

# Cardano HFT Platform — Technical Architecture

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## 1) Vision & Purpose

Enable automated, strategy-based trading on Cardano DEXs with secure wallet management, real-time token discovery, and non-custodial execution. Outcome: production-ready platform bridging traditional HFT with Cardano DeFi.

## 2) Architectural Overview

A **hybrid three-tier system** built for scalability, security, and real-time performance:

### A. Frontend Layer (React + TypeScript + Vite)

- **Framework:** React 18 with TypeScript for type safety
- **Build Tool:** Vite for fast development and optimized production builds
- **State Management:** Redux Toolkit for global state (wallet, tokens, strategies)
- **UI Components:**
  - Custom-designed components with Tailwind CSS
  - Sonner for toast notifications
  - Dark mode support

- **Wallet Integration:**
  - Mesh SDK (CIP-30) for browser wallet connections (Nami, Eternl, Flint)
  - Cardano wallet adapter for multi-wallet support
- **Routing:** React Router for SPA navigation

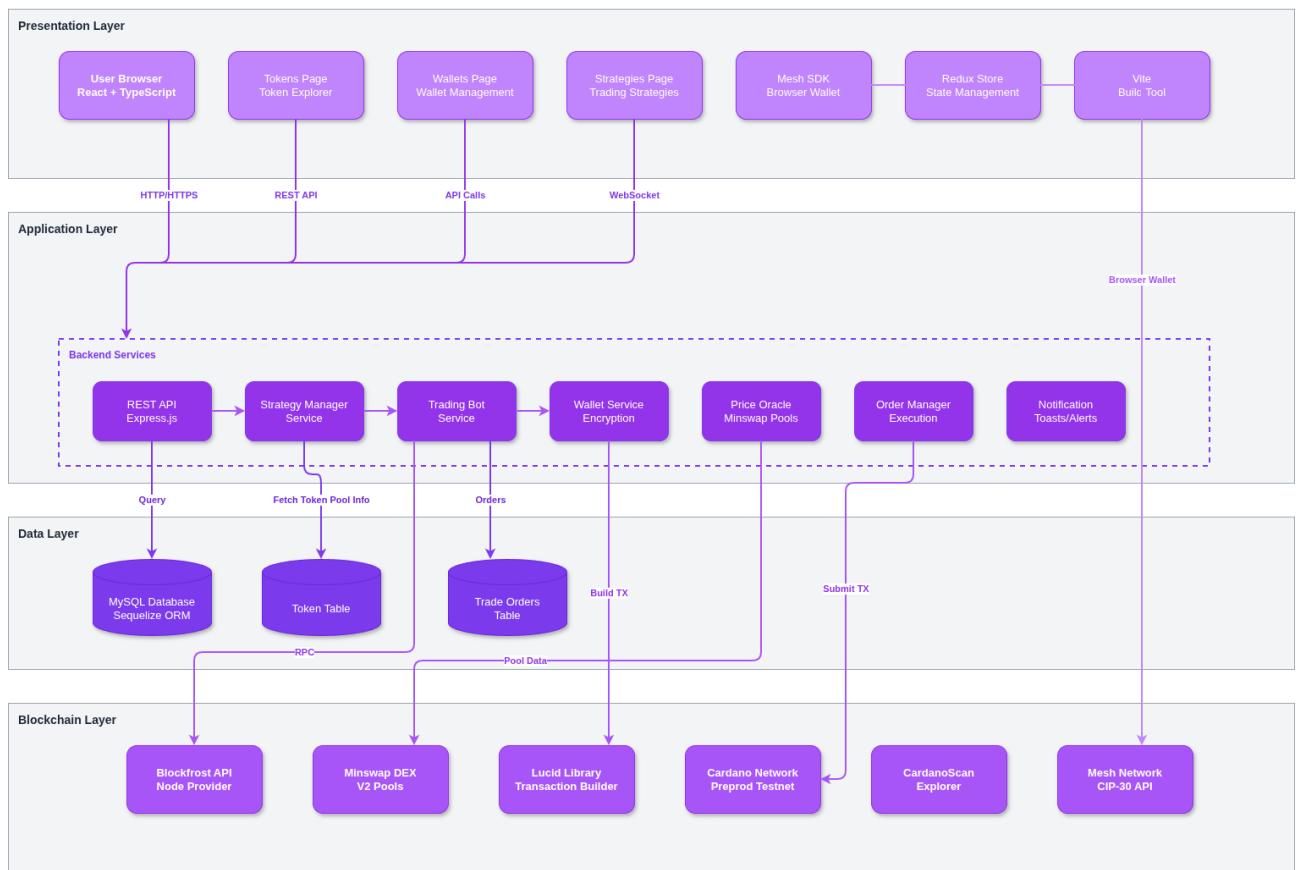
## B. Application & API Layer (Node.js + Express + TypeScript)

- **Runtime:** Node.js with Express.js REST API
- **Architecture:** Service-oriented design with clear separation of concerns
- **Core Services:**
  - **Strategy Manager Service:** Orchestrates trading strategies lifecycle
  - **Trading Bot Service:** Monitors prices and executes orders
  - **Wallet Service:** Manages encrypted wallet storage and transactions
  - **Price Oracle Service:** Fetches live prices from Minswap pools
- **API Endpoints:** RESTful JSON under /api for wallets, tokens, strategies, orders
- **Security:** AES-256-GCM encryption for seed phrases, environment-based secrets

## C. Data + Blockchain Layer

- **Database:** MySQL with Sequelize ORM for structured data
  - **Tables:** Wallets, Tokens (Pools), Trade Orders, Strategies
- **Blockchain Integration:**
  - **Cardano Network:** Preprod Testnet (production-ready for Mainnet)
  - **Node Provider:** Blockfrost API for blockchain queries
  - **DEX:** Minswap V2 pools for token swaps
  - **Transaction Builder:** Lucid-Cardano for building/signing transactions
  - **SDK:** Minswap SDK for pool calculations and swap execution

### Cardano HFT Platform - System Architecture



## 3) Technologies Used in the Solution

Category	Technology	Purpose
<b>Frontend</b>	React + TypeScript	Type-safe UI development with component reusability
<b>Build Tool</b>	Vite	Fast HMR and optimized production builds
<b>State Management</b>	Redux Toolkit	Centralized state for wallet, tokens, and strategies
<b>Styling</b>	Tailwind CSS	Utility-first CSS for rapid UI development
<b>Backend</b>	Node.js + Express	Scalable REST API with TypeScript
<b>Database</b>	MySQL + Sequelize	Relational database with ORM for structured queries
<b>Blockchain</b>	Cardano (Preprod/Mainnet)	Layer-1 blockchain for transaction settlement
<b>APIs &amp; Integrations</b>	Lucid + Blockfrost APIs	Blockchain interaction and node queries
<b>DEX Integration</b>	Minswap V2 SDK	Pool data fetching and swap execution
<b>Wallet Integration</b>	Mesh SDK (CIP-30)	Browser wallet connections (Nami, Eternl, Flint)
<b>Encryption</b>	AES-256-GCM (Node crypto)	Secure seed phrase storage

Category	Technology	Purpose
<b>Payments</b>	ADA (Lovelace)	Native Cardano token for gas and liquidity
<b>Math Library</b>	Big.js	Precise decimal arithmetic for token amounts

#### Key Differentiators:

- **React for frontend** ensures high performance and developer productivity
- **Python (FastAPI)** is NOT used; **Node.js + Express** provides unified JavaScript/TypeScript stack
- **Lucid + Blockfrost APIs** enable direct blockchain interaction without custom node infrastructure
- **AES-256-GCM encryption** secures wallet seed phrases at rest

## 4) Core Principles

Principle	Rationale
Hybrid Off/On-Chain	Strategy logic off-chain for speed; execution on-chain for immutability
Wallet-as-Identity	CIP-30 wallets replace auth; signatures authorize actions
Non-Custodial	Backend wallets encrypted; private keys never exposed to frontend
Real-Time	Bot checks prices (10s), UI updates (5s)
Auditability	Every order has DB record + on-chain txHash

## 5) Key Components

**Frontend:** Tokens (search 100+ pools), Wallets (create/import/fund/delete), Strategies (price-target with start/stop/delete controls).

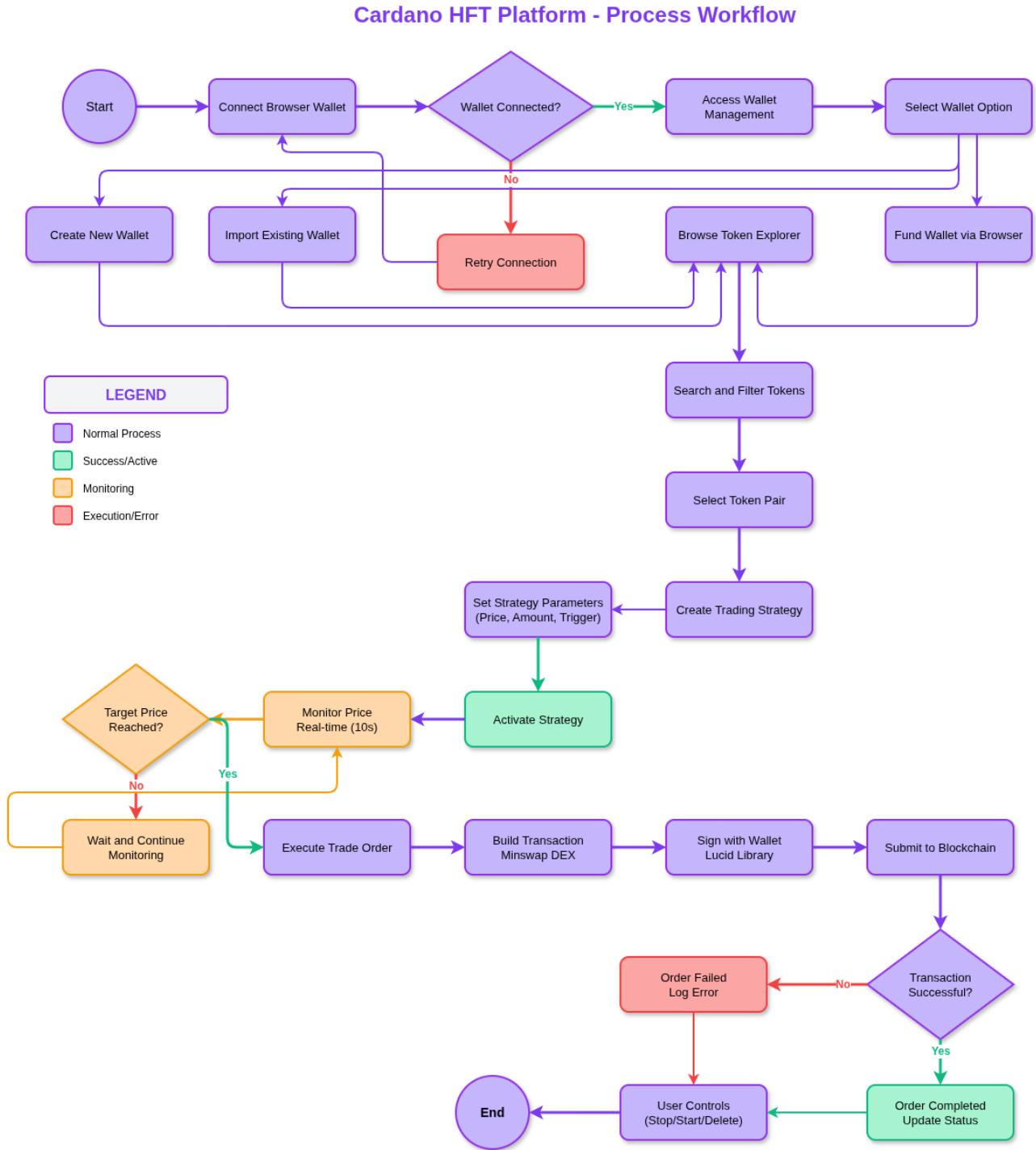
**Backend Services:** Strategy Manager (30s execution loop), Trading Bot (10s order polling + Lucid swaps), Wallet Service (BIP39 + encryption), Price Oracle (Minswap pool data).

## 6) Data Flow (End-to-End)

1. **Connect** browser wallet (Mesh SDK) → store address
2. **Create** backend wallet → encrypt mnemonic → save file
3. **Fund** via browser wallet → Lucid transaction
4. **Browse** tokens → MySQL pools via /api/tokens
5. **Create** strategy → POST /api/strategy/price-target
6. **Execute** loop: Strategy Manager → Trading Bot → Lucid swap → Cardano

7. **Monitor** frontend polls /api/strategy/live (5s)

8. **Controls:** Stop/Start/Delete via API



## 7) API Families

**Wallets:** /api/wallet (create, add, list, balance, remove)

**Tokens:** /api/tokens (list, search, refresh)

**Strategies:** /api/strategy (price-target, live, stop, start, delete)

**Orders:** /api/orders (list, details)

## 8) Data Models

### PoolToken

Field	Type	Description
id	number (PK)	Auto-increment ID
policyId	string	Cardano policy ID
assetName	string	Token asset name
symbol	string	Token symbol (e.g., MIN)
name	string	Full token name
decimals	number	Token decimals
assetA	string	Pool asset A identifier
assetB	string	Pool asset B identifier
reserveA	string	Reserve amount for asset A
reserveB	string	Reserve amount for asset B
totalLiquidity	string	Total pool liquidity
createdAt	Date	Timestamp

### TradeOrder

Field	Type	Description
id	string (PK)	UUID
walletAddress	string (FK)	Reference to Wallet
tradingPair	string	e.g., MIN-ADA
baseToken	string	Policy ID + asset name
quoteToken	string	Quote token (ADA)
isBuy	boolean	Buy or Sell order
amount	number	Order amount in tokens
targetPrice	number	Trigger price in ADA
currentPrice	number	Current market price
triggerAbove	boolean	Trigger above or below target
status	enum	pending, executing, completed, failed
txHash	string	Cardano transaction hash
executedPrice	number	Actual execution price
executedAt	Date	Execution timestamp
errorMessage	string	Error details if failed
createdAt	Date	Order creation timestamp

## **Strategy (In-Memory)**

<b>Field</b>	<b>Type</b>	<b>Description</b>
id	string	UUID
name	string	Strategy name
walletAddress	string	Backend wallet address
tradingPair	string	e.g., MIN-ADA
baseToken	string	Policy ID + asset name
quoteToken	string	Quote token (ADA)
isActive	boolean	Strategy active status
targetPrice	number	Price trigger in ADA
orderAmount	number	Order size in tokens
side	enum	BUY or SELL
triggerType	enum	ABOVE or BELOW
executeOnce	boolean	One-time or recurring

## **9) Security**

AES-256-GCM for seed phrases, non-custodial design, txHash for auditability, encrypted wallet files, no logs of seeds.

## **11) Roadmap**

Grid trading and DCA strategies.

Multi-DEX aggregation.

WebSocket real-time feeds for sub-second updates.

Portfolio analytics with P&L tracking.

API access for algorithmic traders.

Mainnet deployment with institutional security.

## **11) Mockup Screens**

**Cardano HFT** High-Frequency Trading

**Tokens** **Wallets** **Strategies**

**Token Explorer**  
233 tokens synced from Minswap V2 (Preprod)

**Refresh Data** 233 tokens **Search tokens (real-time)...** **Clear**

**M MIN**  
e16c2dc8ae937e8d...  
Price (ADA) ₩0.006835 Liquidity ₩305,217.42  
Source: MinswapV2 Nov 10, 06:05 PM **View Details ..**

**L LINK**  
9c6cd01df2299fc...  
Price (ADA) ₩315.164128 Liquidity ₩7,275.71  
Source: MinswapV2 Nov 10, 06:05 PM **View Details ..**

**t tUSDM**  
11c93226aabfe91...  
Price (ADA) ₩1.486318 Liquidity ₩368,997.19  
Source: MinswapV2 Nov 10, 06:05 PM **View Details ..**

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**Connect Wallet**

- eternl
- lace

**Cardano HFT** High-Frequency Trading

**Tokens** **Wallets** **Strategies**

**BALANCE 391.42 ADA** **Connected addr\_t...4kzs**

**Wallet Management**  
Create, import, and manage your Cardano wallets

**+ Create Wallet** **Import Wallet**

**addr\_testlqpwsc...** Preprod  
Balance ₩ 391.418801 **View Assets (1)**  
**Fund** **Send** **Receive** **trash**

**addr\_testlqregz...** Preprod  
Balance ₩ 46846.639918 **View Assets (15)**  
**Fund** **Send** **Receive** **trash**

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The screenshot shows the 'Cardano HFT' application interface. At the top, there are tabs for 'Tokens', 'Wallets' (which is selected), and 'Strategies'. On the right, it displays a balance of 391.42 ADA and a connected wallet address. Below the tabs, a modal window titled 'Wallet Assets' is open, showing the ADA balance as 46846.639918. Under 'Native Assets (15)', four asset entries are listed:

- 89c6d0fec562a660... (Quantity 1)
- 89c6d0fec562a660... (Quantity 1)
- 89c6d0fec562a660... (Quantity 1)
- d4fece6b39f7cd78... (Quantity 987552342621)

Each entry includes policy and asset IDs.

The screenshot shows the 'Cardano HFT' application interface. At the top, there are tabs for 'Tokens', 'Wallets', and 'Strategies' (which is selected). On the right, it displays a balance of 391.42 ADA and a connected wallet address. Below the tabs, a section titled 'Trading Strategies' is shown with the sub-section 'Create New Strategy'. The form fields are as follows:

- Strategy Name \*: e.g., Buy MIN Dip
- Select Wallet \*: addr\_test1qpwsc7e7a0...nvuq2m4kzs
- Select Token \*: Choose a token...
- Trading Pair: MIN-ADA
- Target Price (ADA) \*: 0.05
- Order Amount (Tokens) \*: 100
- Order Side \*: BUY
- Trigger When Price \*: Falls Below Target
- Execute only once (stop after first trade)

A blue 'Create Strategy' button is at the bottom of the form.

Create and monitor automated trading strategies

### Create New Strategy

Strategy Name *	Select Wallet *
e.g., Buy MIN Dip	addr_test1qpwsc7e7a0...nvuq2m4kzs
Select Token *	Trading Pair
MIN - ADA	MIN-ADA
Target Price (ADA) *	Order Amount (Tokens) *
0.007835	200
Order Side *	Trigger When Price *
BUY	Falls Below Target
<input checked="" type="checkbox"/> Execute only once (stop after first trade)	
Strategy Preview: Will BUY 200 MIN when price falls below \$0.007835 Using wallet: addr_test1qpwsc...	
 Create Strategy	

### Active Strategies

Next update in 4s | Last updated: 12:23:22 PM

<b>MIN DIP</b> MIN-ADA	Active	 Stop	 Delete
Will BUY 200 MIN when price falls below 0.007835 ADA			

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### NFTs

Today

 Activity	 Received	2.00 tADA, 200 asset1marr...tksl
	12:24:19	1.13 USD
 Staking	 Sent	-4.19 tADA
	12:23:59	-2.36 USD
 Voting Center		