PROJECT DOCUMENTATION

Subject: Networking Issues in Mobile Systems

Part 1 – Conceptual Design

Project Topic: Mobile Currency Exchange System

1. General Information

- **Project Name:** Mobile Currency Exchange System
- **Project Authors:** Elif Ezgi Emre
- **Field of Study:** Computer Science
- **Year / Semester:** 2025 / Fall
- **Supervisor:** Marcin Kacprowicz
- **Submission Date:** 4 February 2026

2. Project Description

2.1. Project Objective

The goal of this project is to design and implement a mobile system that enables users to perform basic currency exchange operations. The project aims to practically apply concepts related to communication between a mobile application, a web service (REST), and a database, as well as integration with an external API (National Bank of Poland - NBP).

The system provides users with:

- **Real-time currency exchange rates** retrieved from the National Bank of Poland API
- **Virtual currency exchange operations** (buy/sell) using PLN (Polish Zloty) as the base currency
- **Transaction history** and wallet balance management
- **Robust network error handling** to address mobile networking challenges such as:
  - Connection timeouts
  - Network failures and packet loss
  - Weak network conditions (3G, low Wi-Fi)
  - Server unavailability

The application demonstrates practical implementation of mobile networking best practices, including timeout management, error recovery, and user-friendly error messaging.

2.2. Project Scope

The system consists of three main modules:

A. Mobile Application (React Native / Expo)

Core Features:

- **User Registration and Login**: Secure authentication system with email/password
- **Account Management**: User profile and wallet balance display
- **Currency Exchange Rates**: Real-time display of exchange rates from NBP API
- **Historical Rates Access**: View past exchange rates (via NBP API)
- **Buy/Sell Transactions**: Execute currency exchange operations
- **Transaction History**: View all past transactions with details
- **Wallet Balance**: Display current PLN balance

Technical Features:

- Cross-platform support (Android and iOS)
- Network layer with timeout handling (7 seconds)
- Error handling and retry mechanisms
- Offline cache support for last known rates
- Responsive UI design

B. Web Service (REST API - Node.js/Express)

Core Features:

- **Business Logic Implementation**: Currency exchange office logic
- **NBP API Integration**: Fetch and process exchange rates from National Bank of Poland
- **Mobile App Communication**: RESTful API endpoints for mobile application
- **Data Validation**: Input validation and business rule enforcement
- **User Authorization**: Authentication and session management

Technical Features:

- REST API architecture
- NBP API integration with 5-second timeout
- Error handling and logging
- CORS support for mobile app access
- JSON data format

C. Database (SQL Schema)

Core Features:

- **User Information Storage**: User accounts and authentication data
- **Transaction Recording**: All buy/sell transactions with timestamps
- **Wallet Balance Management**: Currency wallet balances (PLN)
- **Exchange Rate Cache**: Optional caching of exchange rates
- **Notification Settings**: User preferences for rate alerts (future extension)

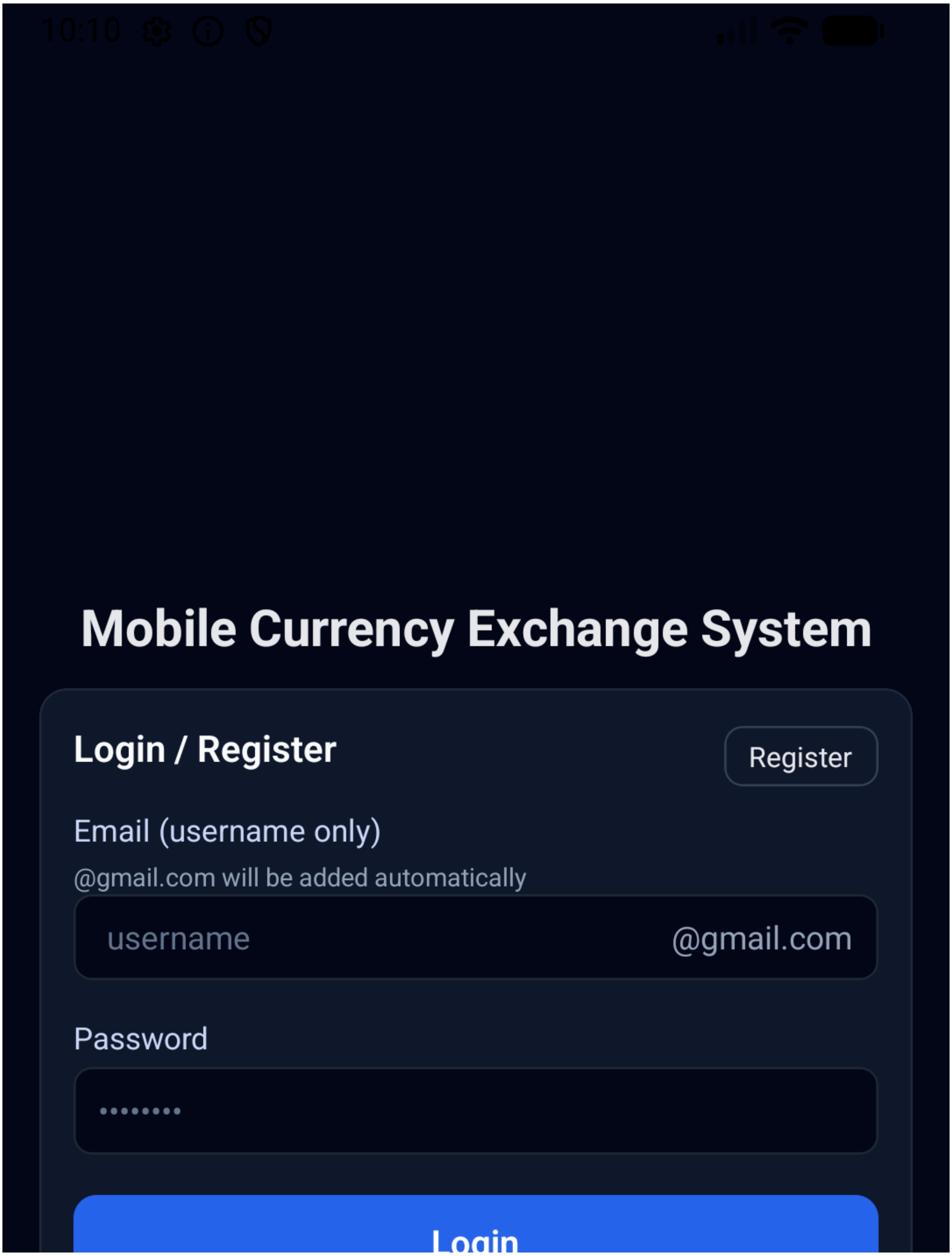
Technical Features:

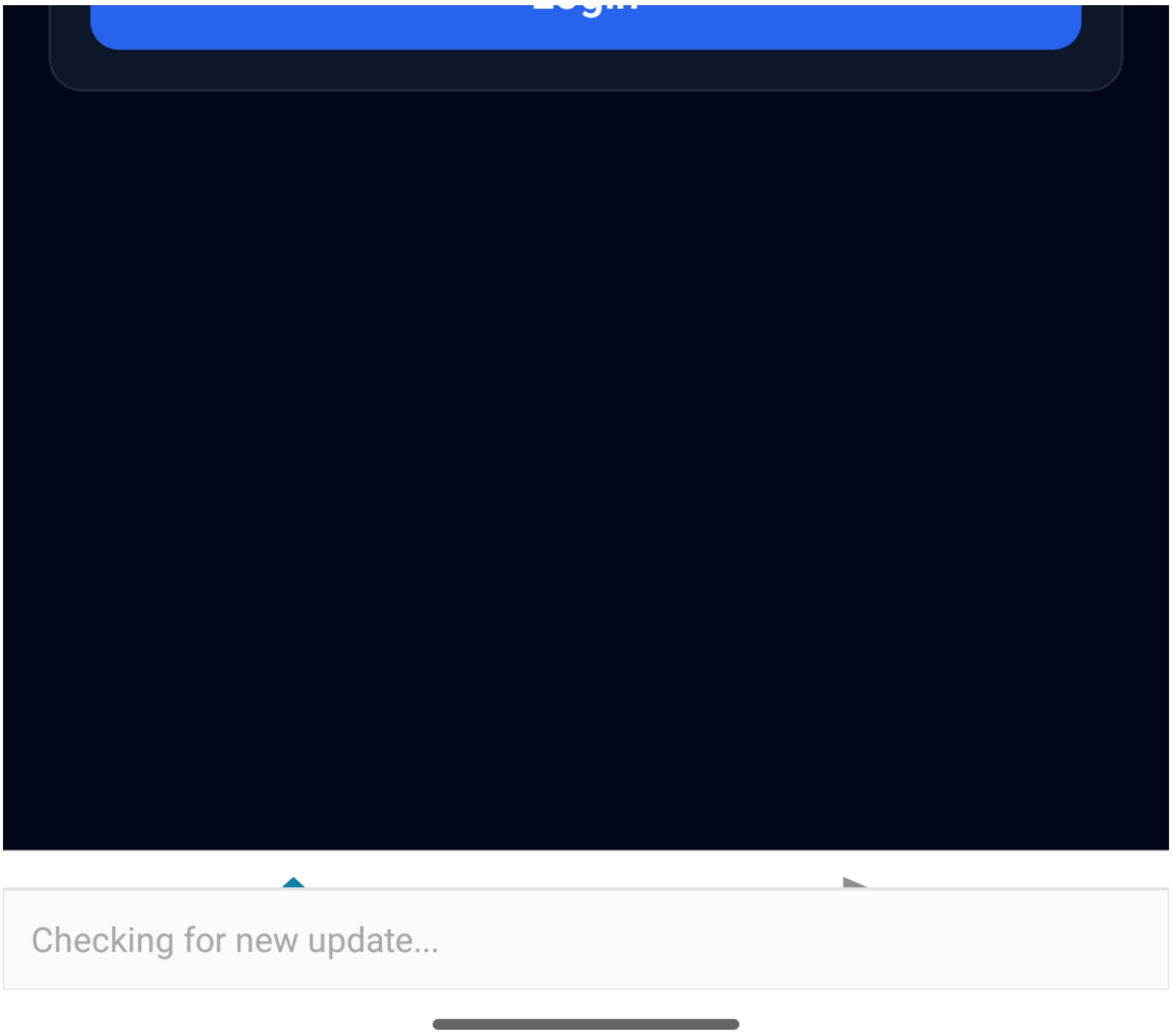
- Relational database design (PostgreSQL/MySQL compatible)
- Normalized schema with proper relationships
- Primary and foreign key constraints
- Indexed fields for performance

2.3. Application Screenshots

The following screenshots show the implemented mobile application running on Android (emulator).

Login Screen (F1, F2)
User can register with name, email (username + @gmail.com), and password, or switch to login.

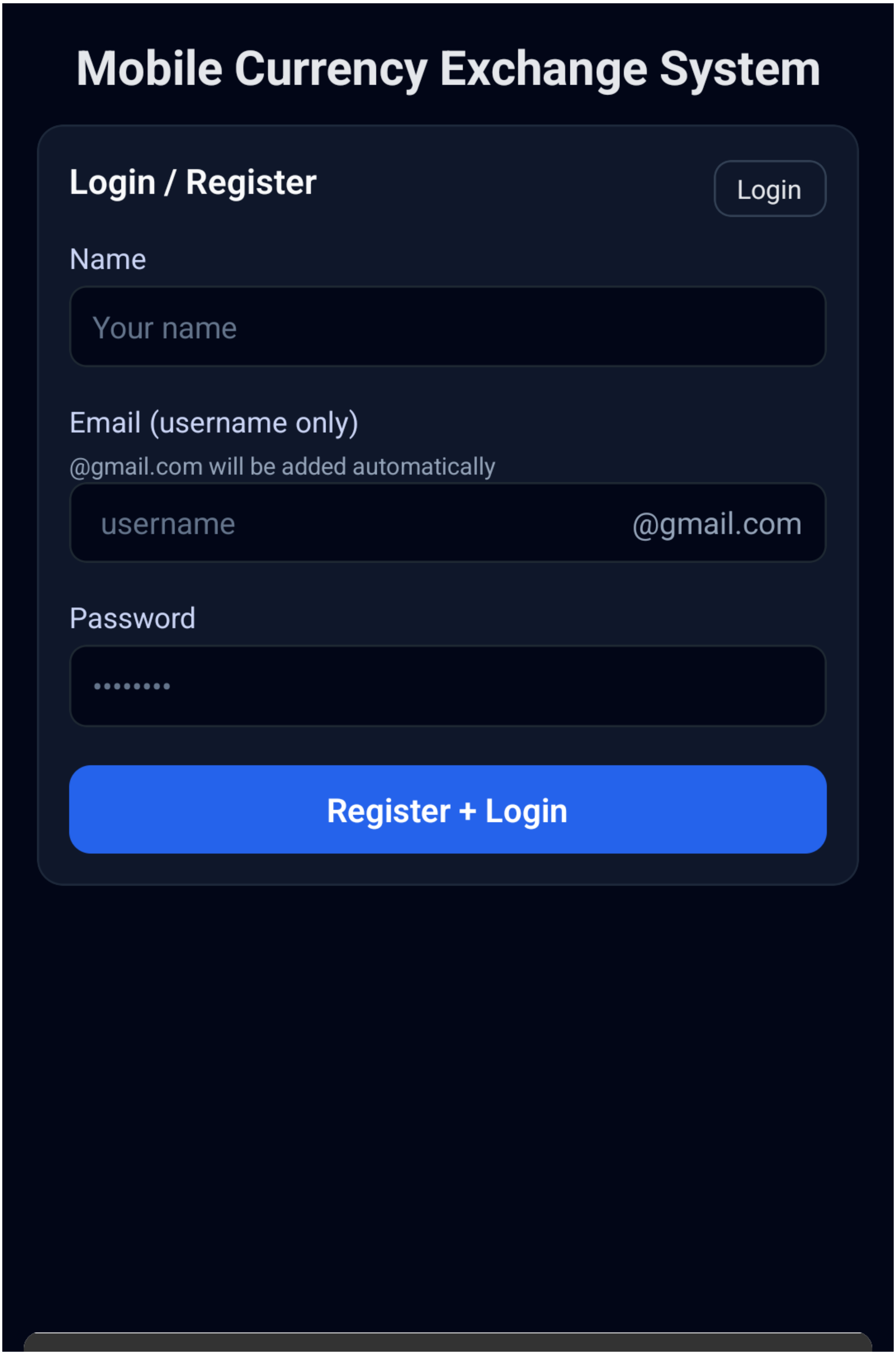




Checking for new update...

Register Screen (F1)

Registration form with name, email, and password fields.



Mobile Currency Exchange System

Login / Register

Login

Name

Your name

Email (username only)

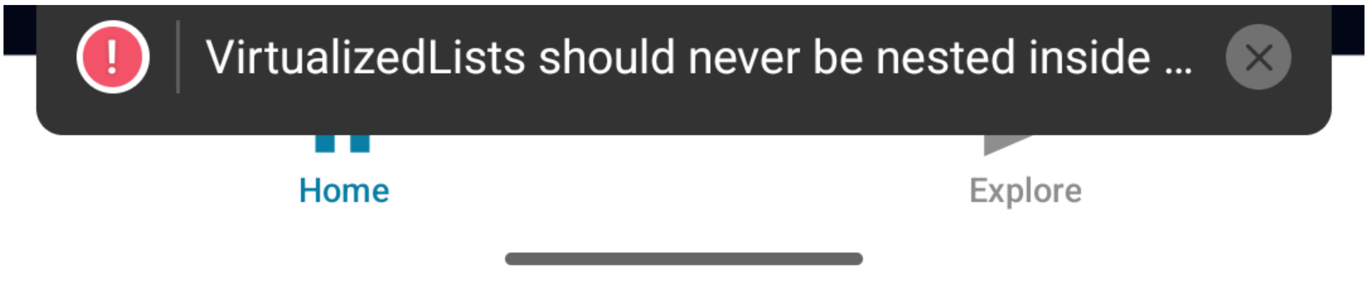
@gmail.com will be added automatically

username @gmail.com

Password

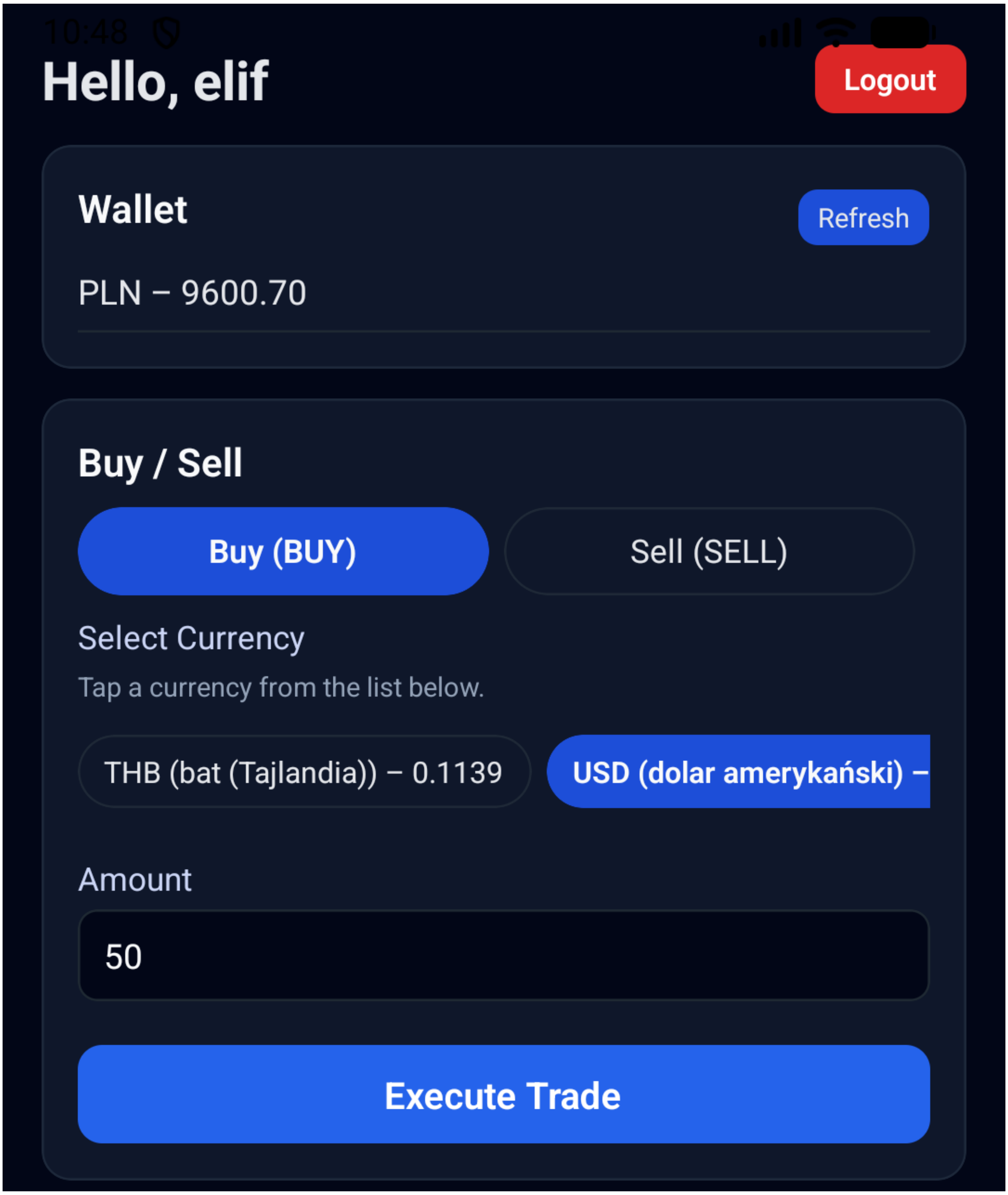
•••••••••

Register + Login



VirtualizedLists should never be nested inside ...

Dashboard – Wallet and Rates (F8, F3)
After login: greeting, PLN wallet balance, Refresh button, and exchange rates from NBP API.



Hello, elif

Wallet

PLN – 9600.70

Buy / Sell

Select Currency

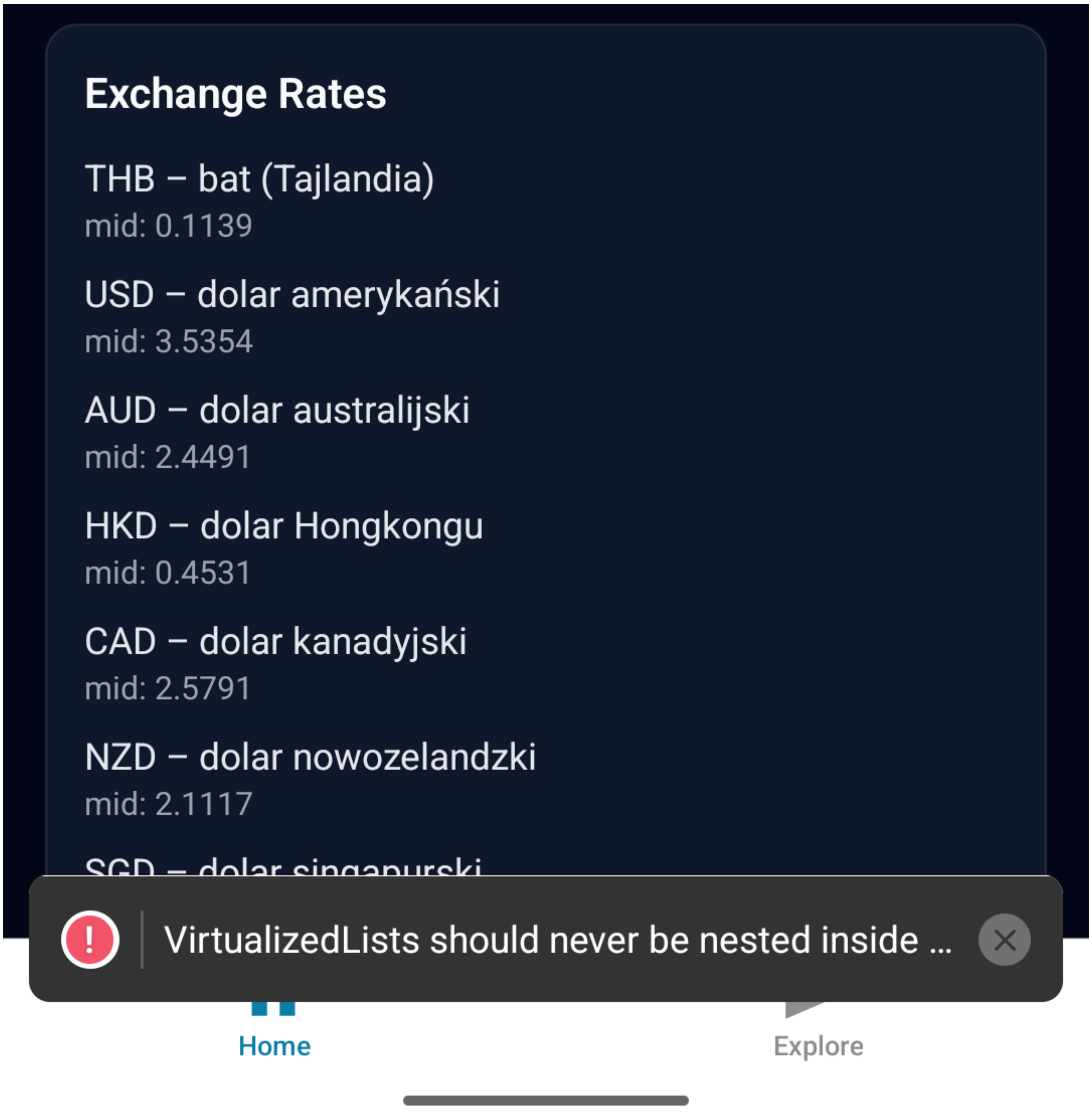
Tap a currency from the list below.

THB (bat (Tajlandia)) – 0.1139

USD (dolar amerykański) –

Amount

50



Exchange Rates

THB – bat (Tajlandia)
mid: 0.1139

USD – dolar amerykański
mid: 3.5354

AUD – dolar australijski
mid: 2.4491

HKD – dolar Hongkongu
mid: 0.4531

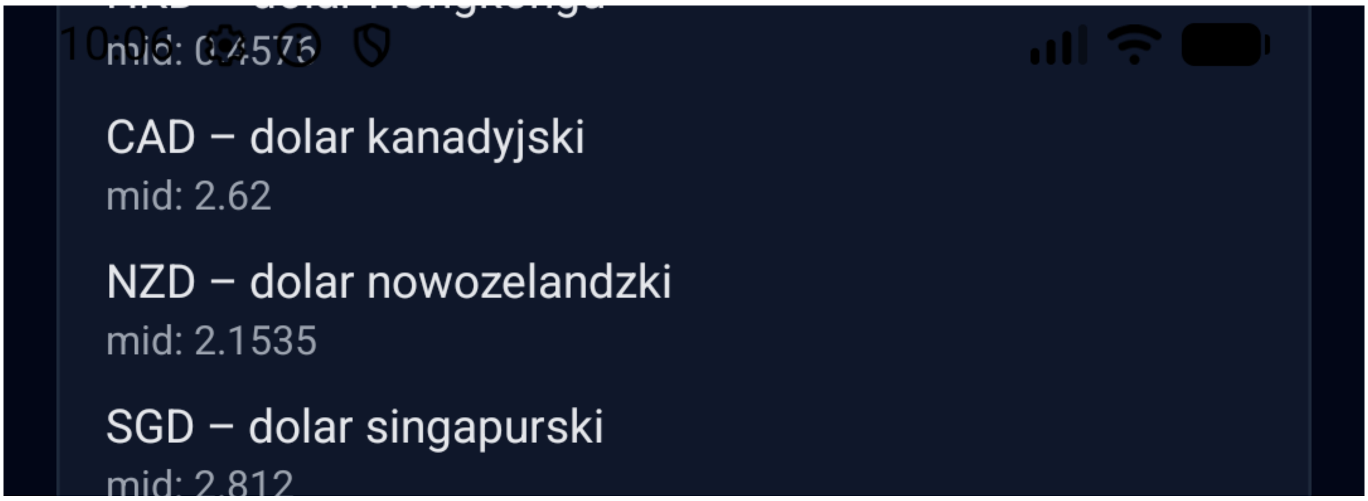
CAD – dolar kanadyjski
mid: 2.5791

NZD – dolar nowozelandzki
mid: 2.1117

SGD – dolar singapurski

VirtualizedLists should never be nested inside ...

Transaction History (F9)
List of past transactions with type, currency pair, amount, rate, and date.

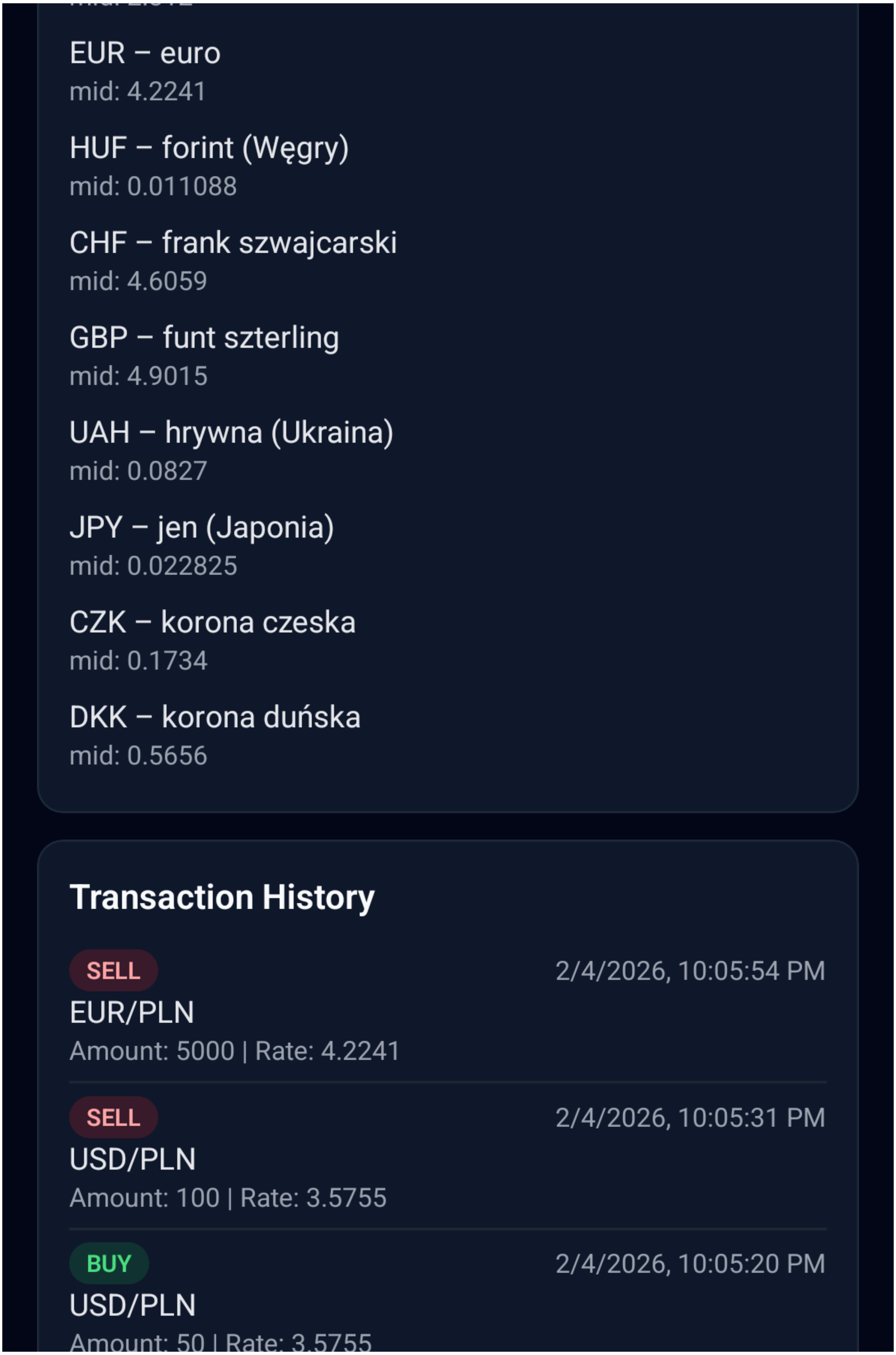


mid: 0.4576

CAD – dolar kanadyjski
mid: 2.62

NZD – dolar nowozelandzki
mid: 2.1535

SGD – dolar singapurski
mid: 2.812



EUR – euro
mid: 4.2241

HUF – forint (Węgry)
mid: 0.011088

CHF – frank szwajcarski
mid: 4.6059

GBP – funt szterling
mid: 4.9015

UAH – hrywna (Ukraina)
mid: 0.0827

JPY – jen (Japonia)
mid: 0.022825

CZK – korona czeska
mid: 0.1734

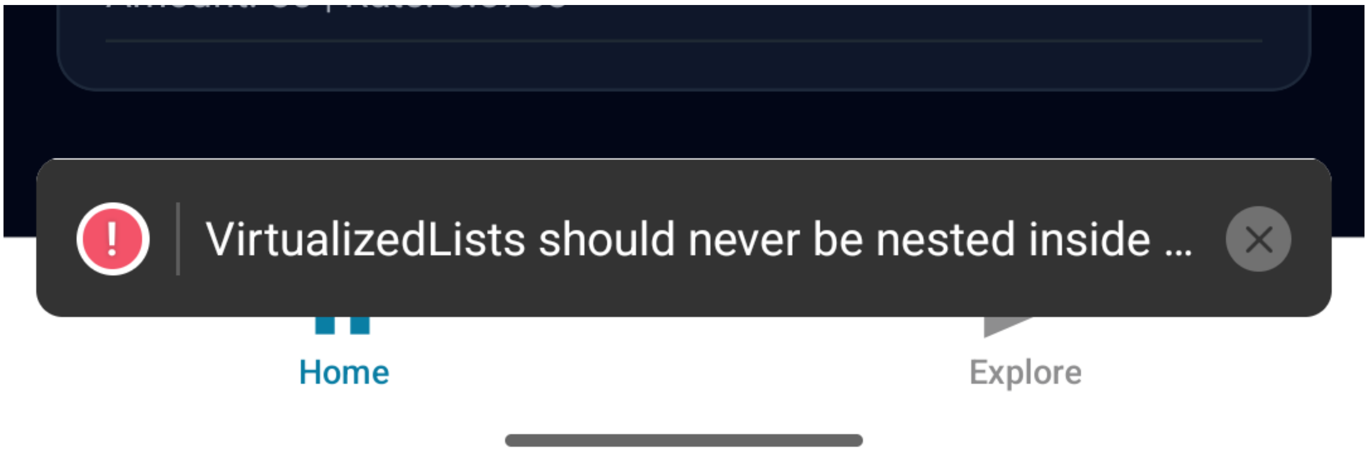
DKK – korona duńska
mid: 0.5656

Transaction History

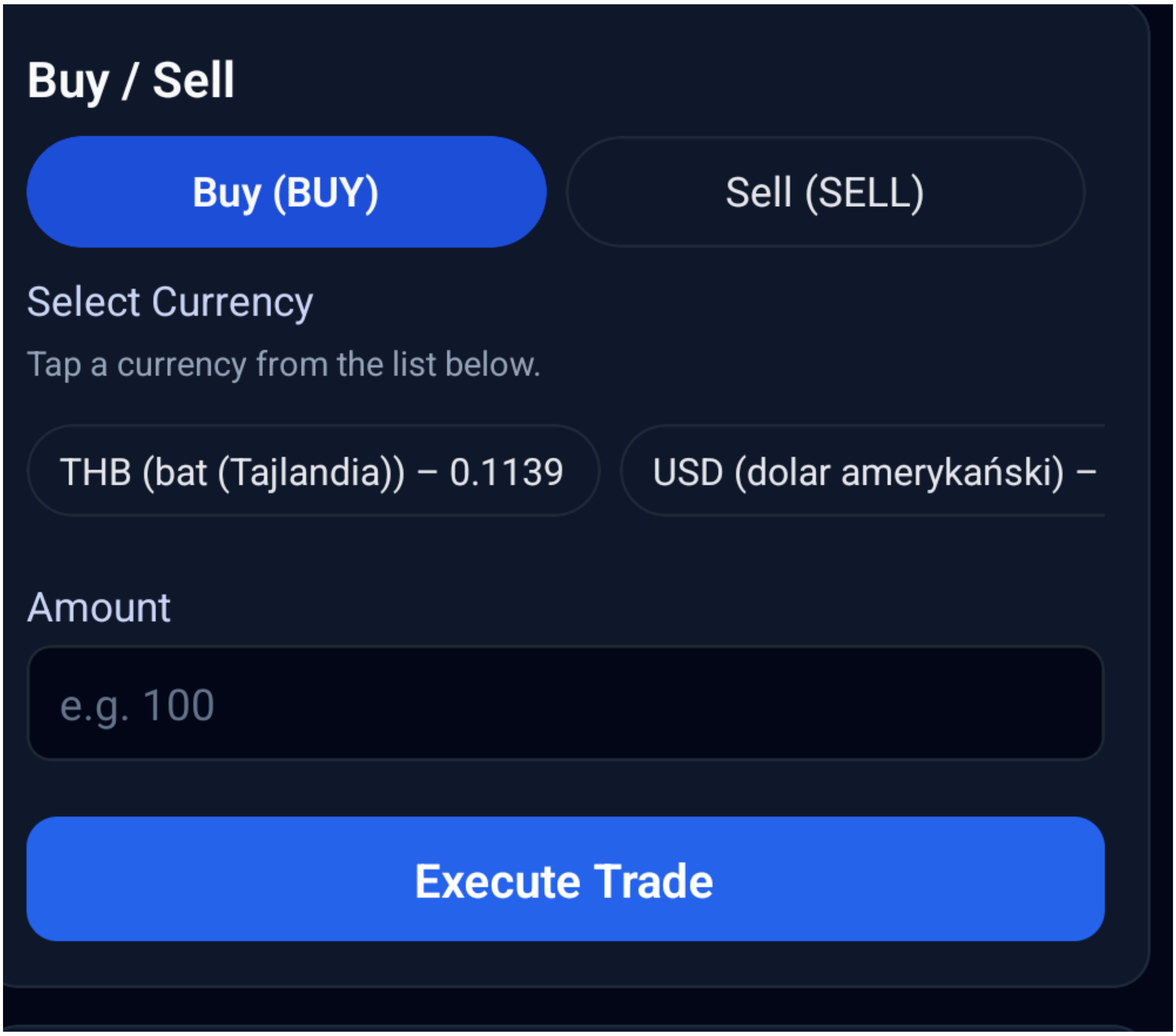
SELL 2/4/2026, 10:05:54 PM
EUR/PLN
Amount: 5000 | Rate: 4.2241

SELL 2/4/2026, 10:05:31 PM
USD/PLN
Amount: 100 | Rate: 3.5755

BUY 2/4/2026, 10:05:20 PM
USD/PLN
Amount: 50 | Rate: 3.5755


VirtualizedLists should never be nested inside ...

Buy / Sell (F6, F7)
Currency selection, amount input, and Execute Trade. BUY/SELL toggle.


Buy / Sell
Buy (BUY)
Sell (SELL)
Select Currency
Tap a currency from the list below.
THB (bat (Tajlandia)) – 0.1139
USD (dolar amerykański) –
Amount
e.g. 100
Execute Trade

---

3. System Requirements

3.1. Functional Requirements

ID	Function Name	Description	Priority
F1	User Registration	User can create an account by providing name, email, and password. System automatically creates a default PLN wallet with initial balance (10,000 PLN).	High
F2	User Login	User can authenticate with email and password. System validates credentials and grants access to the dashboard.	High
F3	View Current Exchange Rates	User can view real-time exchange rates fetched from NBP API. Rates are displayed in a scrollable list showing currency code, currency name, and mid rate.	High
F4	Access Historical Rates	User can view historical exchange rates through NBP API integration (via backend).	Medium
F5	Account Funding	User receives initial virtual balance (10,000 PLN) upon registration. System simulates account funding.	High
F6	Buy Currency	User can purchase foreign currency using PLN from their wallet. System validates balance, calculates cost based on current rate, executes transaction, and updates wallet balance.	High
F7	Sell Currency	User can sell foreign currency and receive PLN in their wallet. System calculates proceeds based on current rate, executes transaction, and updates wallet balance.	High
F8	View Wallet Balance	User can view their current PLN wallet balance prominently displayed on the dashboard.	High
F9	View Transaction History	User can view all past buy/sell transactions with details including transaction type (BUY/SELL), currency pair, amount, exchange rate, and timestamp.	Medium
F10	Refresh Data	User can manually refresh exchange rates, wallet balance, and transaction history by tapping a refresh button.	Medium
F11	Network Error Handling	System displays user-friendly error messages when network requests fail, timeout, or when backend is unreachable. Messages inform user about the issue and suggest retry.	High
F12	Logout	User can log out from the application and return to the login screen. Session is cleared.	Medium
F13	Input Validation	System validates all user inputs (email format, numeric amounts, required fields) before processing requests.	High
F14	Balance Validation	System prevents transactions when user has insufficient balance. Clear error message is displayed.	High

3.2. Non-Functional Requirements

ID	Name	Description	Category
N1	Performance	System response time ≤ 2 seconds for API calls under normal network conditions. Database queries should complete within 500ms.	Performance
N2	Network Resilience	System handles network timeouts (7 seconds for mobile app, 5 seconds for NBP API) gracefully. Implements retry mechanisms for transient failures.	Reliability
N3	Security	All API communications use HTTPS. User passwords should be hashed (bcrypt/argon2) in production. Authentication tokens should be used for session management.	Security
N4	Usability	Application is accessible 24/7. Core user flows (login, view rates, execute trade) should not require more than 3 taps/clicks. Interface is intuitive and follows mobile UI/UX best practices.	Usability
N5	Portability	Application runs on both Android and iOS platforms using React Native/Expo framework. Code is platform-agnostic.	Portability
N6	Scalability	System architecture supports horizontal scaling. Backend can handle multiple concurrent users. Database design allows for efficient querying as data grows.	Scalability
N7	Error Tolerance	System continues to function even when external API (NBP) is temporarily unavailable. User receives clear error messages. Last known rates can be displayed from cache.	Reliability
N8	Offline Support	Application displays last known exchange rates when network connection is lost (read-only mode). User is informed about offline status.	Usability
N9	Logging & Monitoring	All critical operations (login, transactions, errors) are logged for debugging and analysis. Error logs include timestamps, user context, and error details.	Maintainability
N10	Data Integrity	All transactions are atomic. Wallet balances are updated consistently. No data loss occurs during network failures.	Reliability
N11	API Rate Limiting	Backend implements rate limiting to prevent abuse. NBP API calls are cached to reduce external API load.	Performance
N12	Code Quality	Source code follows best practices, is well-commented, and uses version control (Git). Code is modular and maintainable.	Maintainability

---

4. UML Diagrams

4.1. Use Case Diagram

```
┌─────────────────────────────────────────────────────────────┐
│              Mobile Currency Exchange System                │
│                                                             │
│  ┌──────────────────────────────────────────────────────┐   │
│  │                     Mobile App                       │   │
│  │                (React Native/Expo)                   │   │
│  └────────────────────────┬─────────────────────────────┘   │
│                           │                                 │
│                           │ REST API                        │
│                           │                                 │
│  ┌────────────────────────▼─────────────────────────────┐   │
│  │                Backend API Server                    │   │
│  │                (Node.js/Express)                     │   │
│  └────────────────────────┬─────────────────────────────┘   │
│                           │                                 │
│                           │ HTTP GET                        │
│                           │                                 │
│  ┌────────────────────────▼─────────────────────────────┐   │
│  │           External API: NBP                          │   │
│  │    National Bank of Poland                           │   │
│  └──────────────────────────────────────────────────────┘   │
│                                                             │
│  ┌──────────────────────────────────────────────────────┐   │
│  │                     Database                         │   │
│  │                (PostgreSQL/MySQL)                    │   │
│  └──────────────────────────────────────────────────────┘   │
│                                                             │
│  ┌──────────────────────────────────────────────────────┐   │
│  │                     Actor: User                      │   │
│  └──────────────────────────────────────────────────────┘   │
│                                                             │
│  Use Cases:                                                 │
│  • Register User                                            │
│  • Login User                                               │
│  • View Exchange Rates                                      │
│  • View Historical Rates                                    │
│  • Buy Currency                                             │
│  • Sell Currency                                            │
│  • View Wallet Balance                                      │
│  • View Transaction History                                 │
│  • Refresh Data                                             │
│  • Logout                                                   │
└─────────────────────────────────────────────────────────────┘
```

Use Case Descriptions:

1. **Register User**
   - **Actor:** User
   - **Precondition:** User is not logged in

- **Main Flow:** User provides name, email, and password. System validates input, creates account, initializes PLN wallet with 10,000 PLN balance, returns success message.
- **Postcondition:** User account created, wallet initialized

2. **Login User**
   - **Actor:** User
   - **Precondition:** User has registered account
   - **Main Flow:** User enters email and password. System validates credentials, creates session, redirects to dashboard.
   - **Postcondition:** User is logged in, dashboard displayed

3. **View Exchange Rates**
   - **Actor:** User
   - **Precondition:** User is logged in
   - **Main Flow:** User navigates to rates screen. System fetches rates from NBP API via backend, displays rates in list format.
   - **Postcondition:** Current exchange rates displayed

4. **View Historical Rates**
   - **Actor:** User
   - **Precondition:** User is logged in
   - **Main Flow:** User requests historical rates. System queries NBP API for past rates, displays historical data.
   - **Postcondition:** Historical rates displayed

5. **Buy Currency**
   - **Actor:** User
   - **Precondition:** User is logged in, has sufficient PLN balance
   - **Main Flow:** User selects currency, enters amount, confirms purchase. System validates balance, calculates cost, deducts PLN, records transaction, updates wallet.
   - **Postcondition:** Currency purchased, wallet updated, transaction recorded

6. **Sell Currency**
   - **Actor:** User
   - **Precondition:** User is logged in, has currency to sell
   - **Main Flow:** User selects currency, enters amount, confirms sale. System calculates proceeds, adds PLN to wallet, records transaction.
   - **Postcondition:** Currency sold, wallet updated, transaction recorded

7. **View Wallet Balance**
   - **Actor:** User
   - **Precondition:** User is logged in
   - **Main Flow:** User views dashboard. System retrieves wallet balance from database, displays PLN balance.
   - **Postcondition:** Current wallet balance displayed

8. **View Transaction History**
   - **Actor:** User
   - **Precondition:** User is logged in
   - **Main Flow:** User navigates to history screen. System retrieves user's transactions from database, displays in chronological order.
   - **Postcondition:** Transaction history displayed

9. **Refresh Data**
   - **Actor:** User
   - **Precondition:** User is logged in
   - **Main Flow:** User taps refresh button. System fetches latest rates, wallet balance, and transactions, updates display.
   - **Postcondition:** All data refreshed

10. **Logout**
    - **Actor:** User
    - **Precondition:** User is logged in
    - **Main Flow:** User taps logout button. System clears session, redirects to login screen.
    - **Postcondition:** User logged out, session cleared

4.2. Class Diagram

Mobile Application Classes

```
┌──────────────────────────────────────────────────────────────┐
│                     Mobile Application                       │
│                    (React Native/Expo)                       │
├──────────────────────────────────────────────────────────────┤
│                                                              │
│  ┌────────────────────────────────────────────────────────┐  │
│  │                    App Component                       │  │
│  ├────────────────────────────────────────────────────────┤  │
│  │ - user: User | null                                    │  │
│  │ + setUser(user: User): void                            │  │
│  │ + render(): JSX.Element                                │  │
│  └────────────────────────┬───────────────────────────────┘  │
│                           │                                  │
│           ┌───────────────┼────────────────┐                 │
│           │               │                │                 │
│           ▼               ▼                ▼                 │
│  ┌─────────────┐  ┌─────────────┐  ┌─────────────┐           │
│  │ AuthScreen  │  │ Dashboard   │  │ useApi Hook │           │
│  ├─────────────┤  │ Screen      │  ├─────────────┤           │
│  │ - mode      │  ├─────────────┤  │ - loading   │           │
│  │ - email     │  │ - rates     │  │ - error     │           │
│  │ - password  │  │ - wallets   │  │ + request() │           │
│  │ + handle    │  │ - trans...  │  │             │           │
│  │   Submit()  │  │ + loadAll() │  │             │           │
│  └─────────────┘  │ + handle    │  └─────────────┘           │
│                    │  Trade()    │                         │
│                    └─────────────┘                         │
│                                                            │
│                                                            │
│  ┌──────────────────────────────────────────────────────┐  │
│  │                     Data Models                      │  │
│  ├──────────────────────────────────────────────────────┤  │
│  │ User {                                               │  │
│  │   userId: number                                     │  │
│  │   name: string                                       │  │
│  │   email: string                                      │  │
│  │ }                                                    │  │
│  │                                                      │  │
│  │ Wallet {                                             │  │
│  │   walletId: number                                   │  │
│  │   userId: number                                     │  │
│  │   currency: string                                   │  │
│  │   balance: number                                    │  │
│  │ }                                                    │  │
│  │                                                      │  │
│  │ Rate {                                               │  │
│  │   code: string                                       │  │
│  │   currency: string                                   │  │
│  │   mid: number                                        │  │
│  │ }                                                    │  │
│  │                                                      │  │
│  │ Transaction {                                        │  │
│  │   transactionId: number                              │  │
│  │   userId: number                                     │  │
│  │   type: 'BUY' | 'SELL'                               │  │
│  │   currencyPair: string                               │  │
│  │   amount: number                                     │  │
│  │   rate: number                                       │  │
│  │   createdAt: string                                  │  │
│  │ }                                                    │  │
│  └──────────────────────────────────────────────────────┘  │
└────────────────────────────────────────────────────────────┘
```

Backend API Server Classes

```
┌────────────────────────────────────────────────────────────┐
│                  Backend API Server                        │
│                  (Node.js/Express)                         │
├────────────────────────────────────────────────────────────┤
│                                                            │
│  ┌──────────────────────────────────────────────────────┐  │
│  │                     Express App                      │  │
│  ├──────────────────────────────────────────────────────┤  │
│  │ - app: Express                                       │  │
│  │ - PORT: number                                       │  │
│  │ + listen(): void                                     │  │
│  └────────────────────────┬─────────────────────────────┘  │
│                           │                                │
│                          │                                │
│                ┌─────────┼─────────────────┐              │
│                │         │                 │              │
│         ┌──────▼──────┐ ┌─────▼──────┐ ┌─────▼──────┐     │
│         │ Auth Routes │ │Trade Routes│ │Rate Routes │     │
│         ├─────────────┤ ├────────────┤ ├────────────┤     │
│         │+ register() │ │+ buy()     │ │+ getRates()│     │
│         │+ login()    │ │+ sell()    │ │            │     │
│         └─────────────┘ └────────────┘ └────────────┘     │
│                                                           │
│         ┌─────────────────────────────────────────────┐   │
│         │              Service Layer                  │   │
│         ├─────────────────────────────────────────────┤   │
│         │ UserService {                               │   │
│         │   + findUserByEmail(email): User            │   │
│         │   + createUser(data): User                  │   │
│         │   + validatePassword(user, password): boolean│  │
│         │ }                                           │   │
│         │                                             │   │
│         │ WalletService {                             │   │
│         │   + getWallet(userId): Wallet               │   │
│         │   + updateBalance(walletId, amount): Wallet │   │
│         │   + validateBalance(walletId, amount): boolean│ │
│         │ }                                           │   │
│         │                                             │   │
│         │ TradeService {                              │   │
│         │   + executeTrade(userId, type, pair, amount): Trans │
│         │   + calculateCost(amount, rate): number     │   │
│         │   + validateTransaction(data): boolean      │   │
│         │ }                                           │   │
│         │                                             │   │
│         │ RateService {                               │   │
│         │   + fetchRatesFromNBP(): Rate[]             │   │
│         │   + fetchHistoricalRates(date): Rate[]      │   │
│         │   + handleNetworkError(error): Error        │   │
│         │ }                                           │   │
│         └─────────────────────────────────────────────┘   │
│                                                           │
│         ┌─────────────────────────────────────────────┐   │
│         │              Data Models                    │   │
│         ├─────────────────────────────────────────────┤   │
│         │ User {                                      │   │
│         │   userId: number (PK)                       │   │
│         │   name: string                              │   │
│         │   email: string (UNIQUE)                    │   │
│         │   passwordHash: string                      │   │
│         │   createdAt: Date                           │   │
│         │ }                                           │   │
│         │                                             │   │
│         │ Wallet {                                    │   │
│         │   walletId: number (PK)                     │   │
│         │   userId: number (FK → User)                │   │
│         │   currency: string                          │   │
│         │   balance: number                           │   │
│  │ }                                                      │   │
│  │                                                        │   │
│  │ Transaction {                                          │   │
│  │   transactionId: number (PK)                           │   │
│  │   userId: number (FK → User)                           │   │
│  │   walletId: number (FK → Wallet)                       │   │
│  │   type: string                                         │   │
│  │   currencyPair: string                                 │   │
│  │   amount: number                                       │   │
│  │   rate: number                                         │   │
│  │   createdAt: Date                                      │   │
│  │ }                                                      │   │
│  │                                                        │   │
│  │ ExchangeRate {                                         │   │
│  │   rateId: number (PK)                                  │   │
│  │   baseCurrency: string                                 │   │
│  │   targetCurrency: string                               │   │
│  │   rate: number                                         │   │
│  │   timestamp: Date                                      │   │
│  │ }                                                      │   │
│  └────────────────────────────────────────────────────────┘   │
└───────────────────────────────────────────────────────────────┘
```

Class Relationships:

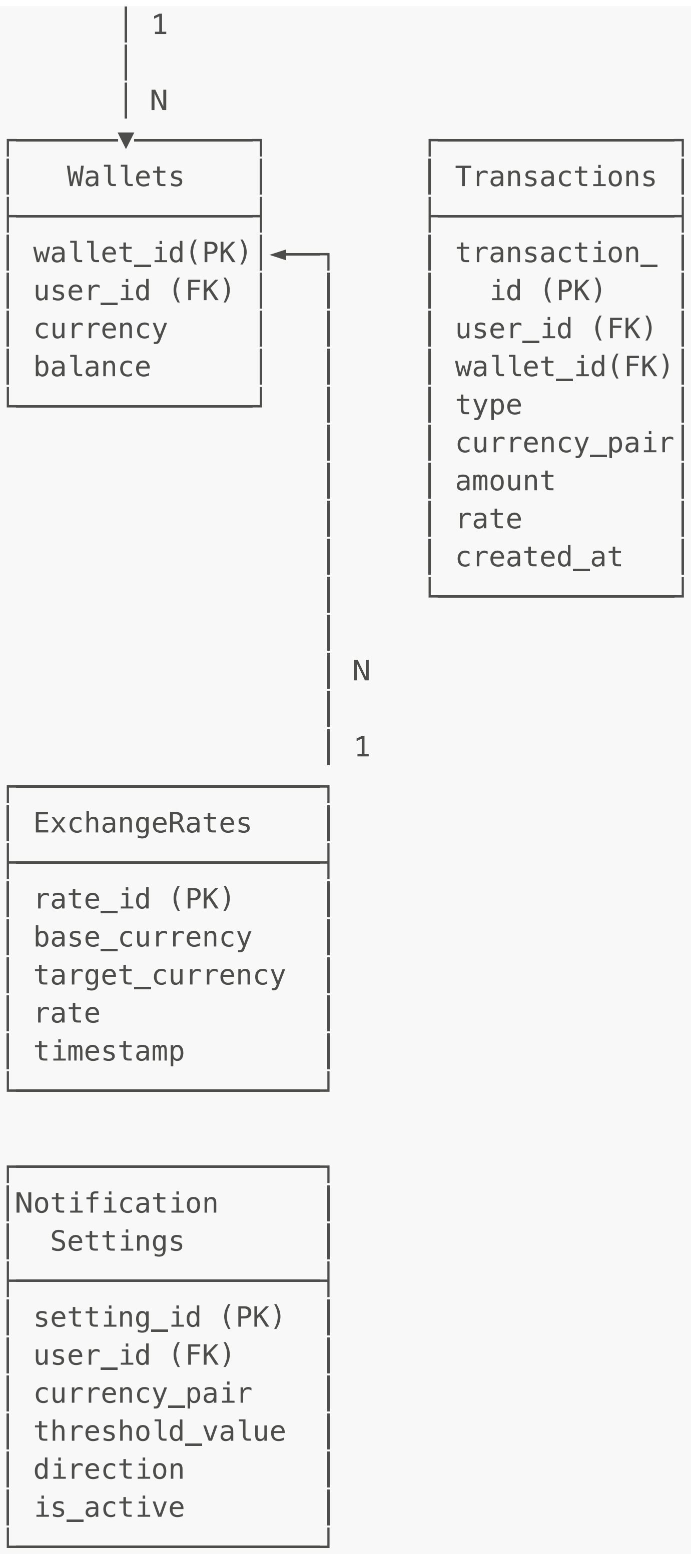
- **App Component** contains **AuthScreen** and **DashboardScreen**
- **AuthScreen** and **DashboardScreen** use **useApi Hook** for network requests
- **useApi Hook** communicates with **Backend API Server** via HTTP
- **Backend API Server** contains **Routes** that use **Services**
- **Services** interact with **Database** to access **Data Models**
- **RateService** communicates with **External NBP API**
- **User** has one-to-many relationship with **Wallet**
- **User** has one-to-many relationship with **Transaction**
- **Wallet** has one-to-many relationship with **Transaction**

---

5. Database Design

5.1. ERD (Entity-Relationship Diagram)

```
                        ┌───────────────┐
                        │     Users     │
                        ├───────────────┤
                        │ user_id (PK)  │
                        │ name          │
                        │ email (UK)    │
                        │ password_hash │
                        │ created_at    │
                        └───────┬───────┘
                                │
```



5.2. Database Tables

Users Table

- **Table Name:** `users`
- **Description:** Stores user account information
- **Columns:**
  - `user_id` (INT, PRIMARY KEY, AUTO_INCREMENT): Unique user identifier
  - `name` (VARCHAR(100), NOT NULL): User's full name

  - `email` (VARCHAR(100), NOT NULL, UNIQUE): User's email address (unique constraint)
  - `password_hash` (VARCHAR(255), NOT NULL): Hashed password using bcrypt/argon2
  - `created_at` (TIMESTAMP, NOT NULL, DEFAULT CURRENT_TIMESTAMP): Account creation timestamp
- **Indexes:** PRIMARY KEY (user_id), UNIQUE INDEX (email)

Wallets Table

- **Table Name:** `wallets`
- **Description:** Stores user wallet balances
- **Columns:**
  - `wallet_id` (INT, PRIMARY KEY, AUTO_INCREMENT): Unique wallet identifier
  - `user_id` (INT, NOT NULL, FOREIGN KEY → users.user_id): Reference to user (ON DELETE CASCADE)
  - `currency` (VARCHAR(10), NOT NULL, DEFAULT 'PLN'): Currency code (e.g., 'PLN', 'USD')
  - `balance` (DECIMAL(18,2), NOT NULL, DEFAULT 0.00): Current balance in specified currency
- **Indexes:** PRIMARY KEY (wallet_id), FOREIGN KEY (user_id), INDEX (user_id, currency)
- **Relationships:** Many-to-One with Users (one user can have multiple wallets)

Transactions Table

- **Table Name:** `transactions`
- **Description:** Records all currency exchange transactions
- **Columns:**
  - `transaction_id` (INT, PRIMARY KEY, AUTO_INCREMENT): Unique transaction identifier
  - `user_id` (INT, NOT NULL, FOREIGN KEY → users.user_id): Reference to user (ON DELETE CASCADE)
  - `wallet_id` (INT, NOT NULL, FOREIGN KEY → wallets.wallet_id): Reference to wallet (ON DELETE RESTRICT)
  - `type` (VARCHAR(10), NOT NULL): Transaction type ('BUY' or 'SELL')
  - `currency_pair` (VARCHAR(10), NOT NULL): Currency pair (e.g., 'USD/PLN')
  - `amount` (DECIMAL(18,2), NOT NULL): Transaction amount in foreign currency
  - `rate` (DECIMAL(18,6), NOT NULL): Exchange rate at time of transaction
  - `created_at` (TIMESTAMP, NOT NULL, DEFAULT CURRENT_TIMESTAMP): Transaction timestamp
- **Indexes:** PRIMARY KEY (transaction_id), FOREIGN KEY (user_id), FOREIGN KEY (wallet_id), INDEX (user_id, created_at)
- **Relationships:** Many-to-One with Users, Many-to-One with Wallets

Exchange Rates Table

- **Table Name:** `exchange_rates`
- **Description:** Caches exchange rates from NBP API (optional, for performance)
- **Columns:**
  - `rate_id` (INT, PRIMARY KEY, AUTO_INCREMENT): Unique rate identifier
  - `base_currency` (VARCHAR(10), NOT NULL): Base currency code (e.g., 'PLN')
  - `target_currency` (VARCHAR(10), NOT NULL): Target currency code (e.g., 'USD')

  - `rate` (DECIMAL(18,6), NOT NULL): Exchange rate value
  - `timestamp` (TIMESTAMP, NOT NULL): Rate timestamp from NBP API
- **Indexes:** PRIMARY KEY (rate_id), INDEX (base_currency, target_currency, timestamp)
- **Note:** This table is optional and used for caching. Rates can also be fetched directly from NBP API.

Notification Settings Table

- **Table Name:** `notification_settings`
- **Description:** User preferences for exchange rate alerts (future extension)
- **Columns:**
  - `setting_id` (INT, PRIMARY KEY, AUTO_INCREMENT): Unique setting identifier
  - `user_id` (INT, NOT NULL, FOREIGN KEY → users.user_id): Reference to user (ON DELETE CASCADE)
  - `currency_pair` (VARCHAR(10), NOT NULL): Currency pair to monitor (e.g., 'USD/PLN')
  - `threshold_value` (DECIMAL(18,6), NOT NULL): Rate threshold value
  - `direction` (VARCHAR(5), NOT NULL): Direction ('UP' or 'DOWN')
  - `is_active` (BOOLEAN, NOT NULL, DEFAULT TRUE): Whether notification is active
- **Indexes:** PRIMARY KEY (setting_id), FOREIGN KEY (user_id), INDEX (user_id, is_active)
- **Relationships:** Many-to-One with Users

5.3. Relationships

1. **Users → Wallets**: One-to-Many

   - One user can have multiple wallets (for different currencies)
   - Foreign key: `wallets.user_id` → `users.user_id`
   - Cascade delete: If user is deleted, wallets are deleted

2. **Users → Transactions**: One-to-Many

   - One user can have many transactions
   - Foreign key: `transactions.user_id` → `users.user_id`
   - Cascade delete: If user is deleted, transactions are deleted

3. **Wallets → Transactions**: One-to-Many

   - One wallet can have many transactions
   - Foreign key: `transactions.wallet_id` → `wallets.wallet_id`
   - Restrict delete: Cannot delete wallet if transactions exist

4. **Users → Notification Settings**: One-to-Many

   - One user can have multiple notification settings
   - Foreign key: `notification_settings.user_id` → `users.user_id`
   - Cascade delete: If user is deleted, settings are deleted

5.4. Data Integrity Constraints

- **Primary Keys**: All tables have auto-incrementing primary keys
- **Foreign Keys**: All foreign keys have referential integrity constraints

- **Unique Constraints**: Email must be unique in users table
- **Check Constraints**: Transaction type must be 'BUY' or 'SELL', direction must be 'UP' or 'DOWN'
- **Default Values**: Wallet balance defaults to 0, currency defaults to 'PLN'
- **NOT NULL Constraints**: Critical fields are marked as NOT NULL

---

6. System Architecture

6.1. Architecture Overview

```
┌──────────────────────────────────────────────────────────────┐
│                    Mobile Application                         │
│                  (React Native / Expo)                        │
│                  Platform: Android / iOS                      │
│                                                               │
│  ┌──────────────┐  ┌──────────────┐  ┌──────────────┐      │
│  │  UI Layer    │  │ Network Layer│  │  State Mgmt  │      │
│  │              │  │              │  │              │      │
│  │ - AuthScreen │  │ - useApi()   │  │ - useState() │      │
│  │ - Dashboard  │  │ - fetch()    │  │ - useEffect()│      │
│  │ - Components │  │ - timeout    │  │ - Context API│      │
│  │ - Navigation │  │ - retry      │  │              │      │
│  └──────────────┘  │ - error mgmt │  └──────────────┘      │
│                    └──────────────┘                          │
│                          │                                   │
│                          │ HTTPS/REST API                     │
│                          │ http://10.0.2.2:4000/api           │
│                          │ (Android Emulator)                 │
│                          │ http://localhost:4000/api         │
│                          │ (iOS Simulator)                    │
└──────────────────────────┼───────────────────────────────────┘
                           │
                           │ JSON Request/Response
                           │
┌──────────────────────────▼───────────────────────────────────┐
│              Backend API Server                               │
│              (Node.js / Express)                               │
│              Port: 4000                                       │
│              Host: 0.0.0.0 (all interfaces)                   │
│                                                               │
│  ┌──────────────┐  ┌──────────────┐  ┌──────────────┐      │
│  │   Routes     │  │  Middleware  │  │  Controllers │      │
│  │              │  │              │  │              │      │
│  │ - /auth/*    │  │ - CORS       │  │ - AuthCtrl   │      │
│  │ - /rates     │  │ - JSON Parse │  │ - TradeCtrl  │      │
│  │ - /users/*   │  │ - Error Hand │  │ - WalletCtrl │      │
│  │ - /health    │  │ - Logging    │  │ - RateCtrl   │      │
│  └──────────────┘  └──────────────┘  └──────────────┘      │
│                                                               │
│  ┌──────────────────────────────────────────────┐           │
│  │  Service Layer                               │           │
│  │  - UserService                                │           │
│  │   - WalletService                          │          │
│  │   - TradeService                           │          │
│  │   - RateService (NBP API Integration)     │          │
│  └──────────────────────────────────────────┘          │
│                                                         │
│  ┌──────────────────────────────────────────┐          │
│  │   Network Error Handling                  │          │
│  │   - Timeout (5s for NBP API)              │          │
│  │   - Retry logic (future)                  │          │
│  │   - Error messages                        │          │
│  │   - Fallback mechanisms                   │          │
│  └──────────────────────────────────────────┘          │
└──────────────────────────┬──────────────────────────────┘
                           │
                           │ HTTP GET (with timeout)
                           │ https://api.nbp.pl/api/...
                           │
┌──────────────────────────▼──────────────────────────────┐
│         External API: National Bank of Poland            │
│         https://api.nbp.pl/api/exchangerates/tables/A    │
│                                                          │
│         Returns: JSON array with exchange rates          │
│         Format: [{table: "A", rates: [{code, currency, mid}]}]│
└──────────────────────────────────────────────────────────┘
                           │
                           │ (Future: Database Integration)
                           │
┌──────────────────────────▼──────────────────────────────┐
│              Database (SQL)                              │
│              PostgreSQL / MySQL                          │
│                                                          │
│  Tables:                                                 │
│  - users                                                 │
│  - wallets                                               │
│  - transactions                                          │
│  - exchange_rates (cache)                                │
│  - notification_settings                                 │
│                                                          │
│  Connection: Connection Pool                             │
│  ORM: (Future: Sequelize/TypeORM)                        │
└──────────────────────────────────────────────────────────┘
```

6.2. Data Flow Diagrams

Login Flow

```
User Input (email, password)
    │
    ▼
Mobile App (AuthScreen)
    │
```

```
     ▼
POST /api/auth/login
     │
     ▼
Backend (Auth Controller)
     │
     ▼
UserService.validateCredentials()
     │
     ▼
Database Query (SELECT * FROM users WHERE email = ?)
     │
     ▼
Password Validation
     │
     ▼
Return User Data (JSON)
     │
     ▼
Mobile App → Dashboard Screen
```

Exchange Rates Flow

```
User Request (View Rates)
     │
     ▼
Mobile App (Dashboard)
     │
     ▼
GET /api/rates
     │
     ▼
Backend (Rate Controller)
     │
     ▼
RateService.fetchRatesFromNBP()
     │
     ▼
HTTP GET https://api.nbp.pl/api/exchangerates/tables/A
     │ (with 5s timeout)
     │
     ├─ Success → Parse JSON → Return Rates
     └─ Timeout/Error → Return Error Message
     │
     ▼
Mobile App → Display Rates or Error
```

Buy Currency Flow

```
User Input (currency, amount)
    │
    ▼
Mobile App (Dashboard)
    │
    ▼
POST /api/users/:userId/trade
Body: {type: "BUY", currencyPair: "USD/PLN", amount: 100, rate: 4.25}
    │
    ▼
Backend (Trade Controller)
    │
    ▼
TradeService.executeTrade()
    │
    ├─ Validate User (exists?)
    ├─ Validate Wallet (exists?, sufficient balance?)
    ├─ Calculate Cost (amount * rate)
    ├─ Update Wallet Balance (balance - cost)
    └─ Create Transaction Record
    │
    ▼
Database Transaction (BEGIN)
    │
    ├─ UPDATE wallets SET balance = ? WHERE wallet_id = ?
    └─ INSERT INTO transactions VALUES (...)
    │
    ▼
Database Transaction (COMMIT)
    │
    ▼
Return Success Response (JSON)
    │
    ▼
Mobile App → Update UI (wallet, transaction history)
```

Error Handling Flow

```
API Request
    │
    ▼
Network Layer (useApi Hook)
    │
    ├─ Timeout (7s) → AbortController.abort()
    ├─ Network Error → Catch block
    └─ HTTP Error (4xx/5xx) → Check response status
    │
    ▼
Error Handler
    │
```

```
      ├─ Timeout Error → "Request timed out. Please check your network."
      ├─ Network Error → "Could not reach server. Check your connection."
      └─ Server Error → Display server error message
      │
      ▼
User sees error message
      │
      ▼
User can retry manually (Refresh button)
```

6.3. Network Architecture Considerations

1. **Mobile App → Backend Communication**

   - Protocol: HTTPS (HTTP in development)
   - Format: JSON
   - Timeout: 7 seconds
   - Error Handling: Try-catch with user-friendly messages
   - Retry: Manual retry via refresh button

2. **Backend → NBP API Communication**

   - Protocol: HTTPS
   - Format: JSON
   - Timeout: 5 seconds
   - Error Handling: Graceful degradation, error messages
   - Caching: Optional (future enhancement)

3. **Backend → Database Communication**

   - Protocol: TCP/IP
   - Connection Pool: Yes (for production)
   - Transactions: Yes (for data integrity)
   - Error Handling: Database errors caught and returned as API errors

4. **Network Resilience Strategies**

   - **Timeout Management**: Prevents hanging requests
   - **Error Messages**: Informative user feedback
   - **Offline Support**: Display cached data when available
   - **Retry Logic**: Manual retry mechanism (automatic retry can be added)

---

7. Project Implementation Plan

The project was carried out between December 2025 and February 2026.

Stage	Description	Deadline	Responsible Person
1	Requirements Analysis	10.12.2025	Elif Ezgi Emre

Stage	Description	Deadline	Responsible Person
2	System Design & Architecture	15.12.2025	Elif Ezgi Emre
3	Database Schema Design	18.12.2025	Elif Ezgi Emre
4	UML Diagrams (Use Case, Class)	20.12.2025	Elif Ezgi Emre
5	ERD Diagram	22.12.2025	Elif Ezgi Emre
6	Backend Development (Node.js/Express)	05.01.2026	Elif Ezgi Emre
7	NBP API Integration	10.01.2026	Elif Ezgi Emre
8	Mobile App Development (React Native)	15.01.2026	Elif Ezgi Emre
9	Network Error Handling	18.01.2026	Elif Ezgi Emre
10	API Integration (Mobile ↔ Backend)	22.01.2026	Elif Ezgi Emre
11	Testing & Debugging	01.02.2026	Elif Ezgi Emre
12	Documentation & Report	03.02.2026	Elif Ezgi Emre
13	Presentation Preparation	04.02.2026	Elif Ezgi Emre

Implementation Details:

Stage 1-5: Analysis and Design Phase (Part 1)

- Gather functional and non-functional requirements
- Design system architecture
- Create UML diagrams (Use Case, Class)
- Design database schema (ERD)
- Prepare conceptual design report

Stage 6-7: Backend Development

- Set up Node.js/Express server
- Implement REST API endpoints
- Integrate NBP API with error handling
- Implement business logic for currency exchange
- Add network timeout and error handling

Stage 8-10: Mobile App Development

- Set up React Native/Expo project
- Implement UI components (Login, Dashboard, etc.)
- Implement network layer with timeout handling
- Integrate with backend API
- Add error handling and user feedback

Stage 11: Testing

- Unit testing for backend services

- Integration testing for API endpoints
- Mobile app testing on Android/iOS
- Network condition testing (timeout, errors)
- User acceptance testing

Stage 12-13: Documentation & Presentation

- Complete project documentation
- Prepare user manual
- Create presentation slides
- Prepare live demonstration

---

8. Conclusions and Possible Extensions

8.1. Conclusions

This project successfully demonstrates a mobile currency exchange system that addresses networking challenges in mobile environments. Key achievements include:

1. **Complete System Implementation**: Successfully implemented mobile application, REST API backend, and database schema following best practices.

2. **NBP API Integration**: Successfully integrated with National Bank of Poland API to fetch real-time exchange rates, demonstrating external API integration skills.

3. **Network Resilience**: Implemented comprehensive network error handling including:

    - Timeout management (7s mobile, 5s backend)
    - User-friendly error messages
    - Graceful degradation when external API is unavailable

4. **Cross-Platform Support**: React Native/Expo framework enables deployment on both Android and iOS platforms with a single codebase.

5. **Scalable Architecture**: Modular design with clear separation of concerns (UI, Network, Business Logic, Data) allows for future enhancements and scalability.

6. **Database Design**: Well-structured SQL schema with proper relationships, constraints, and indexes ensures data integrity and performance.

7. **User Experience**: Intuitive interface with clear feedback for all user actions, including error states and loading indicators.

8.2. Possible Extensions

A. Advanced Features

1. **Push Notifications**

    - Rate alerts when currency reaches threshold
    - Transaction confirmations

   - System updates and announcements

2. **Historical Rate Charts**

   - Interactive charts showing rate trends
   - Multiple time periods (1 day, 1 week, 1 month, 1 year)
   - Comparison between different currencies

3. **Multiple Wallet Support**

   - Support for multiple currencies (USD, EUR, GBP wallets)
   - Currency conversion between wallets
   - Portfolio view showing total value in PLN

4. **Favorites/Watchlist**

   - Mark favorite currencies
   - Quick access to frequently traded currencies
   - Customizable dashboard

5. **Advanced Trading Features**

   - Limit orders (execute when rate reaches target)
   - Stop-loss orders
   - Trading history export (CSV/PDF)
   - Portfolio performance analytics

B. Security Enhancements

1. **Authentication Improvements**

   - JWT token-based authentication
   - Token refresh mechanism
   - Session management

2. **Two-Factor Authentication (2FA)**

   - SMS-based OTP
   - Email-based OTP
   - Authenticator app support

3. **Biometric Authentication**

   - Fingerprint login (Android/iOS)
   - Face ID (iOS)
   - Secure storage of credentials

4. **Data Encryption**

   - Encrypted local storage
   - End-to-end encryption for sensitive data
   - Secure password hashing (bcrypt/argon2)

C. Performance Optimizations

1. **Caching Strategy**
    - Cache exchange rates (reduce NBP API calls)
    - Cache user data
    - Offline mode with local database (SQLite)
2. **Code Optimization**
    - Code splitting for smaller bundle size
    - Image optimization
    - Lazy loading of components
3. **Database Optimization**
    - Query optimization
    - Indexing strategy
    - Connection pooling

D. Analytics & Monitoring

1. **User Analytics**
    - User behavior tracking
    - Feature usage statistics
    - Error tracking and reporting
2. **Performance Monitoring**
    - API response time monitoring
    - Error rate tracking
    - System health dashboard
3. **Business Analytics**
    - Trading volume statistics
    - Popular currency pairs
    - User engagement metrics

E. Social Features

1. **User Profiles**
    - Public profiles
    - Trading statistics
    - Achievement system
2. **Social Trading**
    - Follow other traders
    - Share trading strategies

- Leaderboards

3. **Community Features**

   - Discussion forums
   - Market news and analysis
   - Expert opinions

F. Machine Learning Integration

1. **Rate Prediction**

   - ML models for exchange rate prediction
   - Trend analysis
   - Risk assessment

2. **Personalization**

   - Personalized recommendations
   - Customized dashboard
   - Smart notifications

3. **Fraud Detection**

   - Anomaly detection
   - Suspicious activity alerts
   - Risk scoring

G. Microservices Architecture

1. **Service Decomposition**

   - Separate authentication service
   - Separate trading service
   - Separate rate service
   - Separate notification service

2. **API Gateway**

   - Centralized request routing
   - Rate limiting
   - Authentication/Authorization

3. **Service Mesh**

   - Inter-service communication
   - Load balancing
   - Circuit breaker pattern

H. Additional Integrations

1. **Payment Gateways**

    - Real money deposits/withdrawals
    - Credit card integration
    - Bank transfer support

2. **Multiple Exchange Rate Sources**

    - Integration with multiple APIs
    - Rate comparison
    - Best rate finder

3. **Cryptocurrency Support**

    - Bitcoin, Ethereum, etc.
    - Crypto-to-fiat exchange
    - Crypto wallet integration

---

9. Sources

9.1. API Documentation

1. **National Bank of Poland API**
    - Official Website: https://api.nbp.pl/
    - API Documentation: https://api.nbp.pl/en.html
    - Exchange Rates Endpoint: https://api.nbp.pl/api/exchangerates/tables/A?format=json
    - Historical Rates: https://api.nbp.pl/api/exchangerates/tables/A/{date}?format=json

9.2. Technology Documentation

1. **React Native**

    - Official Documentation: https://reactnative.dev/docs/getting-started
    - React Native Guide: https://reactnative.dev/docs/components-and-apis
    - Networking: https://reactnative.dev/docs/network

2. **Expo**

    - Official Documentation: https://docs.expo.dev/
    - Getting Started: https://docs.expo.dev/get-started/installation/
    - API Reference: https://docs.expo.dev/versions/latest/

3. **Node.js**

    - Official Documentation: https://nodejs.org/en/docs/
    - Node.js Guide: https://nodejs.org/en/docs/guides/
    - Best Practices: https://github.com/goldbergyoni/nodebestpractices

4. **Express.js**

    - Official Documentation: https://expressjs.com/
    - Express Guide: https://expressjs.com/en/guide/routing.html
    - Middleware: https://expressjs.com/en/guide/using-middleware.html

5. **React**

    - Official Documentation: https://react.dev/
    - React Hooks: https://react.dev/reference/react
    - State Management: https://react.dev/learn/managing-state

9.3. Database Documentation

1. **PostgreSQL**

    - Official Documentation: https://www.postgresql.org/docs/
    - PostgreSQL Tutorial: https://www.postgresql.org/docs/current/tutorial.html
    - SQL Reference: https://www.postgresql.org/docs/current/sql.html

2. **MySQL**

    - Official Documentation: https://dev.mysql.com/doc/
    - MySQL Tutorial: https://dev.mysql.com/doc/refman/8.0/en/tutorial.html
    - SQL Syntax: https://dev.mysql.com/doc/refman/8.0/en/sql-statements.html

3. **SQLite**

    - Official Documentation: https://www.sqlite.org/docs.html
    - SQLite Tutorial: https://www.sqlite.org/quickstart.html

9.4. Networking & Mobile Systems

1. **Mobile Network Architecture**

    - Course materials on "Networking Issues in Mobile Systems"
    - Mobile networking challenges and solutions
    - HTTP/HTTPS protocols in mobile environments

2. **REST API Best Practices**

    - RESTful API Design: https://restfulapi.net/
    - HTTP Methods: https://developer.mozilla.org/en-US/docs/Web/HTTP/Methods
    - Status Codes: https://developer.mozilla.org/en-US/docs/Web/HTTP/Status

3. **Network Protocols**

    - HTTP/1.1: RFC 7231 (https://tools.ietf.org/html/rfc7231)
    - HTTPS: RFC 2818 (https://tools.ietf.org/html/rfc2818)
    - TLS: RFC 8446 (https://tools.ietf.org/html/rfc8446)

9.5. Software Engineering & Design

1. **UML Modeling**

    - Course materials on software engineering
    - UML Specification: https://www.omg.org/spec/UML/
    - Use Case Diagrams: https://www.uml-diagrams.org/use-case-diagrams.html

  - Class Diagrams: https://www.uml-diagrams.org/class-diagrams.html

2. **Database Design**

   - Course materials on database systems
   - Database Normalization: https://en.wikipedia.org/wiki/Database_normalization
   - ERD Design: https://www.lucidchart.com/pages/er-diagrams

3. **System Architecture**

   - Microservices Architecture: https://microservices.io/
   - REST API Architecture: https://restfulapi.net/
   - Mobile App Architecture: https://developer.android.com/jetpack/guide

9.6. Error Handling & Network Resilience

1. **Error Handling Patterns**

   - Error Handling in Node.js: https://nodejs.org/en/docs/guides/error-handling/
   - React Error Boundaries: https://react.dev/reference/react/Component#catching-rendering-errors-with-an-error-boundary
   - Network Error Handling: Best practices documentation

2. **Retry Patterns**

   - Exponential Backoff: https://en.wikipedia.org/wiki/Exponential_backoff
   - Circuit Breaker Pattern: https://martinfowler.com/bliki/CircuitBreaker.html
   - Retry Logic: https://github.com/tim-kos/node-retry

9.7. Security

1. **Authentication & Authorization**

   - JWT Authentication: https://jwt.io/
   - OAuth 2.0: https://oauth.net/2/
   - Password Hashing: https://cheatsheetseries.owasp.org/cheatsheets/Password_Storage_Cheat_Sheet.html

2. **Mobile Security**

   - OWASP Mobile Security: https://owasp.org/www-project-mobile-security/
   - React Native Security: https://reactnative.dev/docs/security

9.8. Additional Resources

1. **Git Version Control**

   - Git Documentation: https://git-scm.com/doc
   - GitHub Guides: https://guides.github.com/

2. **Project Management**

   - Agile Methodology: Course materials

- Project Planning: Best practices

3. **Code Quality**
    - ESLint: https://eslint.org/
    - Prettier: https://prettier.io/
    - Code Review Best Practices

Appendix A: API Endpoints Reference

Authentication Endpoints

POST /api/auth/register

- **Description:** Register a new user
- **Request Body:**

```
{
  "name": "John Doe",
  "email": "john@example.com",
  "password": "password123"
}
```

- **Response:** `201 Created`

```
{
  "userId": 1,
  "name": "John Doe",
  "email": "john@example.com"
}
```

POST /api/auth/login

- **Description:** User login
- **Request Body:**

```
{
  "email": "john@example.com",
  "password": "password123"
}
```

- **Response:** `200 OK`

```
{
  "userId": 1,
  "name": "John Doe",
  "email": "john@example.com"
}
```

Exchange Rates Endpoints

GET /api/rates

- **Description:** Get current exchange rates from NBP API
- **Response:** `200 OK`

```
[
  {
    "table": "A",
    "rates": [
      {
        "code": "USD",
        "currency": "dolar amerykański",
        "mid": 4.25
      },
      ...
    ]
  }
]
```

User Resources Endpoints

GET /api/users/:userId/wallets

- **Description:** Get user's wallets
- **Response:** `200 OK`

```
[
  {
    "walletId": 1,
    "userId": 1,
    "currency": "PLN",
    "balance": 10000.00
  }
]
```

POST /api/users/:userId/trade

- **Description:** Execute buy/sell transaction
- **Request Body:**

```
{
  "type": "BUY",
  "currencyPair": "USD/PLN",
  "amount": 100,
  "rate": 4.25
}
```

- **Response:** `201 Created`

```
{
  "transaction": {
    "transactionId": 1,
    "userId": 1,
    "type": "BUY",
    "currencyPair": "USD/PLN",
    "amount": 100,
    "rate": 4.25,
    "createdAt": "2026-01-27T10:00:00Z"
  },
  "wallet": {
    "walletId": 1,
    "balance": 9575.00
  }
}
```

GET /api/users/:userId/transactions

- **Description:** Get user's transaction history
- **Response:** `200 OK`

```
[
  {
    "transactionId": 1,
    "userId": 1,
    "type": "BUY",
    "currencyPair": "USD/PLN",
    "amount": 100,
    "rate": 4.25,
    "createdAt": "2026-01-27T10:00:00Z"
  }
]
```

Health Check Endpoint

GET /api/health

- **Description:** Backend health status

- **Response:** `200 OK`

```
{
  "status": "ok",
  "message": "Backend is running."
}
```

Appendix B: Error Codes and Messages

HTTP Code	Error Type	Description	User Message
400	Bad Request	Invalid request parameters	"Please check your input and try again."
401	Unauthorized	Invalid credentials	"Invalid email or password."
404	Not Found	Resource not found	"User or resource not found."
500	Internal Server Error	Server error	"An unexpected error occurred. Please try again later."
503	Service Unavailable	External API unavailable	"Exchange rate service is temporarily unavailable. Please try again later."

Network Error Messages:

- **Timeout:** "Request timed out. Please check your network connection."
- **Network Error:** "Could not reach server. Check your internet connection."
- **Connection Refused:** "Server is not responding. Please try again later."

Appendix C: Database Schema SQL

```
-- Users Table
CREATE TABLE users (
    user_id       SERIAL PRIMARY KEY,
    name          VARCHAR(100) NOT NULL,
    email         VARCHAR(100) NOT NULL UNIQUE,
    password_hash VARCHAR(255) NOT NULL,
    created_at    TIMESTAMP NOT NULL DEFAULT CURRENT_TIMESTAMP
);

-- Wallets Table
CREATE TABLE wallets (
    wallet_id   SERIAL PRIMARY KEY,
    user_id     INTEGER NOT NULL REFERENCES users(user_id) ON DELETE
CASCADE,
    currency   VARCHAR(10) NOT NULL DEFAULT 'PLN',
    balance    NUMERIC(18, 2) NOT NULL DEFAULT 0
);

-- Transactions Table
CREATE TABLE transactions (
    transaction_id SERIAL PRIMARY KEY,
    user_id        INTEGER NOT NULL REFERENCES users(user_id) ON DELETE
CASCADE,
    wallet_id      INTEGER NOT NULL REFERENCES wallets(wallet_id) ON
DELETE RESTRICT,
    type           VARCHAR(10) NOT NULL CHECK (type IN ('BUY', 'SELL')),
    currency_pair  VARCHAR(10) NOT NULL,
    amount         NUMERIC(18, 2) NOT NULL,
    rate           NUMERIC(18, 6) NOT NULL,
    created_at     TIMESTAMP NOT NULL DEFAULT CURRENT_TIMESTAMP
);

-- Exchange Rates Table (Cache)
CREATE TABLE exchange_rates (
    rate_id        SERIAL PRIMARY KEY,
    base_currency  VARCHAR(10) NOT NULL,
    target_currency VARCHAR(10) NOT NULL,
    rate           NUMERIC(18, 6) NOT NULL,
    timestamp      TIMESTAMP NOT NULL
);

-- Notification Settings Table
CREATE TABLE notification_settings (
    setting_id     SERIAL PRIMARY KEY,
    user_id        INTEGER NOT NULL REFERENCES users(user_id) ON DELETE
CASCADE,
    currency_pair  VARCHAR(10) NOT NULL,
    threshold_value NUMERIC(18, 6) NOT NULL,
    direction      VARCHAR(5) NOT NULL CHECK (direction IN ('UP',
'DOWN')),
    is_active      BOOLEAN NOT NULL DEFAULT TRUE
);

-- Indexes
CREATE INDEX idx_wallets_user_id ON wallets(user_id);
CREATE INDEX idx_transactions_user_id ON transactions(user_id);
CREATE INDEX idx_transactions_created_at ON transactions(created_at);
CREATE INDEX idx_exchange_rates_currency ON exchange_rates(base_currency,
target_currency);
CREATE INDEX idx_notification_settings_user_id ON
notification_settings(user_id);
```

Document Version: 1.0

Last Updated: January 2026

Author: Elif Ezgi Emre
Status: Complete