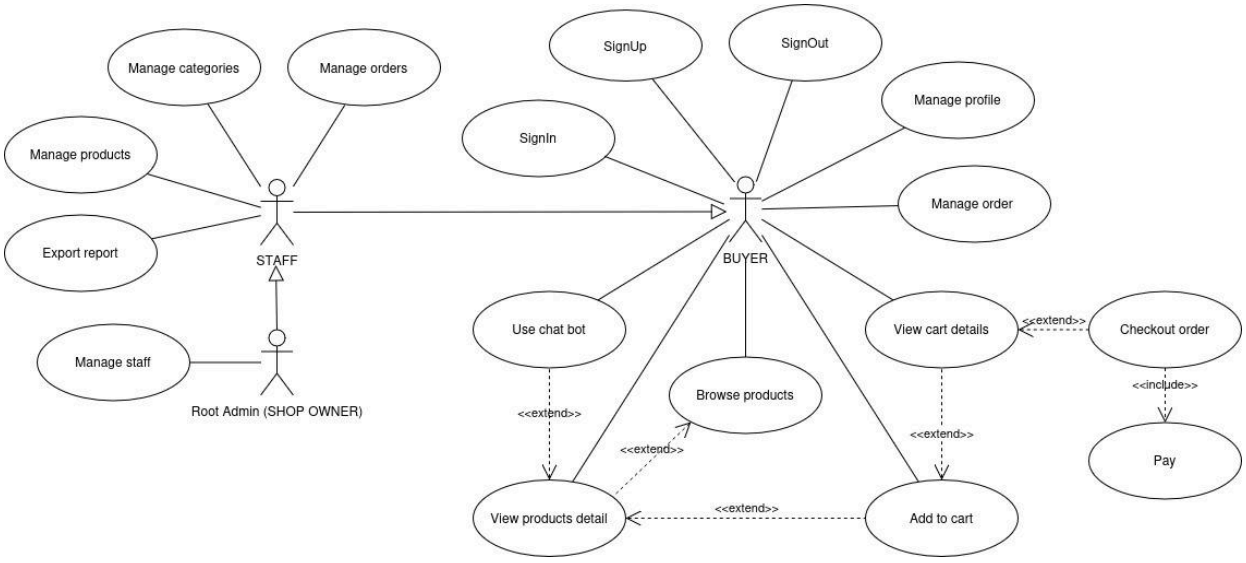
- Support a modern Client–Server architecture: The system follows a clear separation between the Next.js frontend and the NestJS backend, ensuring scalability and maintainability.
- Provide a smooth and responsive user experience: Page rendering, product browsing, and API responses must feel fast and seamless to users.
- Modular integration of AI components: The Chatbot and Embedding modules (LangChain + LLM) must operate as independent services that can be easily updated or replaced without affecting core features.
- Ensure data security and safe transactions: User authentication, session management, and admin access control must follow secure practices.
- Support extensibility and long-term growth: The architecture should allow easy addition of new modules (e.g., more AI features, advanced search, or analytics).
- Enable rapid development and deployment: The design must be simple enough to implement within the 10-week project schedule while supporting incremental delivery across sprints.
- Use affordable and accessible technologies: Given the zero-budget constraint, the system relies on open-source frameworks and free-tier services.

Architectural Constraint:

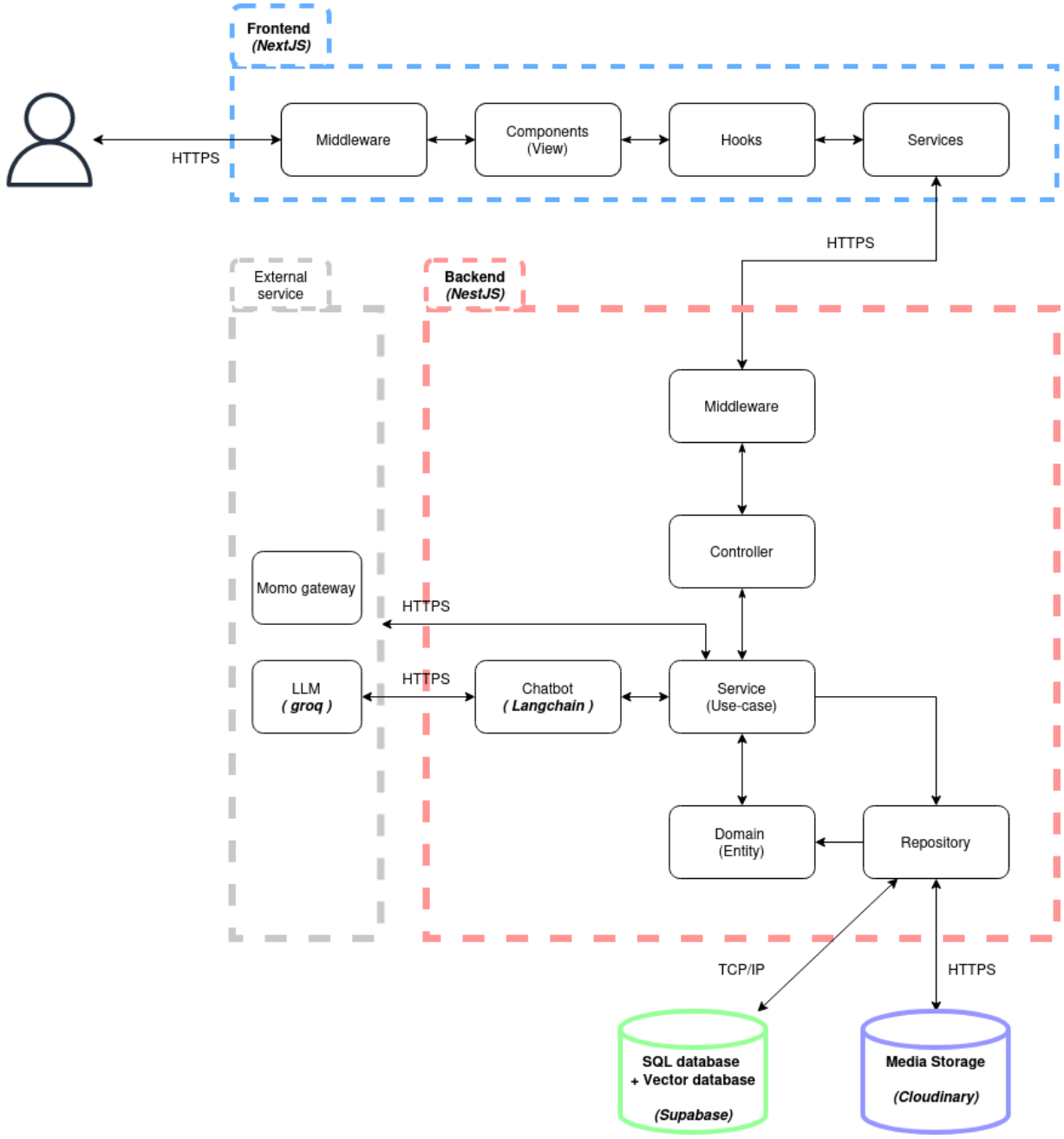
- Application Environment Constraints:
  - The system is web-only; no mobile-native implementation is in scope.
  - Communication between:
    - Frontend ↔ Backend: HTTP/HTTPS
    - Backend ↔ Supabase DB: TCP/IP
    - Backend ↔ Image Storage: HTTPS
    - Backend ↔ LLM/AI Services: HTTPS
  - Deployment must be compatible with typical free-tier hosting platforms (e.g., Vercel, Railway, Render).
- Technology and Programming Language Constraints:
  - Frontend must use Next.js (React-based framework) for routing, SSR/CSR, and performance optimization.
  - Backend must use NestJS following the Onion Architecture as shown in the diagram.
  - TypeScript is the required programming language across both frontend and backend.
  - AI components must use LangChain for LLM orchestration and vector retrieval.
  - Supabase (PostgreSQL + Vector DB) must be used as the primary database solution.
- Security Constraints:
  - Authentication must be implemented using JWT or a secure session-based mechanism.
  - Passwords must be hashed (bcrypt or equivalent).
  - Role-based authorization is required to separate customer, staff, and administrator privileges.
  - API keys must not be exposed in any public repository.
  - Data transmission should be encrypted using HTTPS when deployed.
- Performance Constraints:
  - API response time for core operations (product listing, cart, orders) should ideally be < 300ms.
  - Chatbot performance must remain responsive by relying on embedding-based retrieval instead of direct LLM calls when possible.
  - Images must be handled through a dedicated Image Storage service to reduce backend load.
  - The system should avoid overly complex architectures (e.g., microservices), due to time and manpower limitations.
- Resource and Cost Constraints:
  - As a zero-budget project, the system must rely ONLY on:
    - Supabase Free Tier.
    - Free or open-source frameworks (Next.js, NestJS, LangChain)
    - Free-tier hosting services
  - No licensed or paid proprietary technologies are allowed.

- Team and Schedule Constraints:
    - With a 5-member team, the architecture must enable clear task separation:
        - Frontend development (Next.js)
        - Backend development (NestJS)
        - AI modules (LangChain + LLM)
        - Database/Supabase
    - Given the 10-week schedule and 2-week sprints, each module must be loosely coupled and deployable independently.
- Data and Storage Constraints:
    - Supabase PostgreSQL must store all core data: users, staff, products, orders, etc.
    - Supabase Vector Database must store embeddings for AI retrieval.
    - Product images and VITON-related images must be stored in an external Image Storage service (e.g., Supabase Storage).
    - Secrets and configuration values must be managed securely (environment variables).

3. Use-Case Model



4. Logical View



The system follows an N-Tier Architecture, decomposed into three primary subsystems: Frontend, Backend, and Storage, along with an interface for External Services. Each subsystem is built from distinct, modular components that handle specific responsibilities.

Frontend:

- **View component**: it is responsible for the user interface. It internally layers UI Rendering, State Management Hooks, and API Services to deliver a responsive and interactive user interface.

Backend: There are 3 components in this subsystem, they communicate together by function calling.

- **Controller Component**: The entry point that orchestrates HTTP requests and validates input.
- **Service Component**: The core component containing business rules and transaction logic, interacts with external service through interfaces..
- **Repository Component**: The data access component that abstracts database interactions.

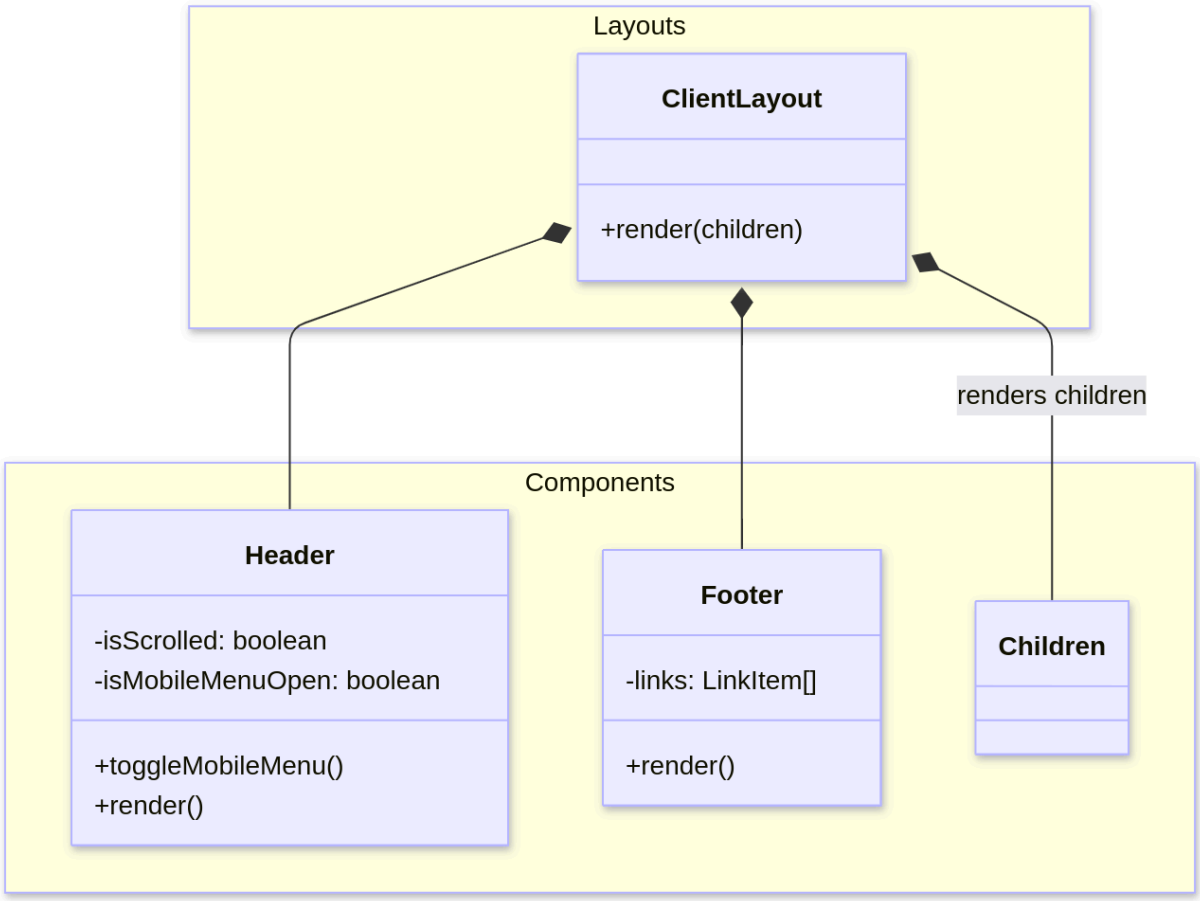
Storage:

- **Database Component**: A relational database storing structured transactional data (Users, Orders).
- **Media Storage Component**: Object storage for unstructured assets like product images and banners.

4.1 Component: View

4.1.1 Customer Pages

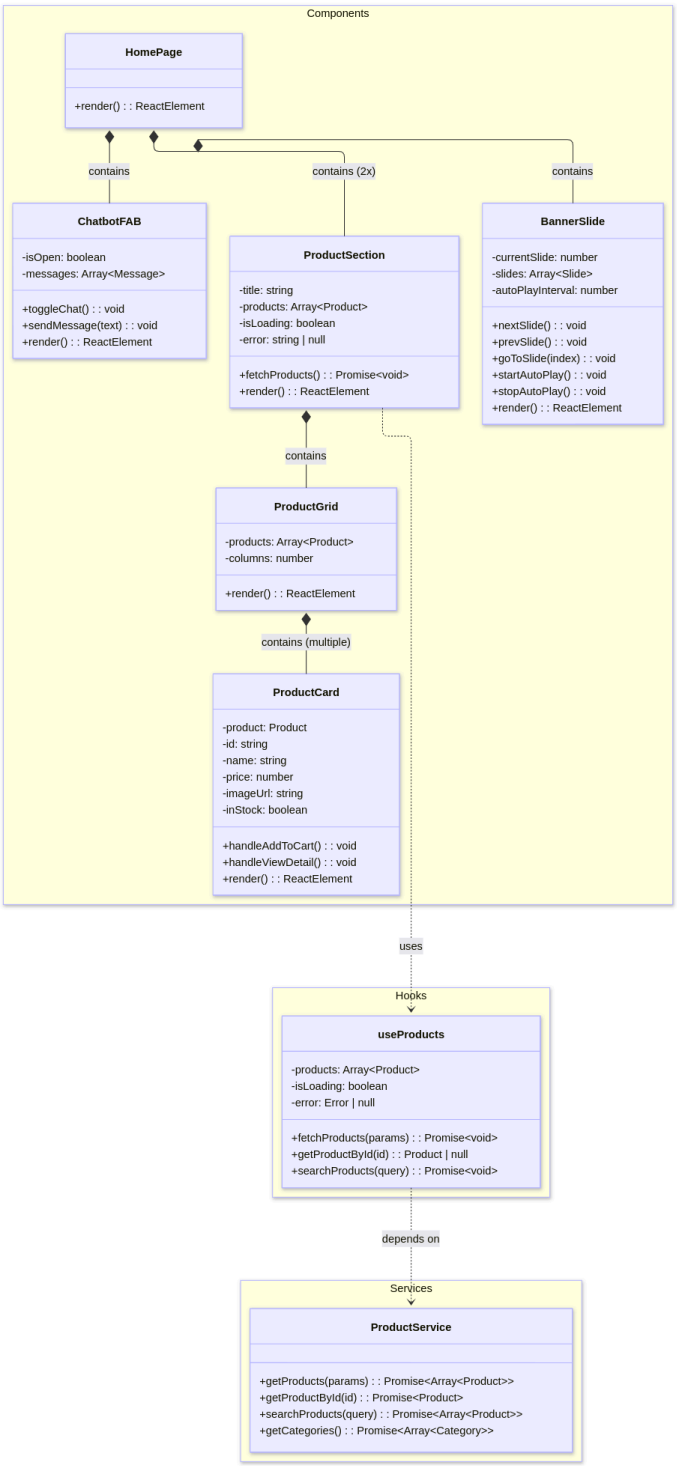
1. Layout



Components

- **ClientLayout**: The top-level wrapper component that renders the children within a consistent site structure (Header and Footer).
- **Header**: The main navigation bar, handling responsive states (mobile menu) and scroll behavior.
- **Footer**: The bottom section of the site contains links and legal information.

2. Homepage


Components
HomePage
+render() : : ReactElement
contains
contains (2x)
contains
ChatbotFAB
-isOpen: boolean
-messages: Array<Message>
+toggleChat() : : void
+sendMessage(text) : : void
+render() : : ReactElement
ProductSection
-title: string
-products: Array<Product>
-isLoading: boolean
-error: string | null
+fetchProducts() : : Promise<void>
+render() : : ReactElement
BannerSlide
-currentSlide: number
-slides: Array<Slide>
-autoPlayInterval: number
+nextSlide() : : void
+prevSlide() : : void
+goToSlide(index) : : void
+startAutoPlay() : : void
+stopAutoPlay() : : void
+render() : : ReactElement
contains
ProductGrid
-products: Array<Product>
-columns: number
+render() : : ReactElement
contains (multiple)
ProductCard
-product: Product
-id: string
-name: string
-price: number
-imageUrl: string
-inStock: boolean
+handleAddToCart() : : void
+handleViewDetail() : : void
+render() : : ReactElement
uses
Hooks
useProducts
-products: Array<Product>
-isLoading: boolean
-error: Error | null
+fetchProducts(params) : : Promise<void>
+getProductById(id) : : Product | null
+searchProducts(query) : : Promise<void>
depends on
Services
ProductService
+getProducts(params) : : Promise<Array<Product>>
+getProductById(id) : : Promise<Product>
+searchProducts(query) : : Promise<Array<Product>>
+getCategories() : : Promise<Array<Category>>

Components

- **HomePage**: The main landing page view orchestrating the layout of banners, product sections, and features.
- **BannerSlide**: A carousel component that rotates through promotional slides (images/text) with auto-play functionality.
- **ProductSection**: A container component that displays a titled section of products (e.g., "New Arrivals") and handles its own data fetching.
- **ProductGrid**: A layout component that arranges product cards in a responsive grid.
- **ProductCard**: A presentation component representing a single product summary, including the image, price, and "Add to Cart" action.
- **ChatbotFAB**: A Floating Action Button (FAB) that toggles the chatbot interface for customer support.

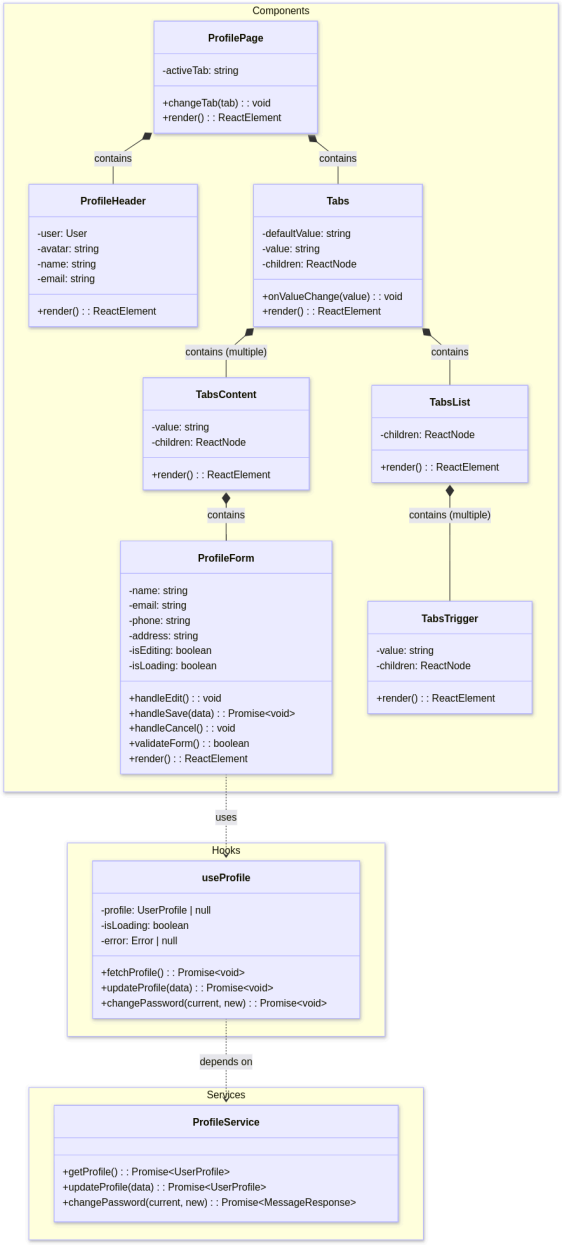
Hooks

- **useProducts**: Manages the fetching and search logic for products, exposing loading states and the product list.

Services

- **ProductService**: The API service responsible for fetching product lists, details, and categories from the backend.

3. Profile



Components

- **ProfilePage**: The main container for the user profile, managing the active tab state (e.g., "Info", "Password").
- **ProfileHeader**: A summary component displaying the user's avatar, name, and email at the top of the profile section.
- **ProfileForm**: An editable form allowing users to update their personal details (name, phone, address).

- **Tabs**: A compound component system (Root, List, Trigger, Content) used to organize profile sections.

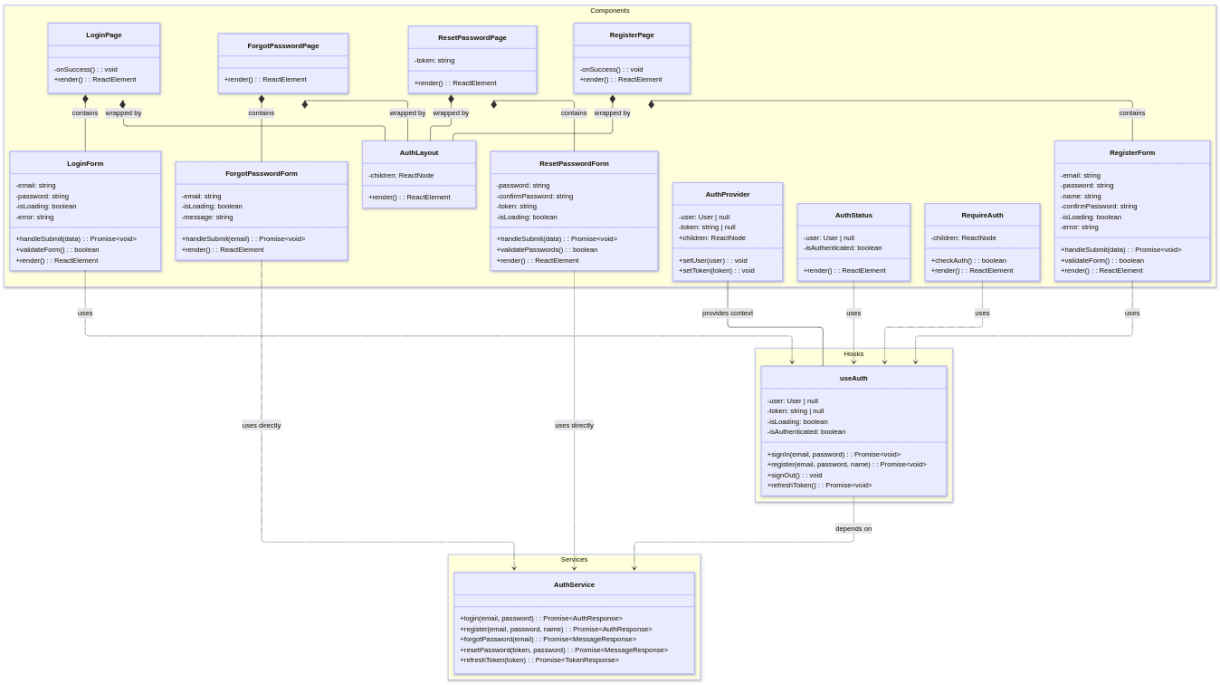
Hooks

- **useProfile**: Manages the fetching and updating of the user's profile data and password changes.

Services

- **ProfileService**: The API service responsible for CRUD operations on the user's own profile data.

3. SignIn/SignUp



Components

- **AuthLayout**: A wrapper component providing a consistent look and feel for all authentication-related pages (Login, Register, Forgot Password).
- **LoginPage**: The entry point page for existing users to sign in.
- **LoginForm**: A form component responsible for capturing email/password and triggering the login action.
- **RegisterPage**: The entry point page for new users to create an account.

- **RegisterForm**: A form component for capturing new user details (name, email, password) with validation.
- **ForgotPasswordPage**: The page allowing users to request a password reset link.
- **ForgotPasswordForm**: A simple form to input the email address for recovery.
- **ResetPasswordPage**: The page where users land after clicking the recovery link to set a new password.
- **ResetPasswordForm**: A form component to capture and validate the new password.
- **AuthStatus**: A UI component that conditionally renders user info or login buttons based on the current authentication state.
- **AuthProvider**: A context provider that initializes and maintains the user's session state globally.
- **RequireAuth**: A high-order component (HOC) or wrapper that protects routes, redirecting unauthenticated users to the login page.

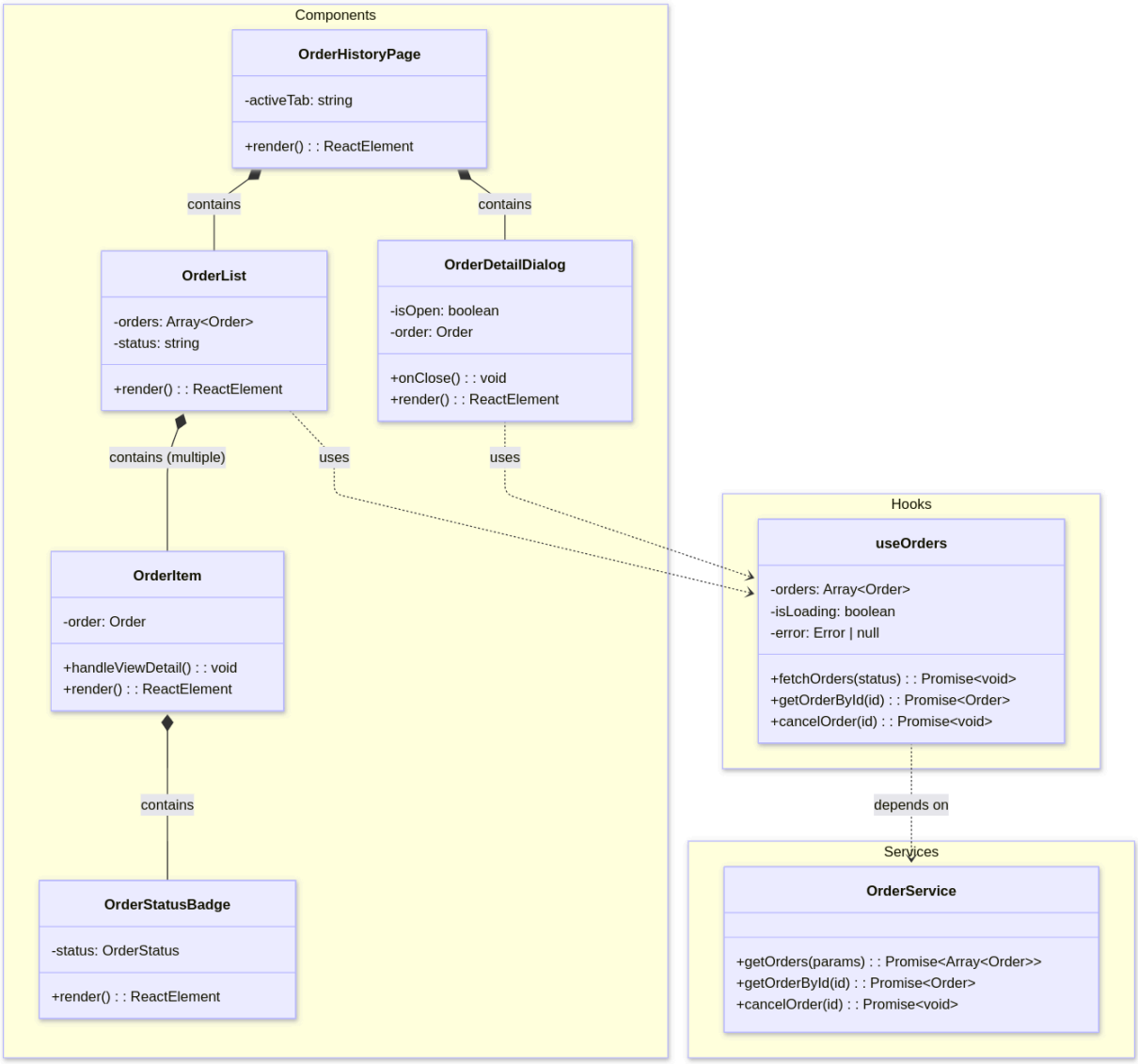
Hooks

- **useAuth**: A custom hook exposing the current user state (user, token, isAuthenticated) and authentication methods (signIn, register, signOut).

Services

- **AuthService**: The API service responsible for communicating with backend auth endpoints, including login, registration, and token management.

4. Order history



Components

- **OrderHistoryPage**: The main page listing the user's order history, typically filtered by status tabs.
- **OrderList**: A list component that renders the collection of order items.
- **OrderItem**: A summary component for a single order row, displaying the ID, total, and status.
- **OrderDetailDialog**: A modal component showing the full details of a specific order (products, shipping info) when clicked.
- **OrderStatusBadge**: A visual component displaying the current status of an order (e.g., "Pending", "Delivered") with appropriate styling.

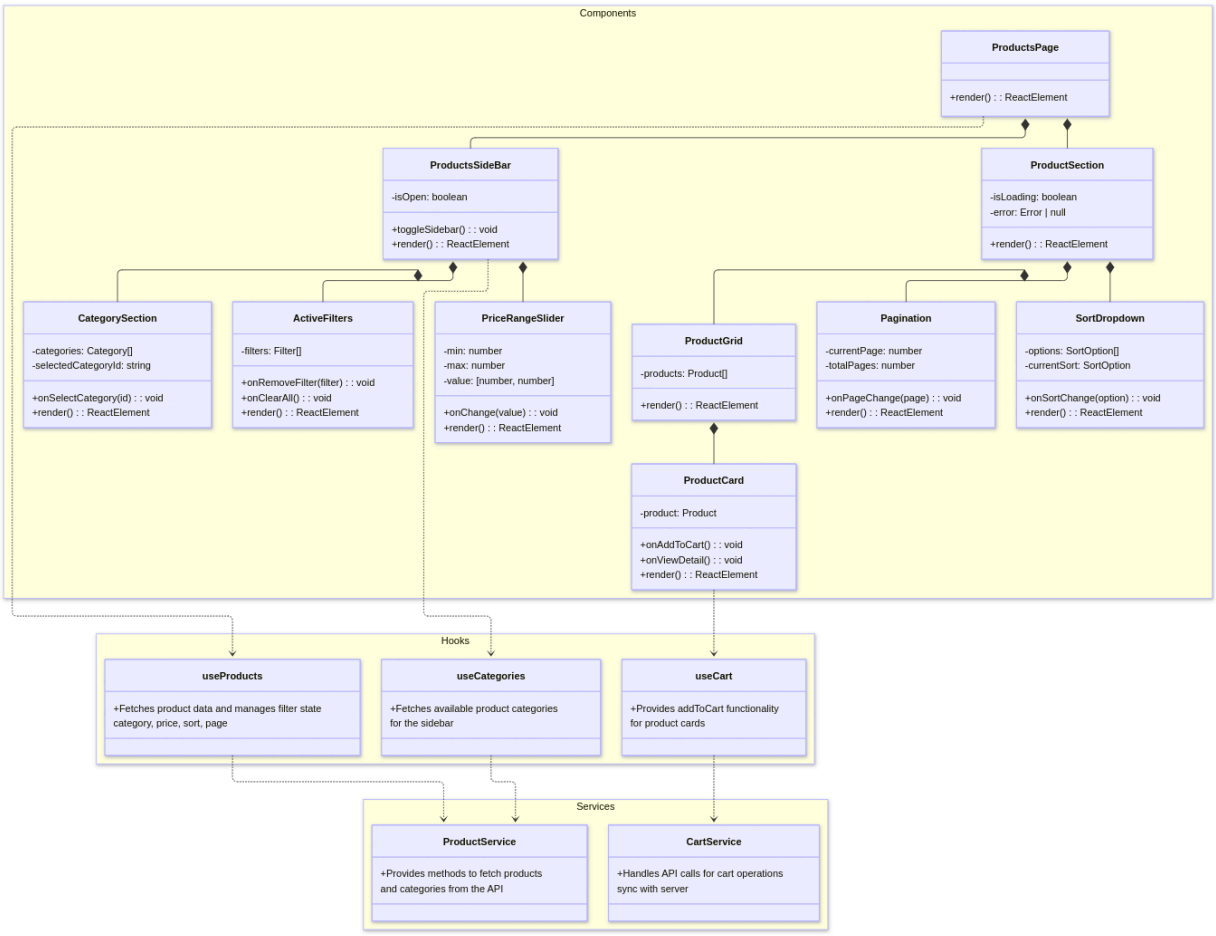
Hooks

- **useOrders**: Manages the fetching of the user's order list and specific order details.

Services

- **OrderService**: The API service responsible for fetching order history and details from the backend.

4. Product list



Components

- **ProductsPage:** Main layout containing the sidebar and product grid.
- **ProductsSidebar:** Displays all filters including categories, price range, and attributes.
- **ProductSection:** Manages the product grid's loading, error states, and display.
- **CategorySection:** Lists all available product categories for filtering.

- **ActiveFilters:** Shows currently active filters with options to clear them.
- **PriceRangeSlider:** Allows users to filter products based on price.
- **ProductGrid:** Renders a grid of ProductCard components.
- **Pagination:** Handles navigation across pages of results.
- **SortDropdown:** Provides sorting options such as newest, price, popularity.
- **ProductCard:** Displays individual product info with a link to the detail page.

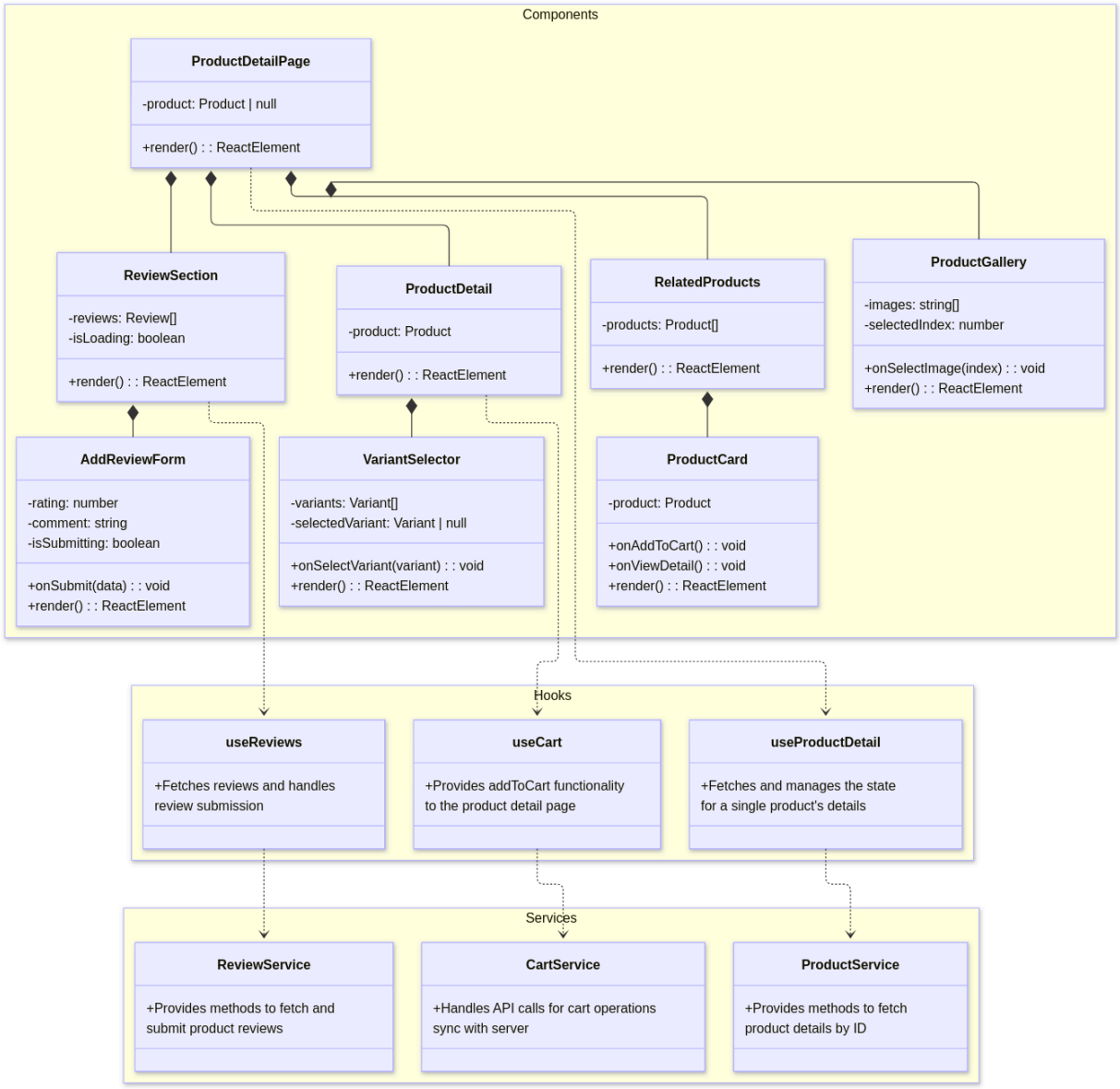
Hooks

- **useProducts:** Fetches products and manages filter state (category, price, sort, page).
- **useCategories:** Fetches available categories to populate the sidebar.
- **useCart:** Provides add-to-cart functionality for product cards.

Services

- **ProductService:** Fetches product lists and categories from the API.
- **CartService:** Manages server-synced cart operations.

5. Product details



Components

- **ProductDetailPage:** Main layout for the product detail view.
- **ReviewSection:** Displays user reviews and ratings for the product.
- **ProductDetails:** Shows full product information, including description, specifications, and price.
- **RelatedProducts:** Shows other products similar or relevant to the current product.
- **ProductGallery:** Displays product images in carousel or grid form, with zoom features.
- **AddReviewForm:** Form for submitting a new review and rating.

- **VariantSelector:** Allows users to choose product variants (size, color).
- **ProductCard:** Shows basic product info (image, price, name) and links to other product pages.

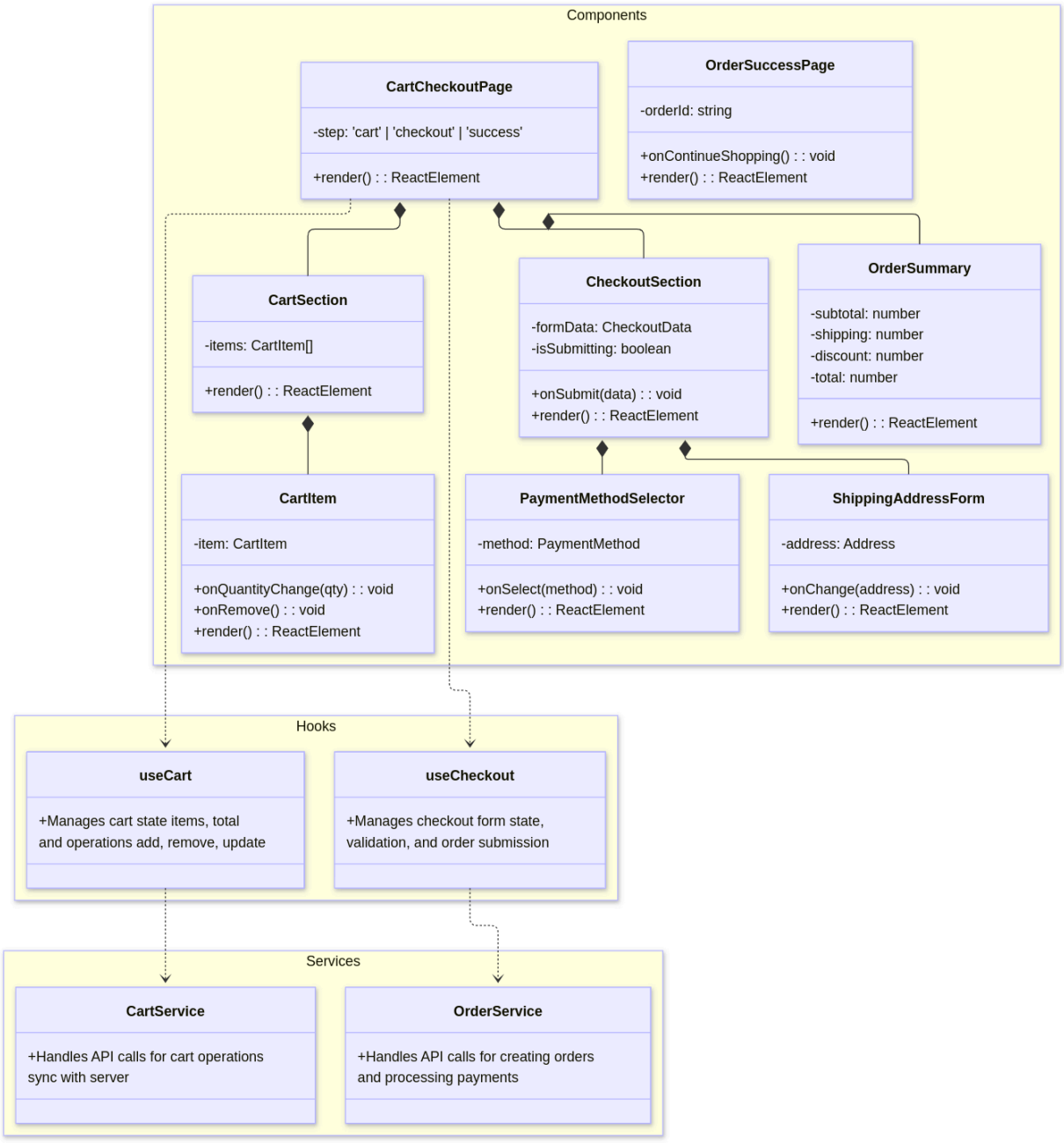
Hooks

- **useReviews:** Fetches product reviews and manages review submission.
- **useCart:** Provides add-to-cart functionality inside the product detail page.
- **useProductDetails:** Fetches and manages the state of an individual product's data.

Services

- **ReviewService:** Provides API methods for fetching and submitting reviews.
- **CartService:** Synchronizes cart operations with the server.
- **ProductService:** Fetches product details using the product ID.

6. Cart & Checkout



Components

- **CartCheckoutPage:** Renders the combined cart and checkout experience.
- **OrderSuccessPage:** Shows a confirmation message after the order is successfully placed.
- **CheckoutSection:** Displays the shipping and payment forms.
- **OrderSummary:** Shows the total cost including taxes and shipping.

- **CartSection:** Lists all cart items with options to update or remove them.
- **PaymentMethodSelect:** Allows the user to choose a payment option (Card, PayPal, etc.).
- **ShippingAddressForm:** Collects the user's shipping information.
- **CartItem:** Displays individual cart item details, pricing, and quantity controls.
- **CouponInput:** Lets the user enter a discount code to apply to their order.

Hooks

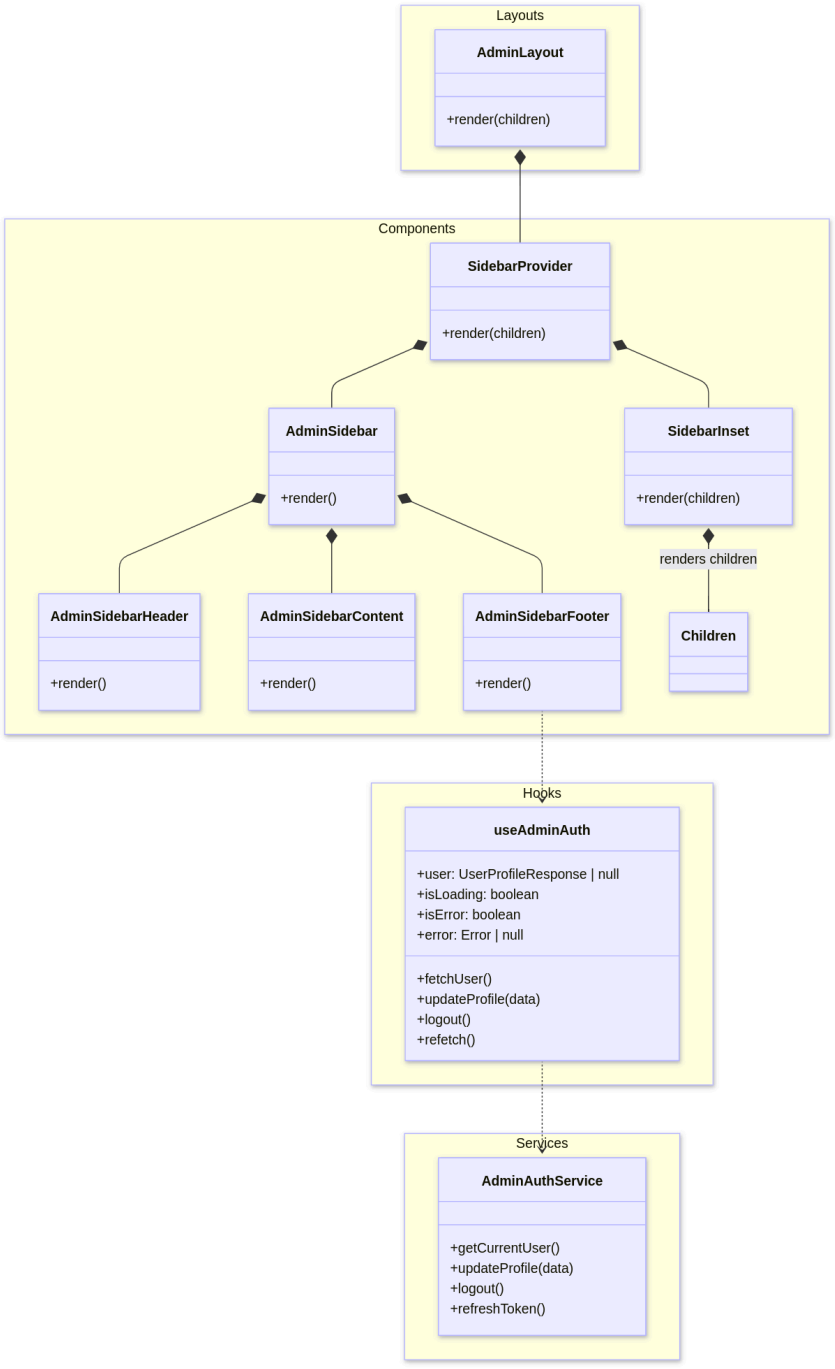
- **useCart:** Manages the cart state including items, totals, and operations like add, remove, and update.
- **useCheckout:** Manages checkout form state, form validation, and triggers order submission.

Services

- **CartService:** Handles API calls related to cart operations and synchronizes them with the server.
- **OrderService:** Handles API calls for order creation and payment processing.

4.1.2 Admin Pages

1. Layout



Components

- **AdminLayout**: The top-level wrapper component that structures the application page, managing the sidebar and main content areas.

- **SidebarProvider**: A context provider that manages the state of the sidebar (collapsed/expanded) and provides this context to child components.
- **SidebarInset**: The wrapper for the main content area that adjusts its layout based on the sidebar's state.
- **AdminSidebar**: The main container for the navigation sidebar element.
- **AdminSidebarHeader**: The top section of the sidebar, typically containing the logo or branding.
- **AdminSidebarContent**: The middle section of the sidebar that renders the scrollable list of navigation menu items.
- **AdminSidebarFooter**: The bottom section of the sidebar, used for displaying the current user's profile and logout controls.

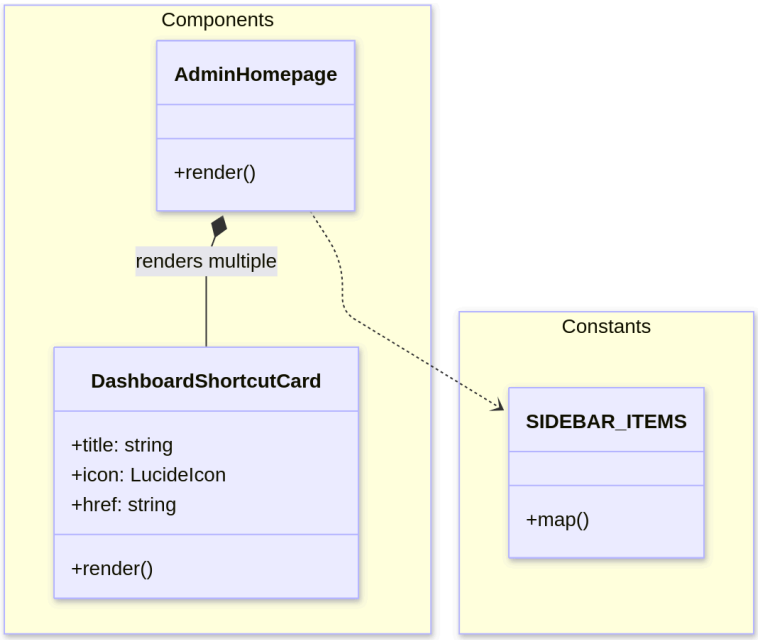
Hooks

- **useAdminAuth**: A custom hook that manages the administrator's authentication state, including fetching the current user profile, updating profile details, and handling logout logic.

Services

- **AdminAuthService**: The API service responsible for communicating with backend authentication endpoints (login, profile updates, token refresh).

2. Homepage



Components

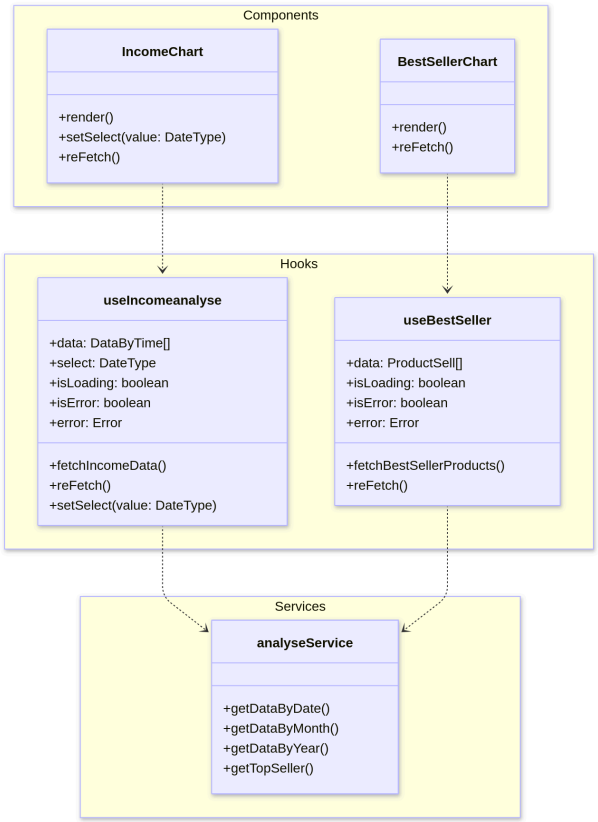
- **AdminHomepage**: The main view component for the landing page, responsible for rendering the overall layout of shortcuts.

- **DashboardShortcutCard**: A reusable UI component that displays a quick-access card (with title, icon, and link) to a specific admin section.

Constants

- **SIDEBAR_ITEMS**: A constant definition containing the configuration for navigation items, which is mapped to generate the dashboard shortcuts and sidebar menu.

3. Dashboard



Components

- **BestSellerChart**: A visualization component (e.g., Bar or Pie chart) that renders the top-selling products data.
- **IncomeChart**: A visualization component (e.g., Line or Area chart) that displays revenue trends over selected time periods.

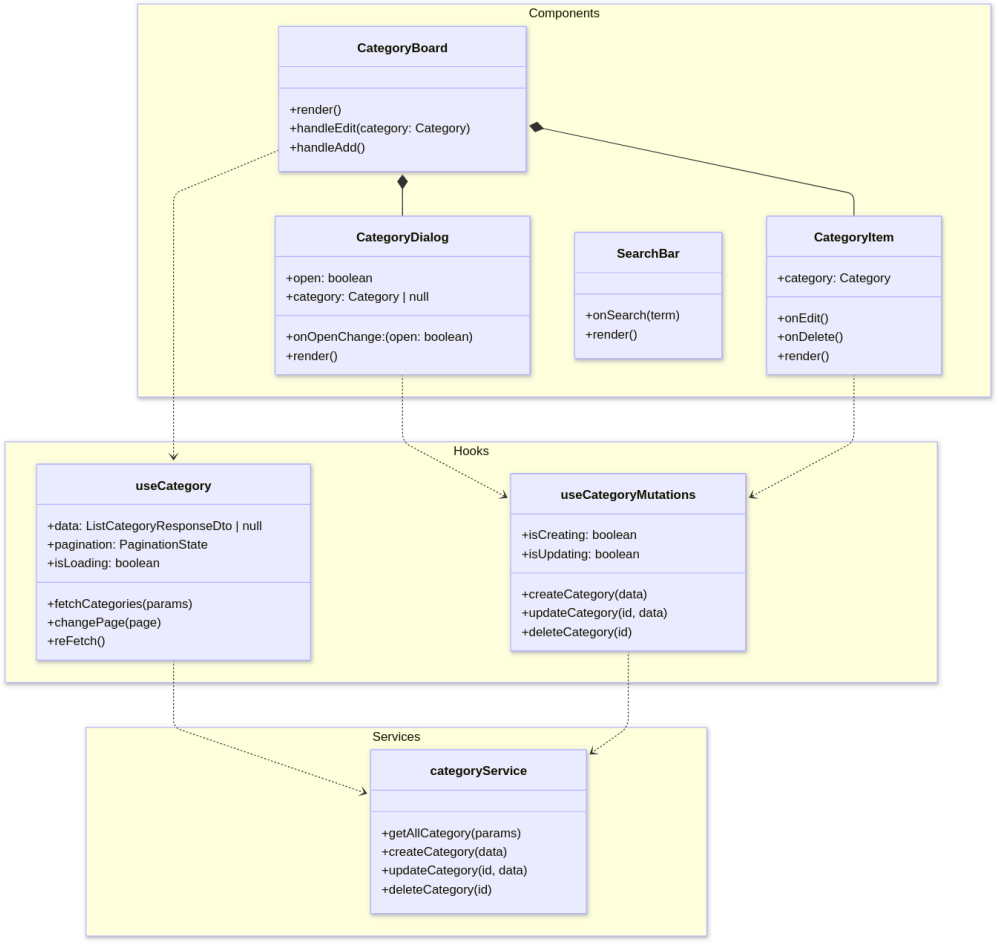
Hooks

- **useIncomeanalyse**: Manages the state and data fetching for revenue analysis, including handling time-period selections (Day/Month/Year).
- **useBestSeller**: Manages the state and data fetching for the best-seller reports.

Services

- **analyseService**: The API service responsible for fetching analytical data from the backend.

4. Category Management



Components

- **CategoryBoard**: The main container component for the category section, orchestrating the list view and action buttons.

- **CategoryItem**: A presentation component representing a single category row or card with edit/delete actions.
- **CategoryDialog**: A modal component used for both creating new categories and editing existing ones.
- **SearchBar**: A reusable input component for filtering the category list by name.

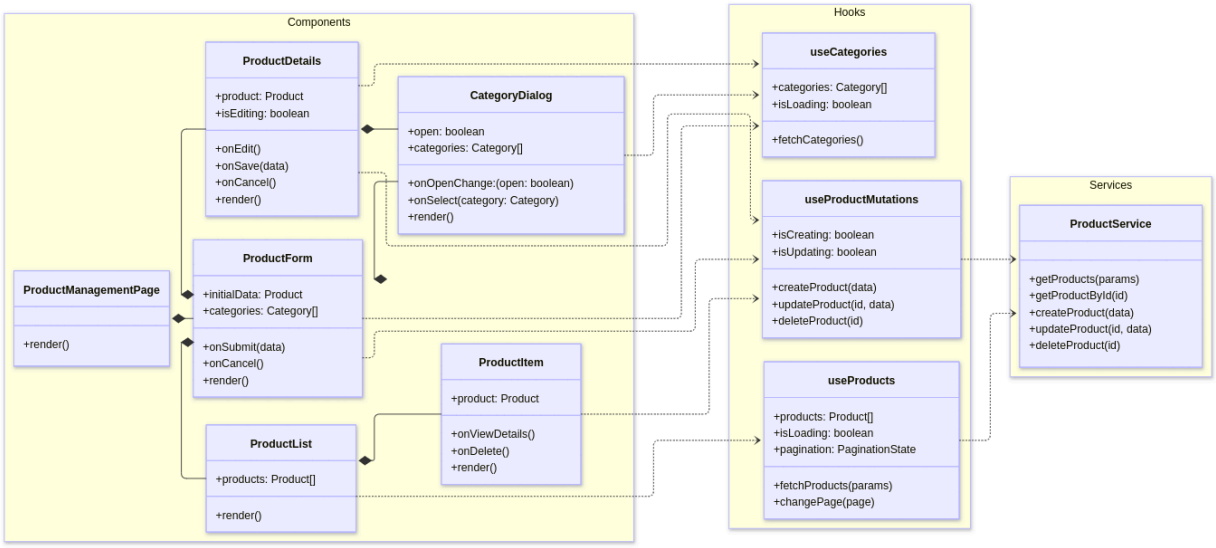
Hooks

- **useCategory**: Manages the reading state of categories, including fetching data, handling pagination, and loading states.
- **useCategoryMutations**: Manages the write operations (Create, Update, Delete) and their associated loading states.

Services

- **categoryService**: The API service responsible for CRUD operations on category entities.

5. Product Management



Components

- **ProductManagementPage**: The main page wrapper for the product management feature.
- **ProductList**: A component responsible for rendering the grid or table of products.
- **ProductItem**: A row or card component representing specific product details and actions.
- **ProductForm**: A form component handling input for creating new products, including category selection.
- **ProductDetails**: A component for viewing and editing detailed information of an existing product.
- **CategoryDialog**: A reused or specific dialog component allowing the selection of categories during product creation/editing.

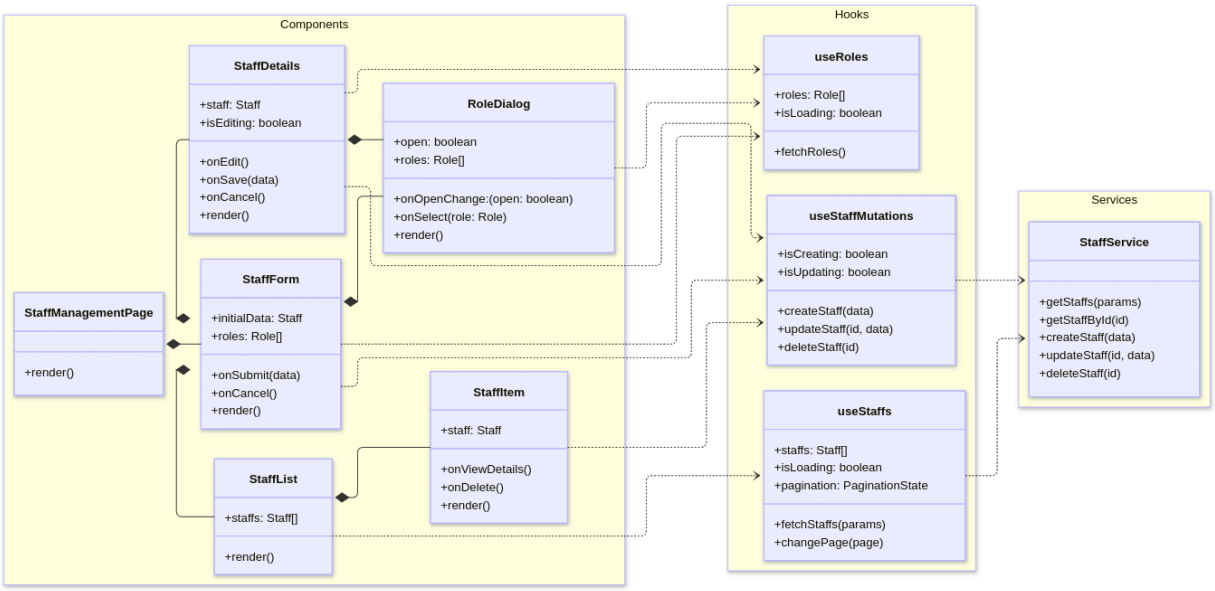
Hooks

- **useProducts**: Manages the state for fetching and paginating the product list.
- **useProductMutations**: Manages the state for Create, Update, and Delete operations on products.
- **useCategories**: A helper hook used within product forms to fetch the list of available categories for selection.

Services

- **ProductService**: The API service responsible for CRUD operations on product entities.

6. Staff Management



Components

- **StaffManagementPage**: The main page wrapper for the staff management feature.
- **StaffList**: A component responsible for rendering the list of staff members.
- **StaffItem**: A component representing a single staff member row with management actions.
- **StaffForm**: A form component used to register new staff members and assign initial roles.
- **StaffDetails**: A component for viewing and editing details of an existing staff member.
- **RoleDialog**: A dialog component used to search and select security roles to assign to a staff member.

Hooks

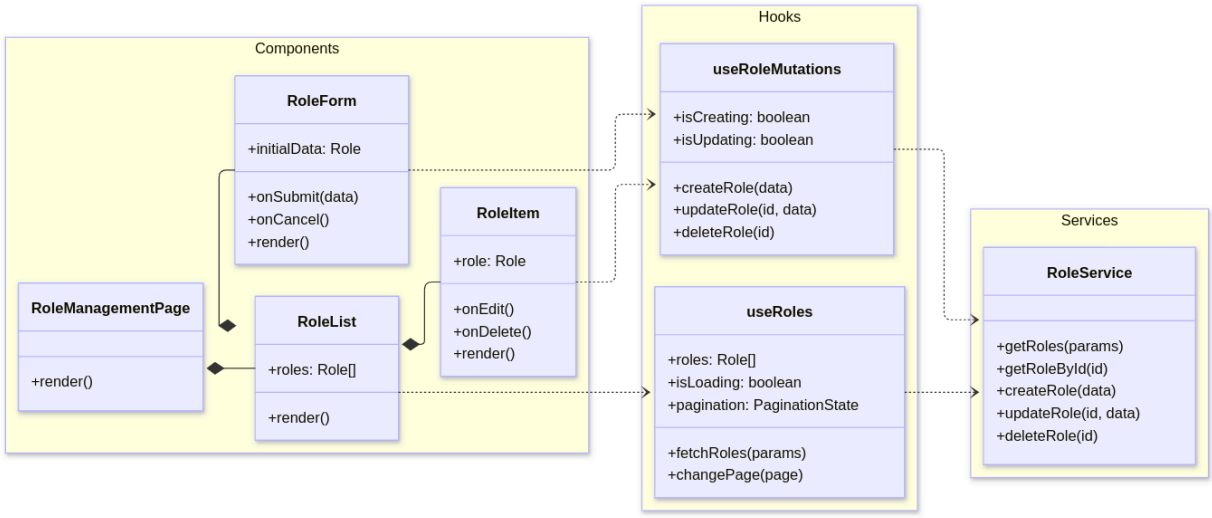
- **useStaffs**: Manages the fetching and pagination of staff member data.
- **useStaffMutations**: Manages the Create, Update, and Delete operations for staff accounts.

- **useRoles**: A helper hook used to fetch available roles for assignment during staff creation or editing.

Services

- **StaffService**: The API service responsible for CRUD operations on staff entities.

7. Role Management



Components

- **RoleManagementPage**: The main page wrapper for the role management feature.
- **RoleList**: A component responsible for listing all defined system roles.
- **RoleItem**: A component representing a single role row with edit/delete actions.
- **RoleForm**: A form component used to define new roles or edit existing permissions.

Hooks

- **useRoles**: Manages the fetching and pagination of the roles list.
- **useRoleMutations**: Manages the Create, Update, and Delete operations for role definitions.

Services

- **RoleService**: The API service responsible for CRUD operations on role entities.

4.2 Component: Controllers

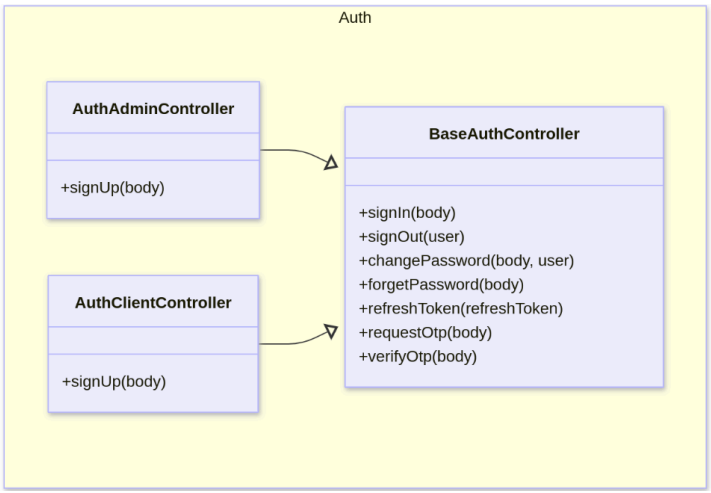
4.2.1 Responsibilities

The Controller component acts as the **Presentation Layer** for the backend API. Its primary responsibilities are:

- **Request Handling**: Receiving HTTP requests (GET, POST, PUT, DELETE) from the client.
- **Orchestration**: Calling the appropriate Service layer methods to execute business logic.
- **Security Integration**: working with Middleware to ensure endpoints are protected by authentication and authorization rules.

4.2.2 Details

1. Auth



Base Auth Controller (Shared Logic)

Method Name	Functionality
signIn(body)	Authenticates a user via email/password and returns an Access/Refresh token pair.
signOut(user)	Invalidates the current user session or revoke tokens to log the user out.
refreshToken(token)	Issues a new Access Token using a valid Refresh Token to extend the session.
changePassword(body)	Updates the authenticated user's password.
forgetPassword(body)	Initiates the account recovery process.
requestOtp(body)	Generates and sends a One-Time Password.

verifyOtp(body)	Validates a user-submitted OTP code.

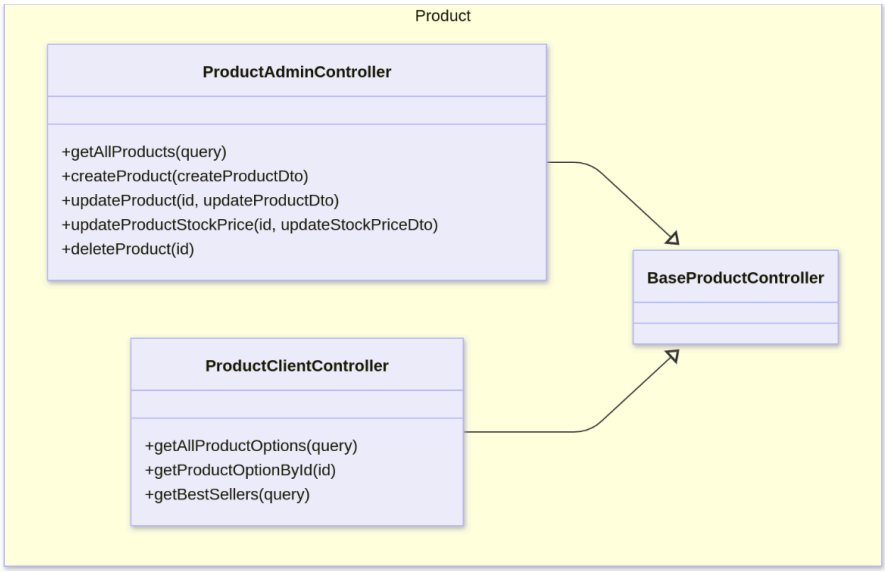
Auth Admin Controller

Method Name	Functionality
signUp(body)	Registers a new internal Admin/Staff account. Root admin will implement this action and assign new staff with appropriate role.

Auth Client Controller

Method Name	Functionality
signUp(body)	Registers a new Customer account (public registration flow).

2. Product



Base Product Controller

Method Name	Functionality
(None exposed directly, logic shared)	Shared validation or helper logic.

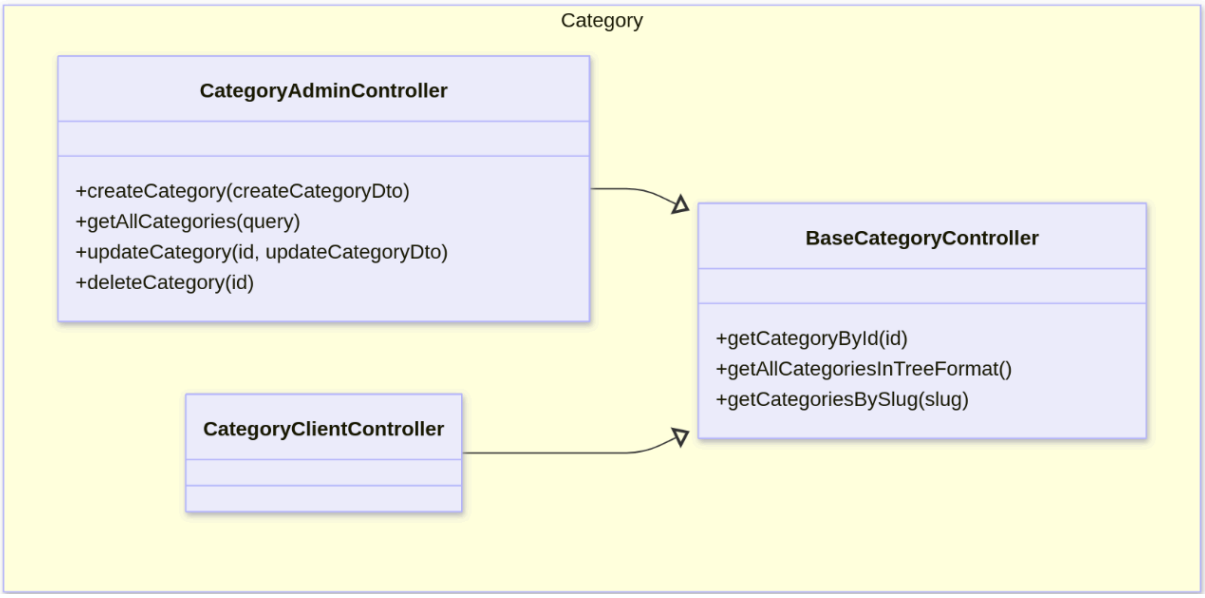
Product Admin Controller

Method Name	Functionality
getAllProducts(query)	Retrieves a paginated list of all products (including inactive).
createProduct(dto)	Creates a new product entry along with its initial variants and options.
updateProduct(id, dto)	Updates general product metadata.
updateProductStockPrice(id, dto)	Updates stock quantity and price for a variant.
deleteProduct(id)	Soft-deletes or removes a product from the catalog.

Product Client Controller

Method Name	Functionality
getBestSellers(query)	Retrieves a list of top-selling products.
getAllProductOptions(query)	Retrieves available product attributes (e.g., all Colors/Sizes) for filtering.
getProductOptionById(id)	Retrieves details for a specific variant option.

3. Category



Base Category Controller

Method Name	Functionality
getCategoryById(id)	Retrieves details of a specific category.
getAllCategoriesInTreeFormat()	Returns the full category structure nested as a tree.
getCategoriesBySlug(slug)	Finds a category using its URL-friendly slug text.

Category Admin Controller

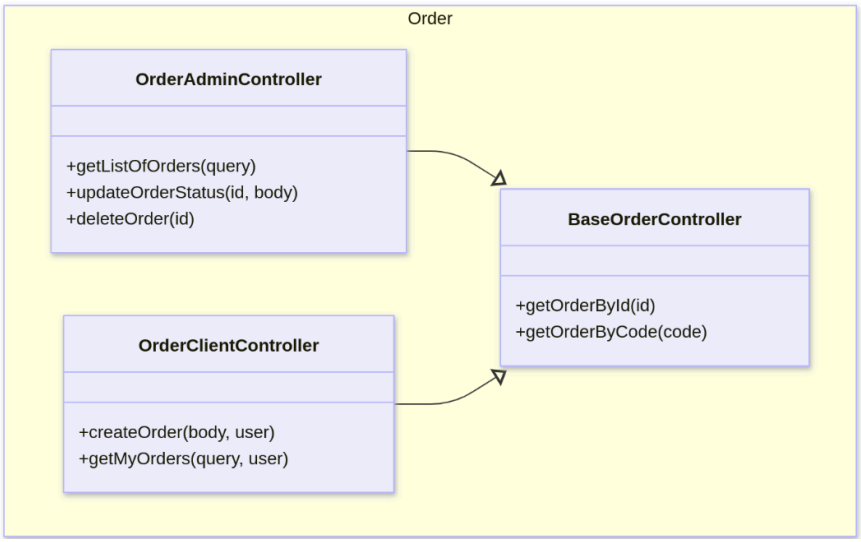
Method Name	Functionality
getAllCategories(query)	Retrieves a flat, paginated list of categories for administration.
createCategory(dto)	Creates a new category node.

updateCategory(id, dto)	Updates category details or moves it to a new parent.
deleteCategory(id)	Removes a category.

Category Client Controller

Method Name	Functionality
(Inherits Base Read Operations)	Used for public navigation menus.

4. Order



Base Order Controller

Method Name	Functionality
getOrderById(id)	Retrieves full details of a specific order.
getOrderByCode(code)	Retrieves an order using its public reference code.

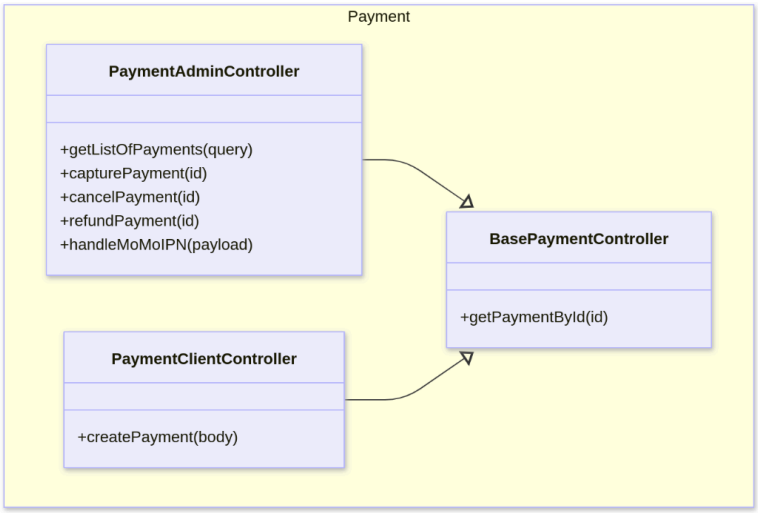
Order Admin Controller

Method Name	Functionality
getListOfOrders(query)	Retrieves a paginated, filterable list of all system orders.
updateOrderStatus(id, body)	Transitions an order to a new state (e.g., "Shipped").
deleteOrder(id)	Cancels or soft-deletes an order.

Order Client Controller

Method Name	Functionality
createOrder(body, user)	Converts a user's cart or selection into a persisted order record.
getMyOrders(query, user)	Retrieves the history of orders placed by the logged-in user.

5. Payment



Base Payment Controller

Method Name	Functionality
getPaymentById(id)	Retrieves detailed logs of a specific payment transaction.

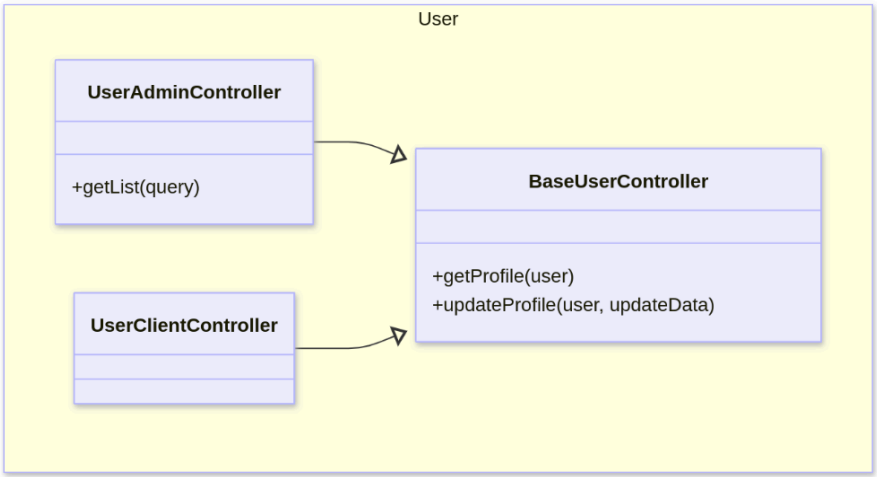
Payment Admin Controller

Method Name	Functionality
getListOfPayments(query)	Retrieves a history of all payment transactions for reconciliation.
capturePayment(id)	Manually captures an authorized payment.
cancelPayment(id)	Voids a pending payment transaction.
refundPayment(id)	Issues a refund for a previously successful transaction.
handleMoMoIPN(payload)	Webhook endpoint for MoMo gateway updates.

Payment Client Controller

Method Name	Functionality
createPayment(body)	Initializes a payment intent and returns checkout information.

6. User



Base User Controller

Method Name	Functionality
getProfile(user)	Retrieves the profile information of the currently authenticated user.
updateProfile(user, data)	Updates personal details for the current user.

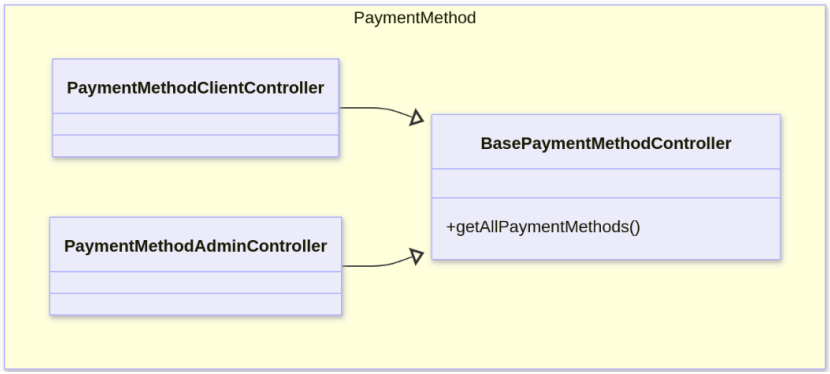
User Admin Controller

Method Name	Functionality
getList(query)	Retrieves a paginated list of all users in the system.

User Client Controller

Method Name	Functionality
(Inherits Base Profile Operations)	Standard user profile management.

7. Payment Method



Base Payment Method Controller

Method Name	Functionality
getAllPaymentMethods()	Returns a list of active payment methods and their configuration.

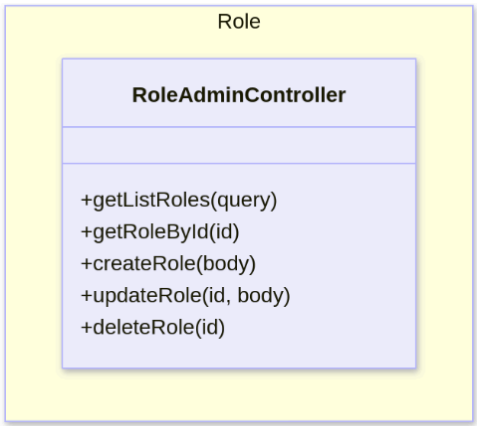
Payment Method Admin Controller

Method Name	Functionality
(Inherits Base Read Operations)	Used during checkout to show options.

Payment Method Client Controller

Method Name	Functionality
(Inherits Base Read Operations)	Used during checkout to show options.

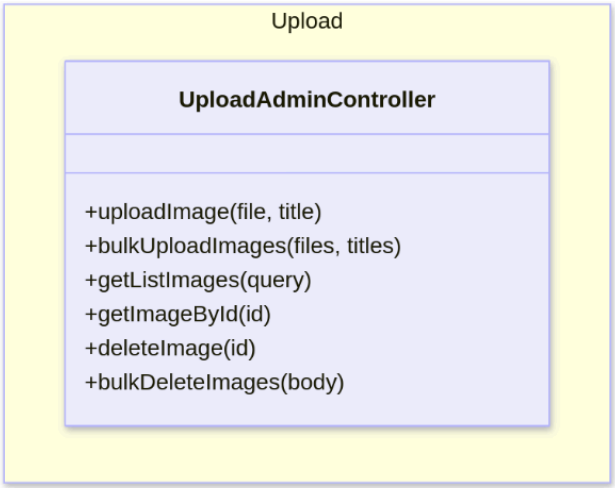
8. Role



Role Admin Controller

Method Name	Functionality
getListRoles(query)	Retrieves all defined roles in the system.
getRoleById(id)	Retrieves a specific role and its list of permissions.
createRole(body)	Defines a new role with a specific set of permissions.
updateRole(id, body)	Modifies the name or permissions of an existing role.
deleteRole(id)	Removes a role from the system.

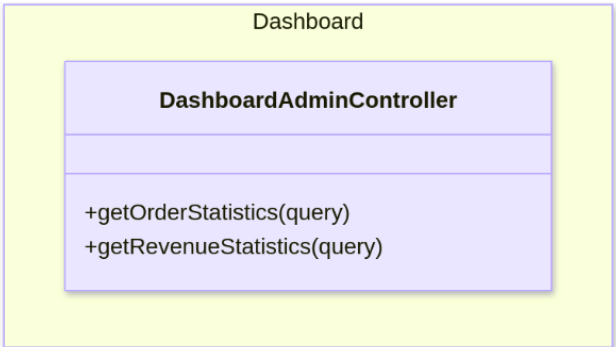
9. Upload



Upload Admin Controller

Method Name	Functionality
uploadImage(file, title)	Uploads a single file and returns its stored URL.
bulkUploadImages(files)	Handles the simultaneous upload of multiple files.
getListImages(query)	Retrieves a gallery of uploaded images.
getImageById(id)	Retrieves metadata for a specific uploaded image.
deleteImage(id)	Removes a single image file from storage.
bulkDeleteImages(body)	Removes multiple image files in a batch operation.

10. Dashboard



Dashboard Admin Controller

Method Name	Functionality
getOrderStatistics(query)	Returns statistical data on orders (counts, status breakdown).
getRevenueStatistics(query)	Returns financial performance data over a specified period.

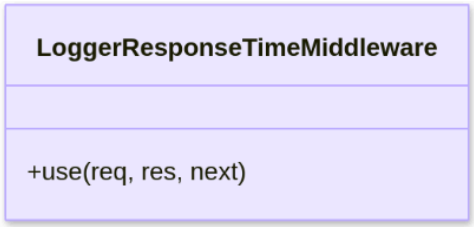
4.3 Component: Middleware

4.3.1 Responsibilities

These components handle cross-cutting concerns in the request/response lifecycle. They operate within the NestJS request pipeline to enforce security, validate data, handle errors, and transform responses.

4.3.2 Details

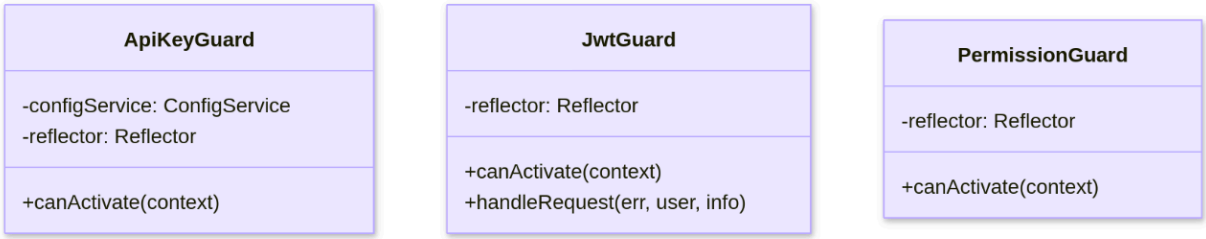
1. LoggerResponseTimeMiddleware



This is a standard HTTP middleware that sits at the very entry point of the request pipeline. It helps monitoring the status of requests.

Method Name	Functionality
use(req, res, next)	Intercepts every incoming HTTP request to log the start time. It then hooks into the response 'finish' event to calculate and log the total duration (latency) of the request for monitoring performance.

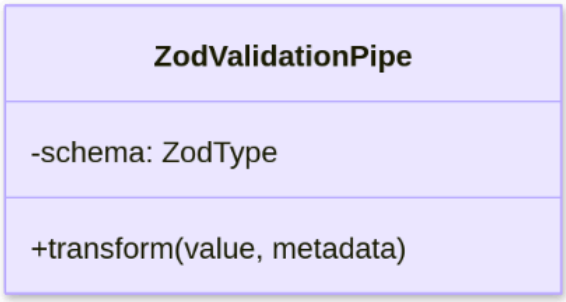
2. Guard



This is a global or route-specific Guard used to secure public-facing APIs that require machine-to-machine authentication (e.g., webhooks or mobile app initial headers).

Method Name	Functionality
ApiKeyGuard	Checks the incoming request headers for a specific API Key. It compares this key against the value stored in ConfigService. If they match, the request is allowed; otherwise, it is denied with a 403 Forbidden error.
JwtGuard	Validates the JWT found in the Authorization header. It verifies the signature and expiration. It also uses Reflector to check if the route is marked as "Public" (skipping validation if so).
PermissionGuard	Retrieves the required permissions defined for the route handler (using Reflector). It then checks if the currently authenticated user possesses these permissions. If not, it denies access.

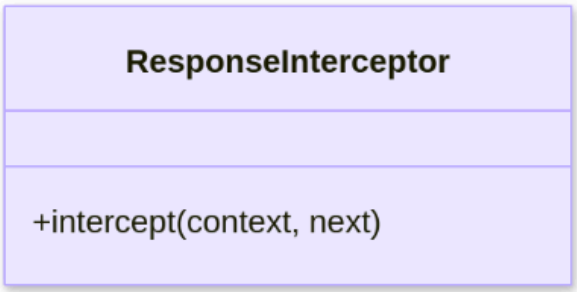
5. Pipe



This Pipe is responsible for request data validation. It ensures that the incoming request body, query params, or params match the expected schema structure defined using the Zod library.

Method Name	Functionality
transform(value, metadata)	Parses the incoming payload (value) against the provided Zod schema (schema). If validation fails, it throws a detailed BadRequestException; otherwise, it returns the sanitized/parsed data.

6. ResponseInterceptor



This Interceptor wraps the successful response from any controller handler into a standardized JSON envelope.

Method Name	Functionality

intercept(context, next)	Intercepts the response stream. It formats the data returned by the controller into a standard structure (e.g., { "data": ..., "statusCode": 200, "message": "Success" }) ensuring consistent API responses across the system.

7. GlobalExceptionFilter

This Filter acts as the final safety net for the application. It catches any unhandled exceptions thrown during request processing.

Method Name	Functionality
catch(exception, host)	Catches errors (both HTTP and system errors). It standardizes the error response format (e.g., { "statusCode": 500, "error": "Internal Server Error", "timestamp": ... }) and logs the error details for debugging before sending the response to the client.

4.4 Component: Business Service

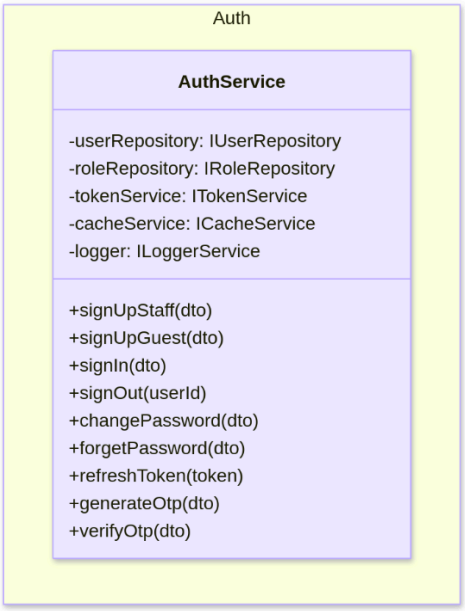
4.4.1 Responsibilities

The Service component acts as the **Application Layer** (and sometimes Domain Service layer). It provides Data transfer objects (DTOs) for other components. Each service has its own class entities which represent the main data format. Its primary responsibilities are:

- **Business Logic Execution**: Implementing the core rules and calculations of the application.
- **Transaction Management**: Ensuring data consistency across multiple database operations via Unit of Work.
- **Orchestration**: Coordinating interactions between the Controller, Repositories, and External Providers.

4.4.2 Details

1. Auth Service



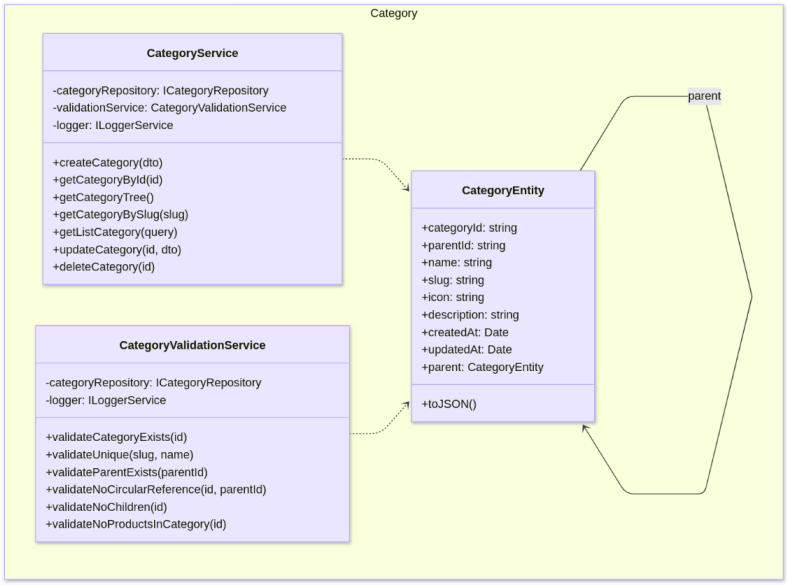
Dependencies (Fields)

Field Name	Type	Description
userRepository	IUserRepository	Access to user persistence for credential validation.
roleRepository	IRoleRepository	Access to role definitions for assignment during signup.
tokenService	ITokenService	Utility for generating and signing JWTs.
cacheService	ICacheService	Temporary storage for OTPs and session data.
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality
signUpStaff(dto)	Registers a new internal user (admin/staff), ensuring appropriate role assignment and security checks.
signUpGuest(dto)	Registers a new external customer (guest), typically with default permissions.
signIn(dto)	Authenticates credentials against the stored hash and issues an access/refresh token pair.
signOut(userId)	Invalidates active sessions or tokens for the specified user.
changePassword(dto)	Verifies the old password and updates the user record with a new hashed password.
forgetPassword(dto)	Generates a recovery token or link and triggers the email notification service.
refreshToken(token)	Validates a long-lived refresh token and issues a new short-lived access token.
generateOtp(dto)	Creates a temporary numeric code for 2FA or verification and stores it with an expiration.
verifyOtp(dto)	Compares the user-submitted code against the active stored OTP.

2. Category Service



Dependencies (Fields)

Field Name	Type	Description
categoryRepository	ICategoryRepository	Data access for category entities.
validationService	CategoryValidationService	Internal service for structural integrity checks.
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality
createCategory(dto)	Validates and persists a new category node in the database.
getCategoryById(id)	Retrieves a single category entity by its ID.

getCategoryTree()	Recursively builds the full hierarchical structure of categories (Parent -> Children).
getCategoryBySlug(slug)	Finds a category based on its URL-friendly slug for SEO purposes.
getListCategory(query)	Retrieves a flat, paginated list of categories.
updateCategory(id, dto)	Modifies category details after performing necessary validation checks.
deleteCategory(id)	Removes a category (typically requires checking for child products first).

3. Category Validation Service

Dependencies (Fields)

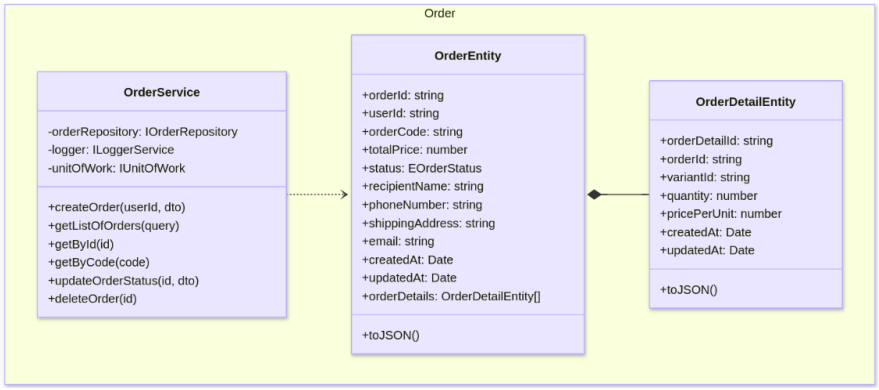
Field Name	Type	Description
categoryRepository	ICategoryRepository	Access to check existence and relationships.
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality
validateCategoryExists(id)	Checks if a category ID corresponds to a valid record in the database.
validateUnique(slug, name)	Ensures no two categories share the same URL slug or display name.
validateParentExists(parentId)	Ensures a referenced parent category actually exists before linking.

validateNoCircularReference(id, parentId)	Prevents a category from becoming its own ancestor in the hierarchy.
validateNoChildren(id)	Checks if a category has sub-categories before allowing deletion.
validateNoProductsInCategory(id)	Checks if a category contains active products before allowing deletion.

4. Order Service



Dependencies (Fields)

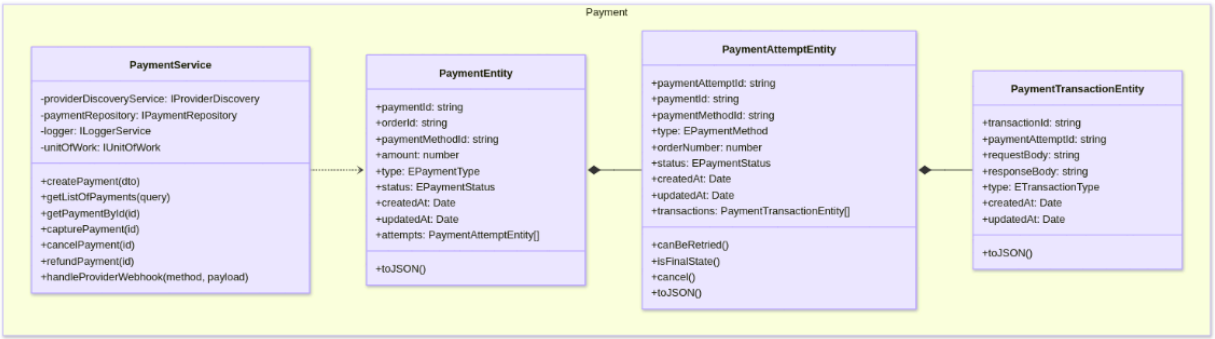
Field Name	Type	Description
orderRepository	IOrderRepository	Data access for orders and line items.
unitOfWork	IUnitOfWork	Manages transactions for multi-step updates (e.g., stock + order).
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality

createOrder(userId, dto)	Converts cart items into a persisted order, calculates final prices, and reserves stock.
getListOfOrders(query)	Retrieves paginated orders for admin views with filtering capabilities.
getById(id)	Retrieves the full order aggregate including all line items (OrderDetail).
getByCode(code)	Retrieves an order by its public-facing reference number.
updateOrderStatus(id, dto)	Transitions the order state (e.g., Pending -> Shipped) and triggers related events.
deleteOrder(id)	Soft-deletes or cancels an order record.

5. Payment Service



Dependencies (Fields)

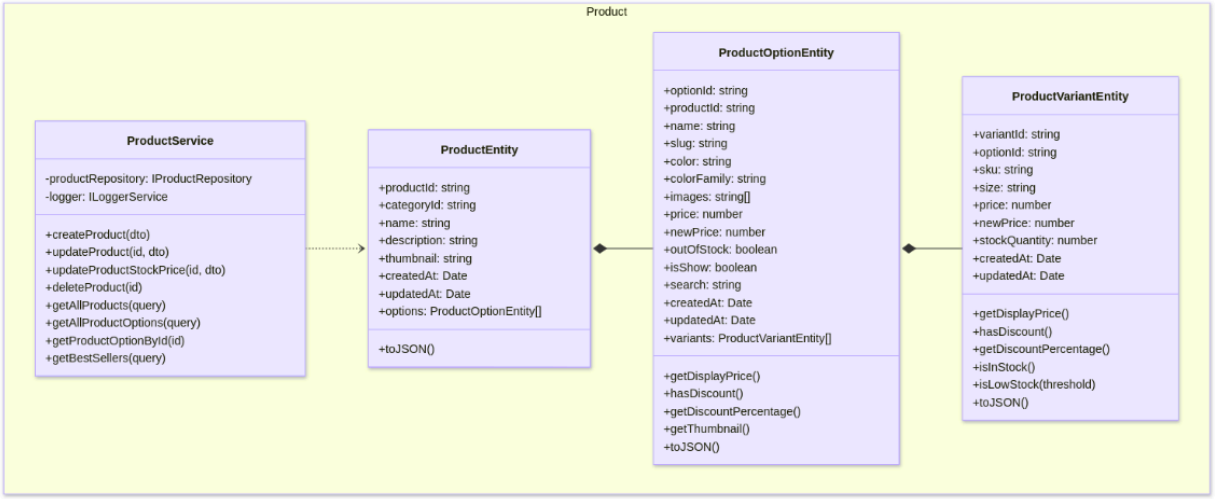
Field Name	Type	Description
providerDiscoveryService	IProviderDiscovery	Resolves the correct gateway strategy (MoMo, Stripe) at runtime.
paymentRepository	IPaymentRepository	Data access for payment records.

unitOfWork	IUnitOfWork	Ensures atomicity when updating payment status and order status.
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality
createPayment(dto)	Initializes a payment intent and returns checkout data/URLs.
getListOfPayments(query)	Retrieves payment history for reconciliation and auditing.
getPaymentById(id)	Retrieves full details of a payment transaction and its attempts.
capturePayment(id)	Finalizes an authorized payment (for two-step auth-capture flows).
cancelPayment(id)	Voids a pending payment attempt.
refundPayment(id)	Processes a refund for a successful payment.
handleProviderWebhook(method, payload)	Processes asynchronous status updates from gateways (MoMo).

6. Product Service



Dependencies (Fields)

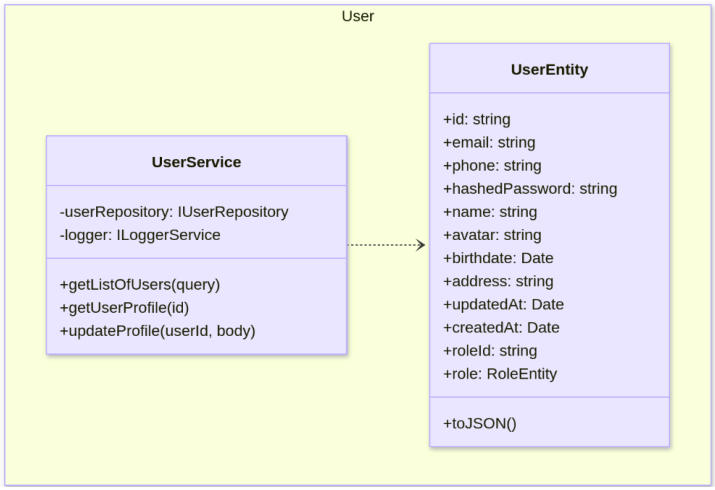
Field Name	Type	Description
productRepository	IProductRepository	Data access for the product aggregate.
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality
createProduct(dto)	Creates a product and its nested options/variants in a single transaction.
updateProduct(id, dto)	Updates general product metadata (name, description).
updateProductStockPrice(id, dto)	Efficiently updates inventory and pricing for specific variants.
deleteProduct(id)	Removes a product and all associated variants from the catalog.

getAllProducts(query)	Retrieves the full admin list of products.
getAllProductOptions(query)	Retrieves available filter attributes (e.g., all Colors).
getProductOptionById(id)	Retrieves a specific option configuration.
getBestSellers(query)	Calculates top products based on historical sales data.

7. User Service



Dependencies (Fields)

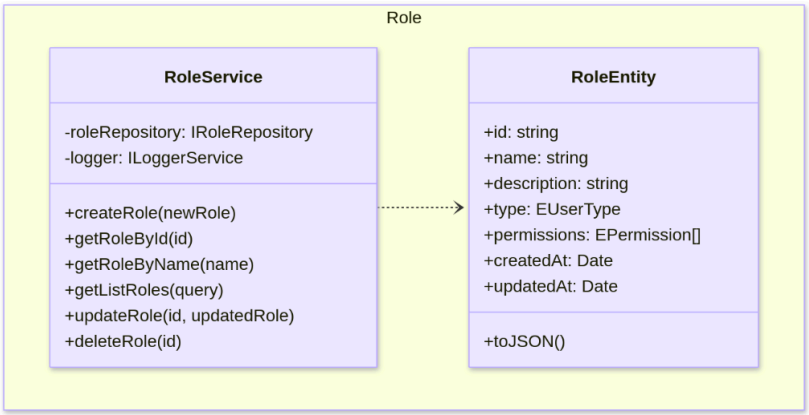
Field Name	Type	Description
userRepository	IUserRepository	Access to user profile data.
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality

getListOfUsers(query)	Lists registered accounts for administration.
getUserProfile(id)	Retrieves sensitive profile data for the account owner.
updateProfile(userId, body)	Updates personal info like address, phone number, or avatar.

8. Role Service



Dependencies (Fields)

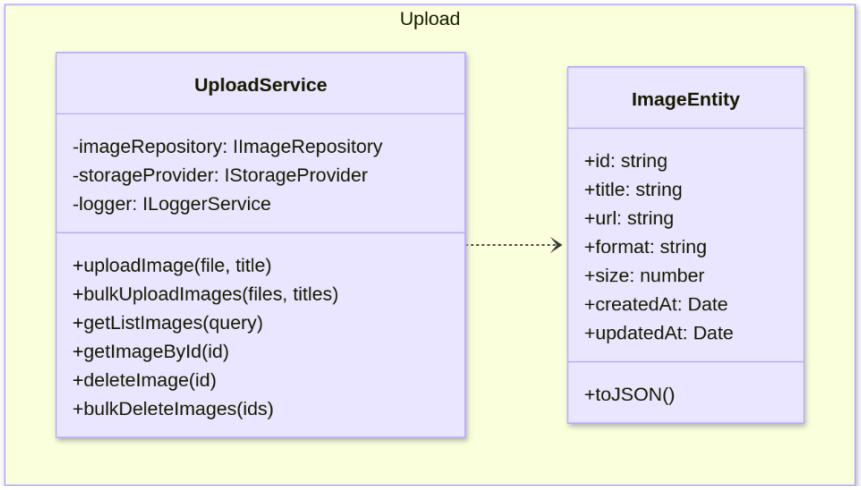
Field Name	Type	Description
roleRepository	IRoleRepository	Access to role and permission storage.
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality
createRole(newRole)	Defines a new security role with specific permissions.
getRoleById(id)	Retrieves a role definition.

getRoleByName(name)	Lookup utility for internal logic (e.g., finding the "Admin" role).
getListRoles(query)	Lists all available system roles.
updateRole(id, updatedRole)	Modifies permissions attached to a specific role.
deleteRole(id)	Removes a role (typically checks for usage first).

9. Upload Service



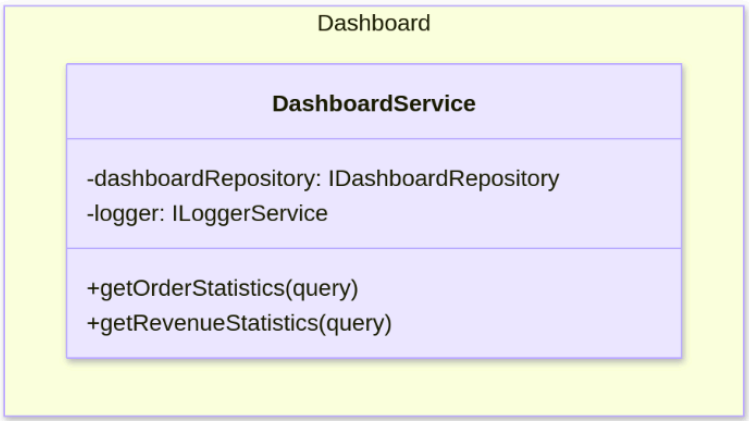
Dependencies (Fields)

Field Name	Type	Description
imageRepository	IImageRepository	Stores metadata about the file (URL, size).
storageProvider	IStorageProvider	Handles the physical file I/O (S3, Disk).
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality
uploadImage(file, title)	Processes a file upload stream and saves metadata.
bulkUploadImages(files, titles)	Handles batched file uploads.
getListImages(query)	Retrieves a gallery of uploaded assets.
getImageById(id)	Retrieves metadata for a specific file.
deleteImage(id)	Removes the file from storage and the database.
bulkDeleteImages(ids)	Batch deletion of multiple files.

10. Dashboard Service



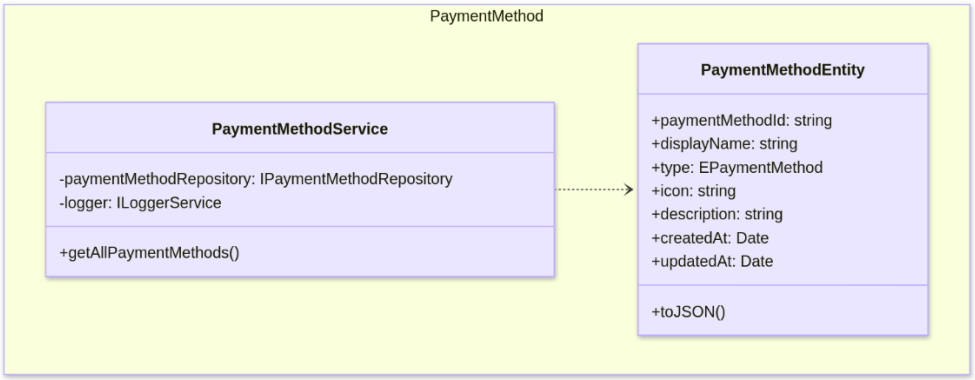
Dependencies (Fields)

Field Name	Type	Description
dashboardRepository	IDashboardRepository	Specialized read-only repository for analytics queries.
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality
getOrderStatistics(query)	Aggregates order data by status/date.
getRevenueStatistics(query)	Calculates financial totals over time.

11. Payment Method Service



Dependencies (Fields)

Field Name	Type	Description
paymentMethodRepository	IPaymentMethodRepository	Access to configured payment methods.
logger	ILoggerService	System logging interface.

Methods

Method Name	Functionality
getAllPaymentMethods()	Lists enabled payment options for the checkout UI.

4.5 Component: Repository

4.5.1 Responsibilities

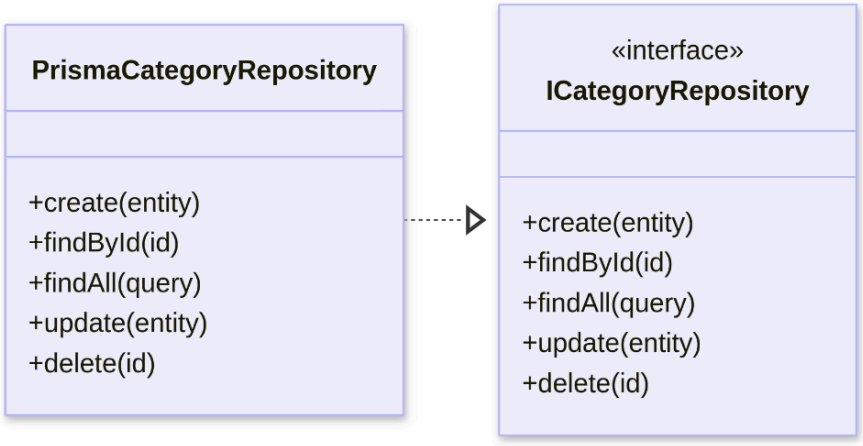
The Repository component acts as the Infrastructure Layer (specifically the Data Access layer). Each domain has specific repository interfaces that keep the service layer isolated from technology. We can easily change to a new database but not affect other components. Its primary responsibilities are:

- **Data Persistence**: Abstracting the underlying database technology (SQL, NoSQL, etc.) from the rest of the application.
- **Query Encapsulation**: containing complex database queries (e.g., joins, aggregations) so services remain clean.
- **Entity Mapping**: Converting raw database rows/documents into Domain Entities.

In this project, we choose Prisma to handle database connection, so each implementation of the repository has the prefix Prisma.

4.5.2 Details

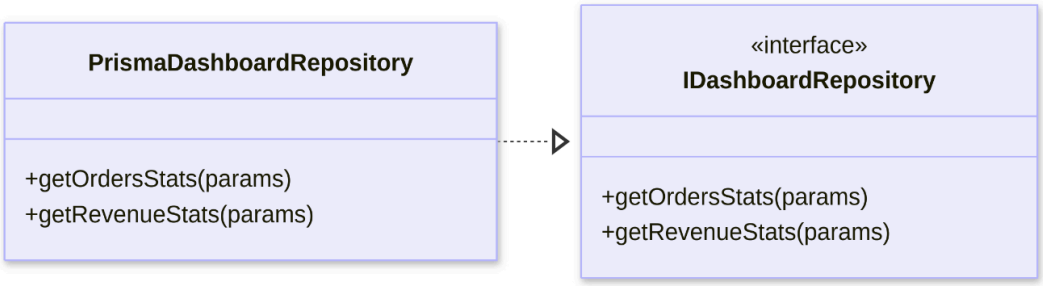
1. Category Repository



Method Name	Functionality
create(entity)	Persists a new category entity into the database.
findById(id)	Retrieves a specific category by its unique identifier.
findAll(query)	Retrieves a list of categories based on filtering criteria.

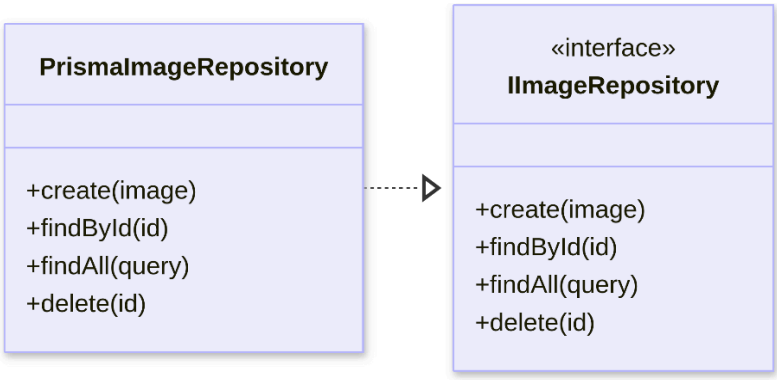
update(entity)	Updates the attributes of an existing category record.
delete(id)	Removes a category record from the database.

2. Dashboard Repository



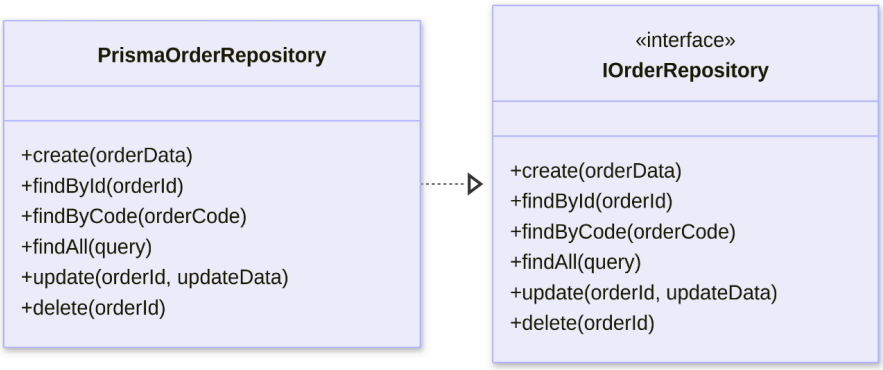
Method Name	Functionality
getOrdersStats(params)	Aggregates order data (counts, status distribution) based on time range parameters.
getRevenueStats(params)	Calculates total revenue and financial metrics based on time range parameters.

3. Image Repository



Method Name	Functionality
create(image)	Saves the metadata of a newly uploaded image.
findById(id)	Retrieves image metadata by its ID.
findAll(query)	Retrieves a gallery of image records based on filters.
delete(id)	Removes an image metadata record.

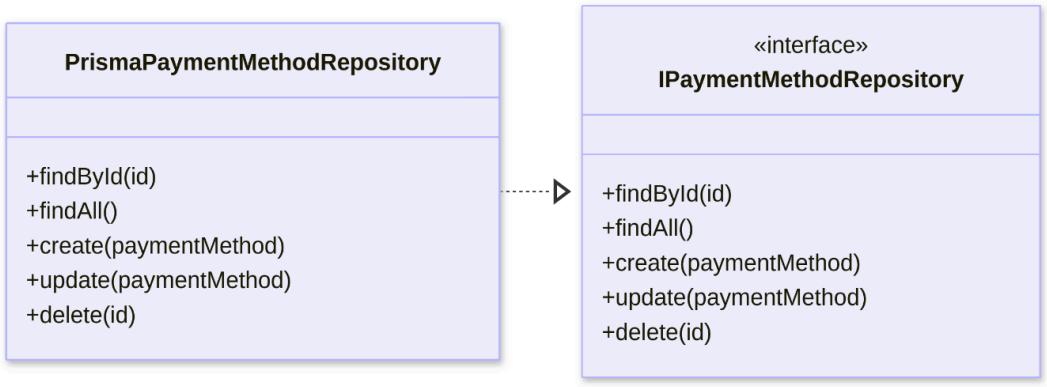
4. Order Repository



Method Name	Functionality
create(orderData)	Inserts a new order and its details into the database.
findById(orderId)	Retrieves a full order aggregate by its internal ID.
findByCode(orderCode)	Retrieves an order using its public-facing reference code.
findAll(query)	Retrieves a paginated list of orders for administration.

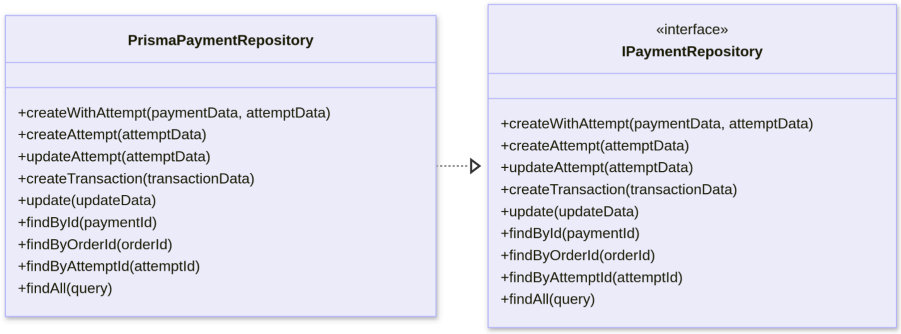
update(orderId, updateData)	Modifies order status or details.
delete(orderId)	Soft-deletes or removes an order record.

5. Payment Method Repository



Method Name	Functionality
findById(id)	Retrieves a specific payment method configuration.
findAll()	Retrieves all available payment methods.
create(paymentMethod)	Adds a new supported payment gateway configuration.
update(paymentMethod)	Modifies an existing payment method configuration.
delete(id)	Removes a payment method configuration.

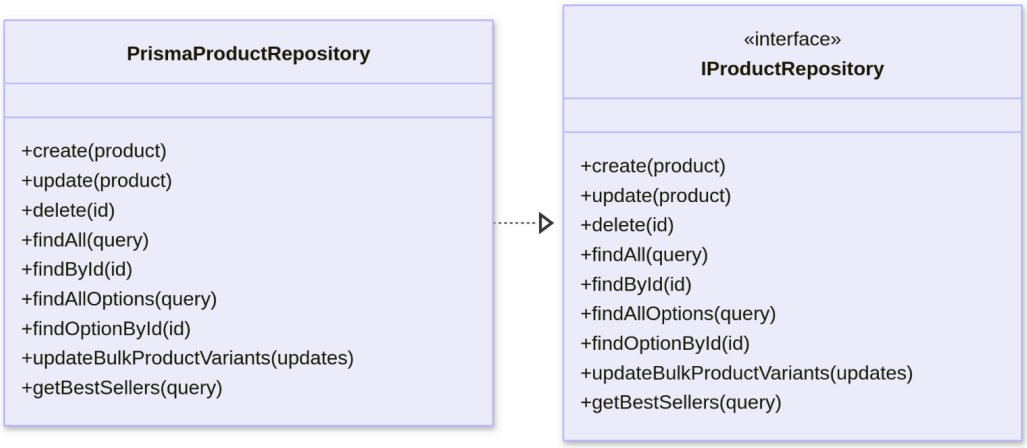
6. Payment Repository



Method Name	Functionality
createWithAttempt(paymentData, attemptData)	Atomically creates a payment record and its first attempt.
createAttempt(attemptData)	logs a new attempt for an existing payment obligation.
updateAttempt(attemptData)	Updates the status of a specific payment attempt.
createTransaction(transactionData)	Logs a raw provider transaction (request/response) for auditing.
update(updateData)	Updates the overall status of the parent payment record.
findById(paymentId)	Retrieves the full payment aggregate.
findByOrderId(orderId)	Finds the payment record associated with a specific order.
findByAttemptId(attemptId)	Finds a payment record via one of its attempt IDs.

findAll(query)	Retrieves a history of payments for reconciliation.

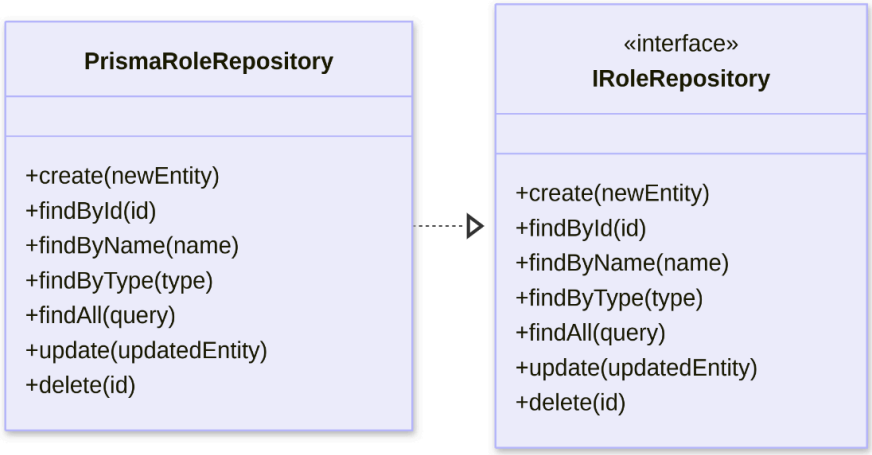
7. Product Repository



Method Name	Functionality
create(product)	Persists a new product aggregate (including options/variants).
update(product)	Updates product details.
delete(id)	Removes a product from the catalog.
findAll(query)	Retrieves a filterable list of products.
findById(id)	Retrieves a full product aggregate.
findAllOptions(query)	Retrieves distinct product options (e.g., all available colors).

findOptionById(id)	Retrieves a specific option configuration.
updateBulkProductVariants(updates)	Efficiently performs batch updates on inventory/pricing.
getBestSellers(query)	specific query to rank products by sales volume.

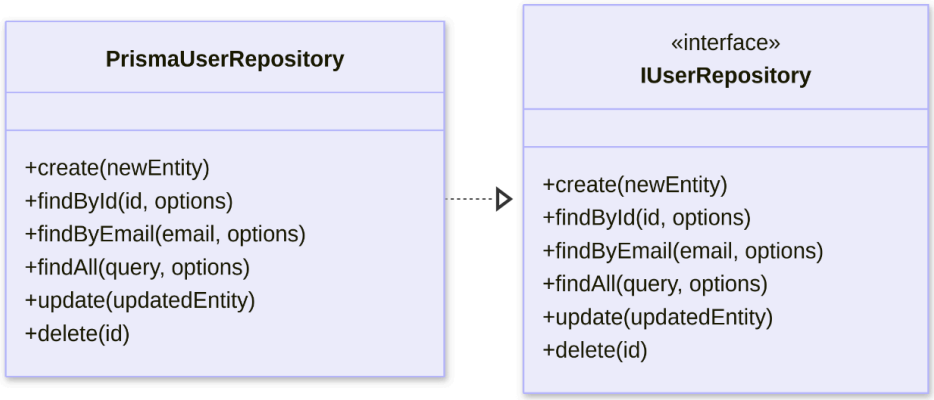
8. Role Repository



Method Name	Functionality
create(newEntity)	Persists a new role definition.
findById(id)	Retrieves a role and its permissions by ID.
findByName(name)	Retrieves a role by its unique name (e.g., "Admin").
findByType(type)	Finds roles associated with a specific user type.
findAll(query)	Retrieves all defined roles.
update(updatedEntity)	Modifies role permissions or metadata.

delete(id)	Removes a role definition.

9. User Repository



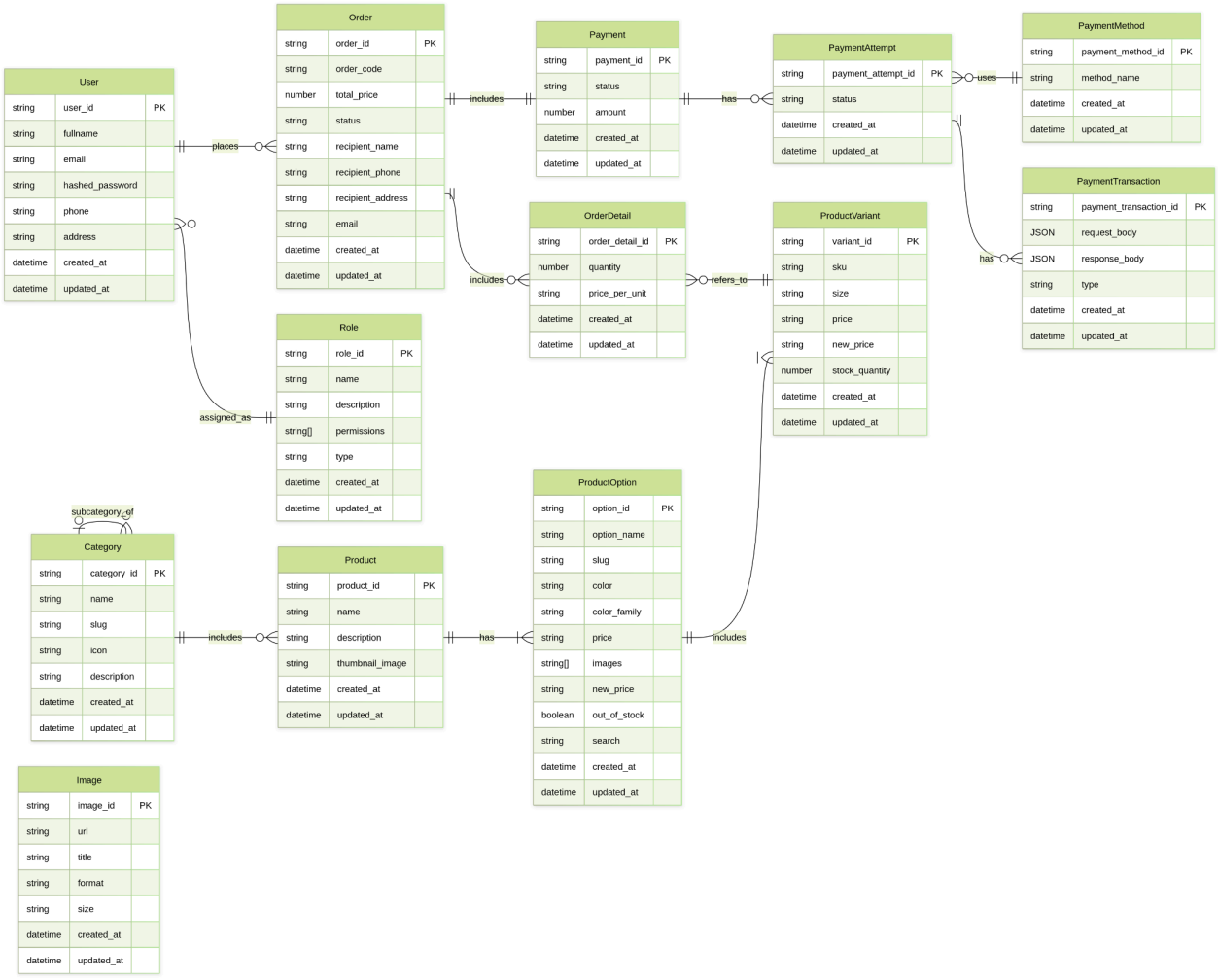
Method Name	Functionality
create(newEntity)	Persists a new user record.
findById(id, options)	Retrieves a user by ID, optionally including relations.
findByEmail(email, options)	Retrieves a user by their unique email address.
findAll(query, options)	Retrieves a paginated list of users.
update(updatedEntity)	Updates user profile or account details.
delete(id)	Removes a user record.

4.6 Component: Database

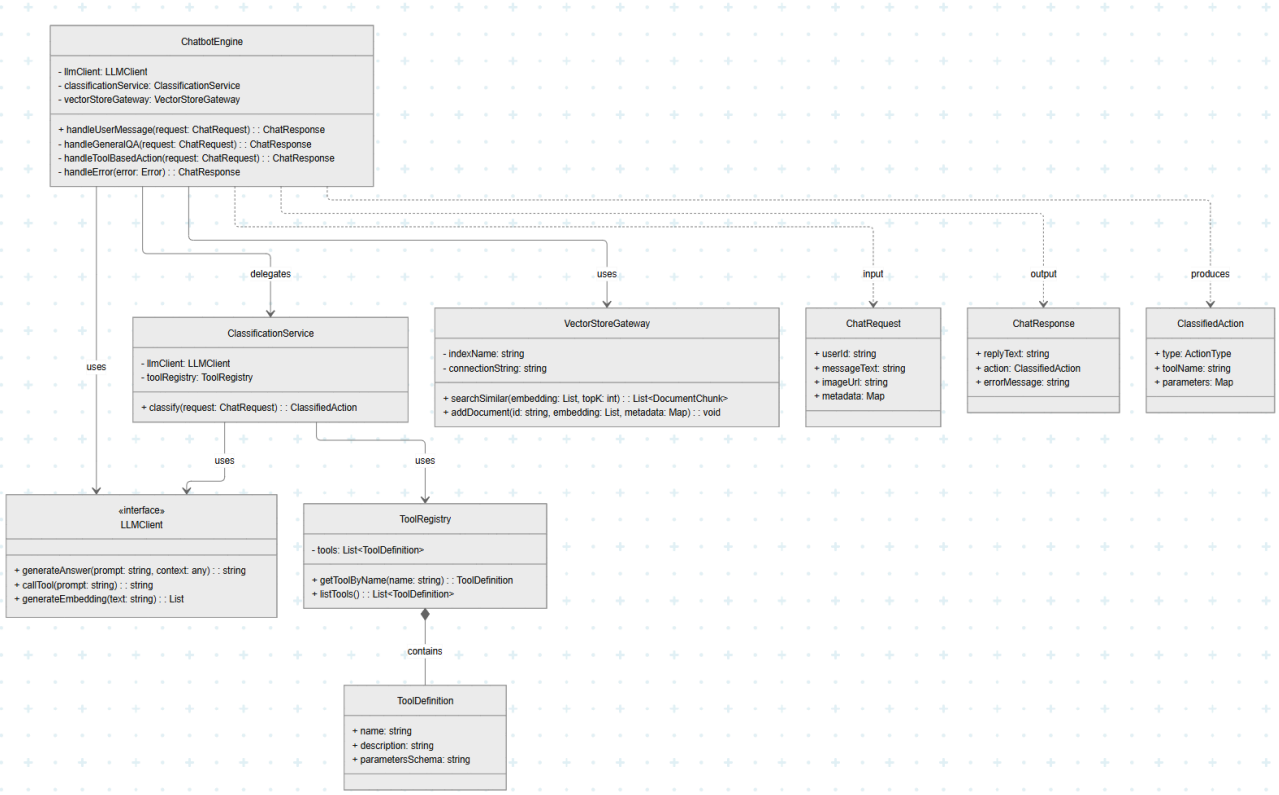
For the database, we have selected SQL database. This choice is appropriate because it guarantees strict data consistency, which is critical given the high frequency of orders and payments. Each entity identified

in the class diagram will correspond to a specific table within the database allowing the data model to remain clear, normalized, and easy to maintain.

Only the backend can communicate with the database. It will ensure more security and loose the couple between other components. The backend communicates with the database through a combination of the Infrastructure layer and the SQL driver provided by our cloud database service (Supabase). The infrastructure layer contains class repositories that implement the interfaces defined in the Core layer. Communication occurs over secure TCP/IP connections, ensuring that all database operations remain safe and protected.



4.7 Component: AI



4.7.1. ChatbotEngine

a) Description

The ChatbotEngine is the core orchestrator of the AI chatbot system.It receives user messages, retrieves relevant context via RAG, invokes the LLM for reasoning, and delegates system-level actions to the classification layer. It is responsible for producing the final ChatResponse returned to the web application.

b) Fields

Field Name	Type	Description
llmClient	LLMClient	Provides LLM capabilities such as generation, tool-calling, and embedding.

classificationService	ClassificationService	Determines which tool/function the LLM intends to execute.
vectorStoreGateway	VectorStoreGateway	Performs vector search for Retrieval-Augmented Generation (RAG).

c) Methods

Method Name	Functionality
handleUserMessage(request: ChatRequest)	Main entry point. Processes a user message and returns a final ChatResponse.
handleGeneralQA(request: ChatRequest)	Handles natural language Q&A using RAG + LLM reasoning.
handleToolBasedAction(request: ChatRequest)	Executes system actions chosen by the LLM (via ClassifiedAction).
handleError(error: Error)	Produces a standardized error response in case of failure.

4.7.2. LLMClient

a) Description

The LLMClient wraps the underlying language model API (groq). It generates responses, produces embeddings, and performs tool-calling for structured action selection.

b) Fields

Field Name	Type	Description
apiKey	string	API key for authenticating with the LLM provider.
modelName	string	The LLM model being used (e.g., "mixtral", "llama3").
endpointUrl	string	Base URL of the LLM service.

c) Methods

Method Name	Functionality
generateAnswer(prompt: string, context: any)	Generates a natural language response using the model.
callTool(prompt: string)	Returns JSON representing the LLM's selected tool/function.
generateEmbedding(text: string)	Produces vector embeddings for similarity search (RAG).

4.7.3. ClassifiedAction

a) Description

ClassifiedAction is the structured output representing which system tool/function the LLM wants to execute and with what parameters. *(This class contains no methods, it is a pure data carrier.)*

b) Fields

Field Name	Type	Description
type	ActionType	The type/category of action requested (e.g., TRY_ON, GET_PRICE).
toolName	string	The name of the selected tool from the registry.
parameters	Map<string, any>	Dynamic parameters passed to the tool.

4.7.4. ClassificationService

a) Description

ClassificationService is responsible for interpreting the user input and LLM output to determine which tool should be executed. It acts as the bridge between free-text reasoning and actionable system commands.

b) Fields

Field Name	Type	Description
llmClient	LLMClient	Used to perform tool selection via LLM.
toolRegistry	ToolRegistry	Contains all available tools and their metadata.

c) Methods

Method Name	Functionality
classify(request: ChatRequest)	Uses the LLM to identify the intended tool and produce a ClassifiedAction.

4.7.5. ToolRegistry

a) Description

ToolRegistry stores the list of available tools that the LLM may call. It enables dynamic tool lookup and ensures the chatbot has access only to approved system actions.

b) Fields

Field Name	Type	Description
tools	List<ToolDefinition>	The complete list of registered tools/functions.

c) Methods

Method Name	Functionality
getToolByName(name: string)	Retrieves a tool definition by name.
listTools()	Returns all available tool definitions.

4.7.6. ToolDefinition

a) Description

Defines a single tool/function that the LLM can call. Each tool has a name, description, and parameter schema for validation. (This class contains no methods, it is metadata only.)

b) Fields

Field Name	Type	Description
name	string	Tool name as referenced by the LLM.
description	string	Human-readable description of the tool's functionality.
parametersSchema	string	JSON schema describing required parameters.

4.7.7. VectorStoreGateway

a) Description

The VectorStoreGateway enables Retrieval-Augmented Generation (RAG) by storing and retrieving document embeddings.

b) Fields

Field Name	Type	Description
indexName	string	Name of the vector index used for similarity search.
connectionString	string	Connection details for the vector database.

c) Methods

Method Name	Functionality
searchSimilar(embedding, topK)	Retrieves the top-K similar document chunks.
addDocument(id, embedding, metadata)	Inserts a new document into the vector store.

4.7.8 ChatRequest

a) Description

Represents a message sent from the web application to the chatbot, containing metadata such as the current product page context.

b) Fields

Field Name	Type	Description
userId	string	The user who sent the message.
messageText	string	The content of the user's message.
imageUrl	string	Optional: image used for try-on or visual queries.
metadata	Map<string, any>	Contextual data (e.g., current productId, page type).

4.7.9. ChatResponse

a) Description

Represents the final response returned to the web UI, containing both natural language output and optional tool execution metadata.

b) Fields

Field Name	Type	Description
replyText	string	The chatbot’s natural language response.
action	ClassifiedAction	Optional tool execution details for other system components.
errorMessage	string	Error message if processing fails.

4.8 Component: External Service

4.8.1 LLM (groq)

Description

The system integrates with Groq LLM through the official Groq SDK.

No direct HTTP calls or manual endpoint construction are required.

Instead, the backend invokes high-level SDK methods, and the SDK internally communicates with Groq’s REST API endpoints.

Method Name	Functionality	Endpoint (SDK-Managed)
generateChatCompletion	Chat response generation	/openai/v1/chat/completions
callToolWithLLM	Tool/function calling	/openai/v1/chat/completions
generateEmbedding	Embedding generation (RAG)	/openai/v1/embeddings

4.8.2 Momo

Description

We integrate the MoMo Gateway to facilitate payments via versatile methods such as Credit Cards, ATM Cards (Napas), and QR Codes. The fundamental flow allows users to initiate a payment on our platform, be redirected to MoMo to complete the transaction, and seamlessly return.

Basic Flow:

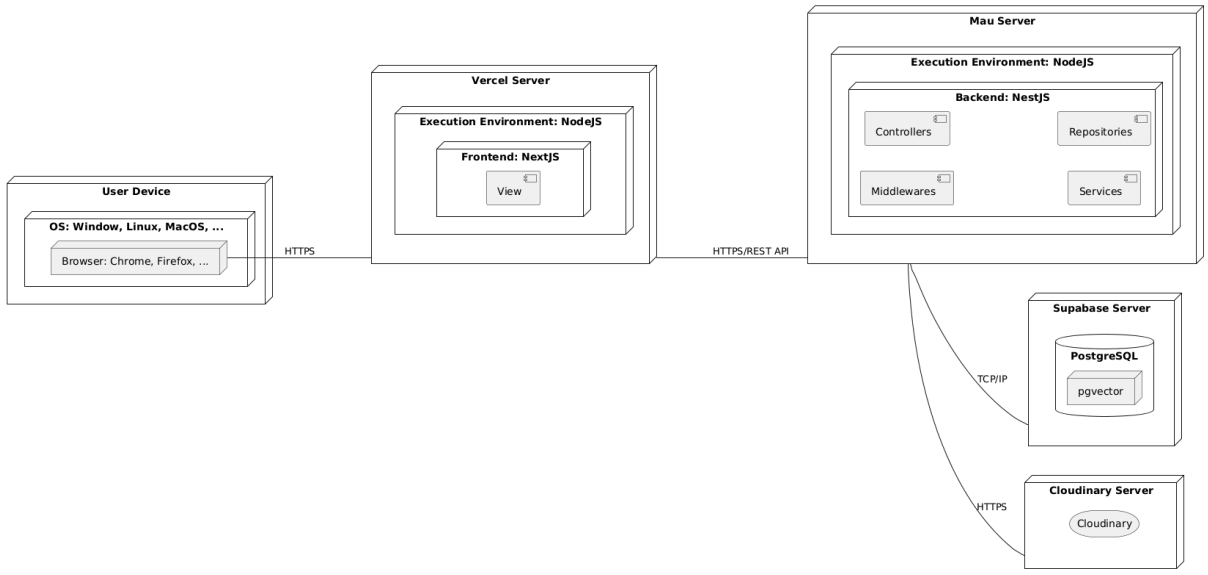
- **Initiation**: The server sends a request to MoMo to generate a payment link (PayURL).
- **User Action**: The user pays via the MoMo App or Gateway.
- **Notification**: MoMo sends a Webhook (IPN) to our server to notify us of the result.
- **Confirmation**: Our server checks the inventory/database.
    - If valid: We send a **Capture** request to finalize the transaction.
    - If invalid (old payurl, cancel order): We send a **Cancel** request to release the hold on the user's funds.
- **Refund**: If a completed order is returned, we send a **Refund** request.

Key Endpoints (Server to MoMo)

Method Name	Functionality
requestPayUrl(orderInfo)	**Endpoint: Payment Creation** Sends a request to /v2/gateway/api/create. It packages the order amount, order ID, and callback URLs. MoMo returns a payUrl (for web) and deepLink (for mobile) which we use to redirect the user to the payment screen.

confirmTransaction(orderId, type)	**Endpoint: Manual Confirm** Sends a request to /v2/gateway/api/confirm. This is the critical "Decision" endpoint. We send a requestType of either **"capture"** (to complete the payment and take the money) or **"cancel"** (to void the transaction and release the money back to the user).
refundTransaction(transId, amount)	**Endpoint: Refund** Sends a request to /v2/gateway/api/refund. Used when an Admin approves a return or cancellation after the money has already been captured. It instructs MoMo to return a specific amount to the user's original payment method.

5. Deployment



5.1 User Tier

Devices and OS: Client devices (Desktops, Laptops, Tablets, Smartphones) running standard operating systems (Windows, macOS, Linux, iOS, Android) capable of running modern web browsers.

Communication: The browser communicates with the Frontend Server via **HTTPS** to request static assets and render the user interface.

5.2 Frontend Sub-system

Hosted Environment: Vercel Server (Cloud Platform).

Execution Environment: NodeJS.

Components: Web Application containing Layer Components, Hooks, and Services.

Communication:

- **Inbound:** Receives **HTTPS** requests from the User's Browser.
- **Outbound:** Interacts with the Backend Server via **HTTPS** using **REST API** protocols for dynamic data fetching and state management.

5.3 Backend Sub-system

Hosted Environment: Mau Server.

Execution Environment: NodeJS.

Components: Web Application containing Middlewares, Controllers, Services, and Repositories.

Communication:

- **Inbound:** Receives **HTTPS/REST API** requests from the Frontend sub-system.
- **Outbound (Database):** Connects to the PostgreSQL database using **TCP/IP**.
- **Outbound (Storage):** Connects to the Cloudinary storage service via **HTTPS/API** for media management.

5.4 Database

Hosted Environment: Supabase Server (Managed Database Service).

Technology: PostgreSQL database engine.

Plugins: Utilizes the **pgvector** plugin (likely for vector similarity search/AI features).

Communication: Accepts connections from the Backend Server via **TCP/IP**.

5.5 Storage

Hosted Environment: Cloudinary Server (SaaS Media Management).

Communication: Accessible by the Backend Server via secure **HTTPS/API** calls for uploading, retrieving, and transforming media assets.

6. Implementation View

6.1 Frontend side

```bash
src_frontend
├── app // Each page in app is in a folder (App router in NextJS)
│   ├── admin
│   ├── products
│   ├── sign-in
│   ├── ...
│   ├── layout.tsx
│   ├── page.tsx
│   └── global.css // global styles, define reusable styles
│
├── components // Shared components
│   ├── ui // element ui components (button, input, etc)
│   ├── search-bar // shared components
│   └── ... // shared components
├── context // shared context (React context)
├── features  // Each feature is a separate module
│   ├── product
│   │   ├── components // Only render UI
│   │   ├── hooks // manage state, side effects, etc
│   │   ├── services // manage api calls
│   │   └── types // Types, interfaces, etc
│   └── ...
├── hooks // Shared hooks
└── lib // Shared utils, custom api client, etc
```


app/: The "Router". Handles Routing and Layout Composition.

- Organization: File-system based routing. Folders become URL paths.
- Dependencies: Imports Features

File/Folder	Description

page.tsx	**The View Entry**. Represents the content of a specific route. It should be relatively thin, mostly importing and rendering widgets from features/.
layout.tsx	**The Shell**. Defines the UI that persists across route transitions (e.g., Sidebars, Headers).
[folder_name]	**Route Segments**. Each folder defines a segment of the URL path.

features/: The "Domain Core". Encapsulates functionality.

- Organization: Grouped by Business Domain (Product, Auth, Cart).
- Dependencies: Depends on Shared (lib, hooks, components).

Folder	Description
[feature]/components	**Specific Components**. The combination of many UI elements that are specific to this feature
[feature]/hooks	**Controllers**. Custom hooks that bundle state, side effects, and API calls. They return data and handlers for the components to use.
[feature]/services	**API Layer**. Functions that call the backend endpoints related to this feature.
[feature]/types	**Models**. Interfaces defining the shape of data used within this feature.

components/: The UI Library. Reusable building blocks.

- Organization: Grouped by Component Type.
- Dependencies: Zero dependencies on Features.

Folder	Description
ui/	**Primitives**. Low-level, stylable elements (Buttons, Inputs, Cards). Often generated by libraries like Shadcn UI.

[name]/	**Molecules**. reusable components used in multiple features (e.g., a standardized SearchBar or PageTitle).

context/: Global State, React Context Providers for app-wide state. For example:

- ThemeContext.tsx: Manages Dark/Light mode preference.
- AuthContext.tsx: Holds the global user session and token (if not using a library like NextAuth).
- ToastContext.tsx: Manages global notification popups.

hooks/: Generic Logic, custom hooks that are utility-based, not business-based. For example:

- use-debounce.ts: Utility to delay function execution (e.g., for search inputs).
- use-local-storage.ts: Utility to persist state to browser storage.
- use-click-outside.ts: Utility to detect clicks outside an element (for closing modals).

lib/: Utilities and Configuration. Implementation details, helper functions, and static configuration.

6.2 Backend side

On the backend side, we adopt the Clean Architecture pattern. The system is organized into layered components, where dependencies always point from the outer layers toward the inner ones. The architecture consists of four primary layers: Core, Application, Infrastructure, and Presentation.

Core is the most stable and independent layer. It contains all entities and the essential business logic of the system. In addition, it defines interfaces that the outer layers must rely on. This layer is fully isolated from frameworks and external technologies and depends only on the programming language itself.

- Organization: Grouped by Domain (e.g., product, user, order).
- Dependencies: None.

Structure:

Folder	Description
[domain]/entities	Pure TypeScript classes representing business objects. They encapsulate state and behavior
[domain]/interfaces	Abstract definitions (Ports) that outer layers must implement. This includes Repository interfaces (IOrderRepository).
[domain]/enums	Values constant to the business domain (e.g., EOrderStatus, EUserRole).
[domain]/exceptions	Custom error classes representing business failures (e.g., ProductOutOfStockException).

Application handles the system's use cases. It orchestrates business rules by interacting with the Core layer and using its entities and interfaces. This layer decides what the application should do but does not care how the underlying operations are implemented.

- Organization: Grouped by Domain.
- Dependencies: Depends on Core.

Structure:

Folder	Description
[domain]/services	Classes implementing specific use cases (e.g.. create order, pay). They orchestrate flow using Entities and Repositories but do not touch the database directly.
[domain]/dtos	Simple objects defining input/output for Use Cases. These decouple the inner logic from HTTP JSON structures.

Infrastructure contains all technical details. It provides concrete implementations for the interfaces defined in the inner layers. This includes frameworks, databases, external APIs, and other technologies.

Because of this, it is the layer most affected by external changes.

- Organization: Grouped by Technology (Database, External Services) and Modules.
- Dependencies: Depends on Core, Application and implements their interfaces.

Structure:

Folder	Description
modules	NestJS Modules that bind the architecture together (DI Container configuration).
prisma	Prisma client configuration, concrete implementations of I[Domain]Repository
services	Adapters for external tools like storage (Cloudinary), payment gateway (Momo), logger and cache

Presentation is the outermost layer, responsible for receiving client requests and returning responses. In our system, this layer exposes a set of **HTTP RESTful APIs**. These APIs allow the frontend to communicate with the backend through standard HTTP methods such as GET, POST, PUT, and DELETE. Each endpoint maps incoming requests to the appropriate use case in the Application layer, executes business logic, and returns structured JSON responses to the frontend. This communication style keeps both sides loosely coupled, making it easier to modify or replace the frontend without affecting backend logic.

- Organization: Grouped by Technical Role (Controllers, Guards, Filters, …), then by Domain inside Controllers.
- Dependencies: Depends on Application.

Structure:

Folder	Description
controllers/[domain]	Classes decorated with @Controller. They define endpoints (GET/POST), parse input, call Application Services, and return DTOs.
dtos	Network-facing DTOs with validation decorators (class-validator) defining expected JSON shapes.
guards	Logic to allow/deny requests (e.g., checking JWT tokens).
pipes	Logic to transform or validate input data before it reaches the controller.

filters	Global error handlers that translate Domain Exceptions into HTTP status codes.
interceptors	Logic to wrap responses (e.g., standard API response structure).

shared: Code reused across multiple layers or modules that doesn't belong to a specific domain.

Folder	Description
helpers	Generic utility functions (e.g., Date formatting, String manipulation).
enums	System-wide constants (e.g., SortOrder, Locale).
dtos	Shared data structures (e.g., PaginationDto).

Root entry:

File	Description
main.ts	Entry Point. Bootstraps the NestJS application.
app.module.ts	Root Module. The main configuration registry.