Final Project Report
Advanced Computer Programming

Topic

Group : …

Instructor : DINH-TRUNG VU

2025-06

Chapter 1 Introduction

1.1 Group Information

1) **Group Project Repository**: https://github.com/Chintsogt0825/Final.git
2) **Group members**:
   1. Chintsogt – 113021194 (leader)
   2. Khangai – 113021187

Overview

Our project leverages several advanced Python features and libraries to build a real-time cryptocurrency price dashboard with prediction capabilities.

We used:

- Data Classes: To define structured data models for price entries.
- Threading: To run the Zenoh subscriber in the background for asynchronous real-time data fetching.
- Requests & Beautiful Soup: To fetch and parse live cryptocurrency news from Google News RSS feeds.
- Dash & Plotly: For interactive web-based visualization of historical and predicted prices.
- NumPy: For numerical computations in generating synthetic price predictions.
- JSON Parsing: To handle incoming Zenoh data formatted in JSON.

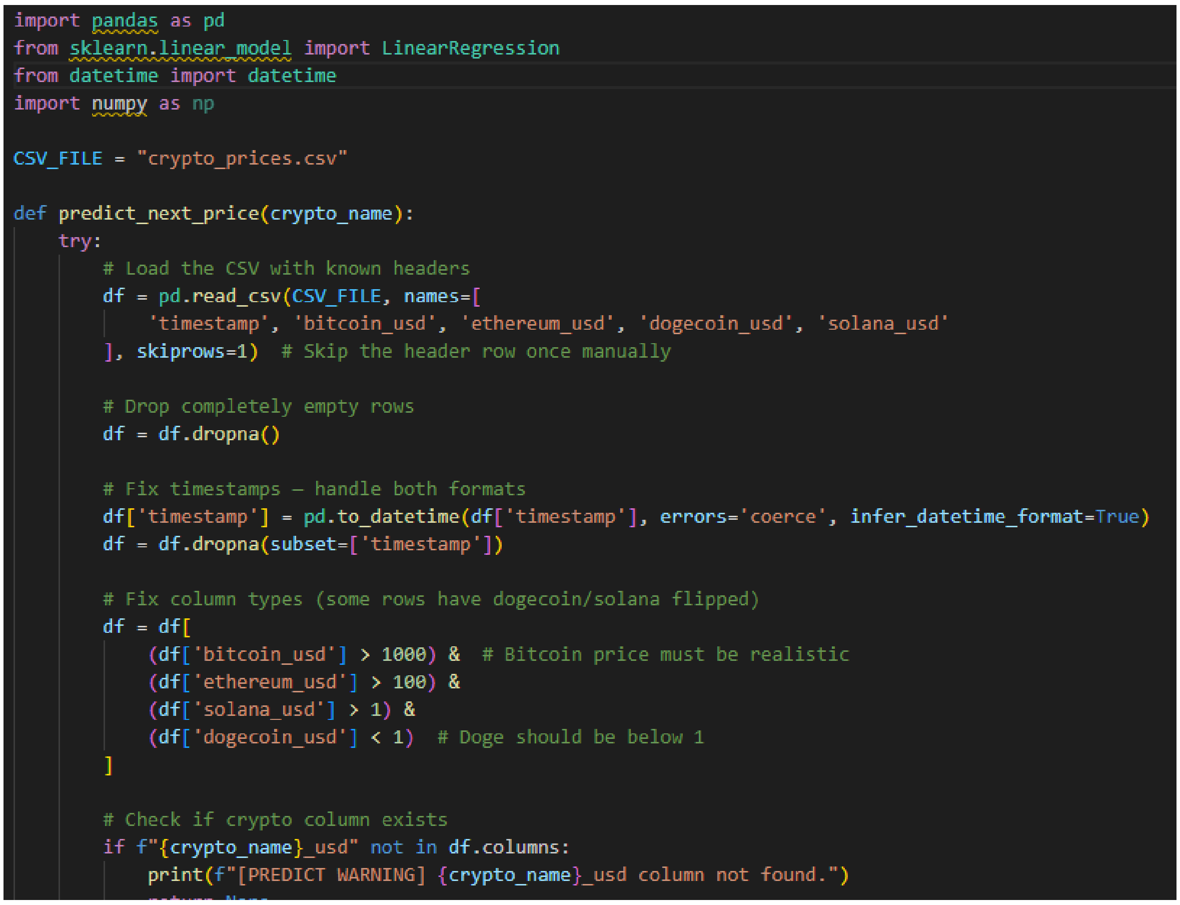
Our project successfully collects real-time crypto prices (Bitcoin, Ethereum, Dogecoin, Solana), visualizes historical trends, generates 24-hour synthetic price predictions with confidence metrics, and displays related cryptocurrency news. The dashboard updates dynamically every minute and allows users to select cryptocurrencies and adjust historical data length.

Chapter 2: Implementation

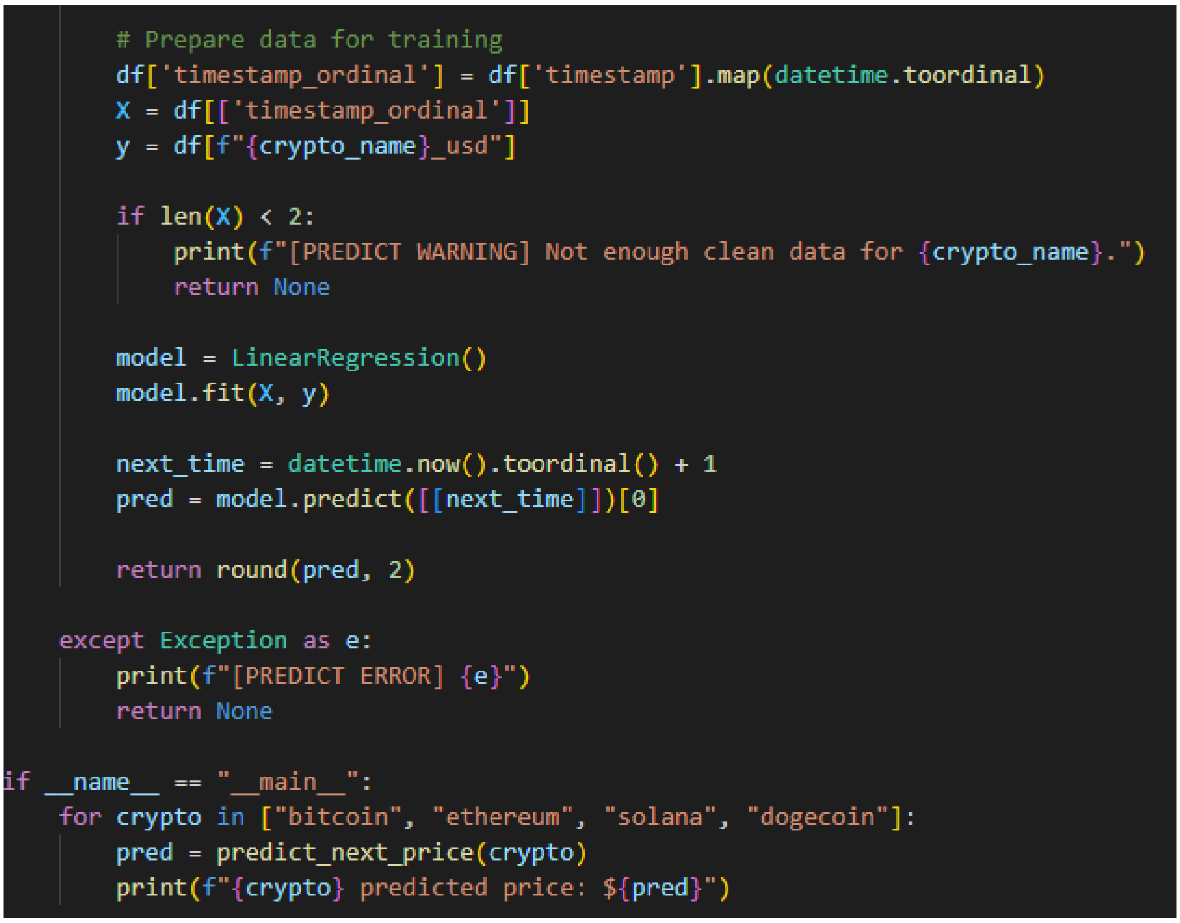
2.1 Class 1: PriceEntry

2.1.1 Fields

- `timestamp`: datetime object marking the price record time.



```python
import pandas as pd
from sklearn.linear_model import LinearRegression
from datetime import datetime
import numpy as np

CSV_FILE = "crypto_prices.csv"

def predict_next_price(crypto_name):
    try:
        # Load the CSV with known headers
        df = pd.read_csv(CSV_FILE, names=[
            'timestamp', 'bitcoin_usd', 'ethereum_usd', 'dogecoin_usd', 'solana_usd'
        ], skiprows=1)  # Skip the header row once manually

        # Drop completely empty rows
        df = df.dropna()

        # Fix timestamps — handle both formats
        df['timestamp'] = pd.to_datetime(df['timestamp'], errors='coerce', infer_datetime_format=True)
        df = df.dropna(subset=['timestamp'])

        # Fix column types (some rows have dogecoin/solana flipped)
        df = df[
            (df['bitcoin_usd'] > 1000) &  # Bitcoin price must be realistic
            (df['ethereum_usd'] > 100) &
            (df['solana_usd'] > 1) &
            (df['dogecoin_usd'] < 1)  # Doge should be below 1
        ]

        # Check if crypto column exists
        if f"{crypto_name}_usd" not in df.columns:
            print(f"[PREDICT WARNING] {crypto_name}_usd column not found.")
```



```python
        # Prepare data for training
        df['timestamp_ordinal'] = df['timestamp'].map(datetime.toordinal)
        X = df[['timestamp_ordinal']]
        y = df[f"{crypto_name}_usd"]

        if len(X) < 2:
            print(f"[PREDICT WARNING] Not enough clean data for {crypto_name}.")
            return None

        model = LinearRegression()
        model.fit(X, y)

        next_time = datetime.now().toordinal() + 1
        pred = model.predict([[next_time]])[0]

        return round(pred, 2)

    except Exception as e:
        print(f"[PREDICT ERROR] {e}")
        return None

if __name__ == "__main__":
    for crypto in ["bitcoin", "ethereum", "solana", "dogecoin"]:
        pred = predict_next_price(crypto)
        print(f"{crypto} predicted price: ${pred}")
```

- `price`: float representing the cryptocurrency price in USD.

2.1.2 Methods

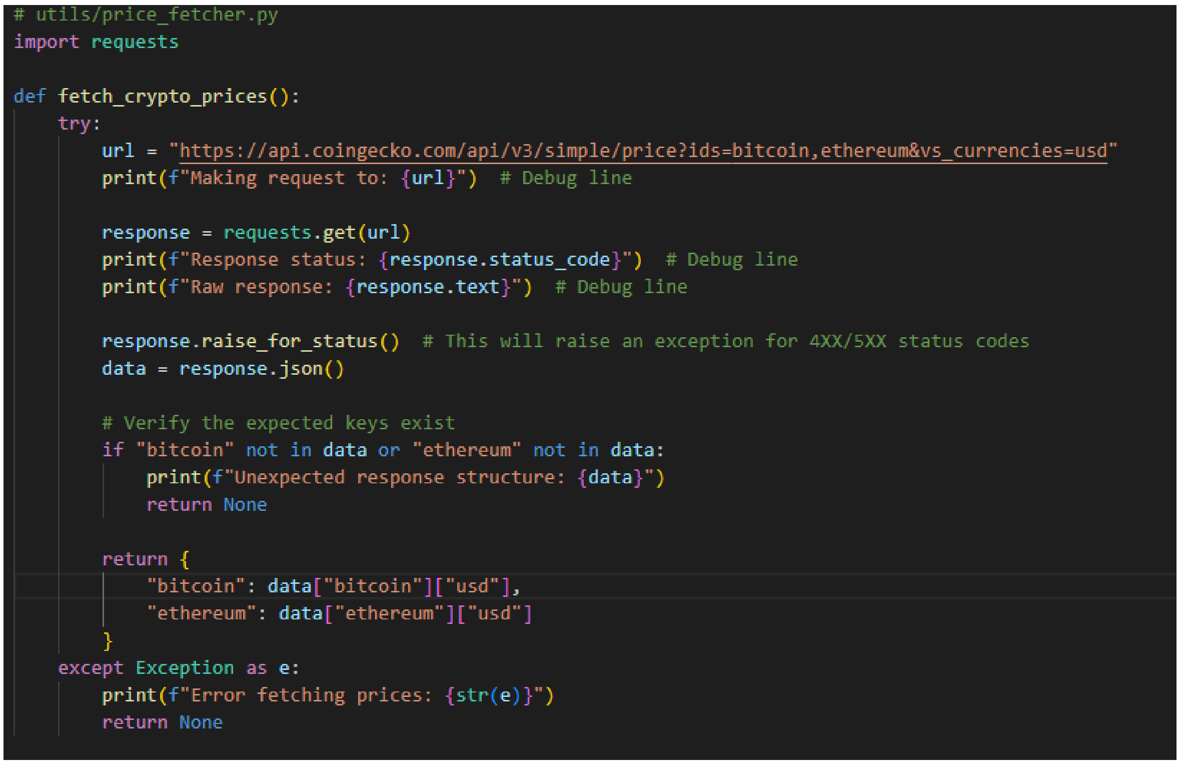
-

2.1.3 Functions

- Used as a structured container to hold individual price data points in memory.

2.2 Module: price_fetcher.py

- Contains a function `fetch_crypto_prices()` that uses `requests` to call the CoinGecko API.



```python
# utils/price_fetcher.py
import requests

def fetch_crypto_prices():
    try:
        url = "https://api.coingecko.com/api/v3/simple/price?ids=bitcoin,ethereum&vs_currencies=usd"
        print(f"Making request to: {url}")  # Debug line

        response = requests.get(url)
        print(f"Response status: {response.status_code}")  # Debug line
        print(f"Raw response: {response.text}")  # Debug line

        response.raise_for_status()  # This will raise an exception for 4XX/5XX status codes
        data = response.json()

        # Verify the expected keys exist
        if "bitcoin" not in data or "ethereum" not in data:
            print(f"Unexpected response structure: {data}")
            return None

        return {
            "bitcoin": data["bitcoin"]["usd"],
            "ethereum": data["ethereum"]["usd"]
        }
    except Exception as e:
        print(f"Error fetching prices: {str(e)}")
        return None
```

- Handles HTTP errors and validates response structure.
- Returns a dictionary of current prices for Bitcoin and Ethereum.

2.3 Zenoh Subscriber

- Uses Zenoh library to subscribe asynchronously to topic `crypto/prices`.
- Parses incoming JSON messages containing price updates for multiple cryptocurrencies.
- Updates in-memory price history buffers and appends data to a CSV file.
- Uses a thread-safe lock for file writes.

2.4 Dash Web Application

- Contains layout with dropdowns, graphs, cards, tables, gauges, and news section.
- Utilizes Dash callbacks to update visuals every 60 seconds or on user input.

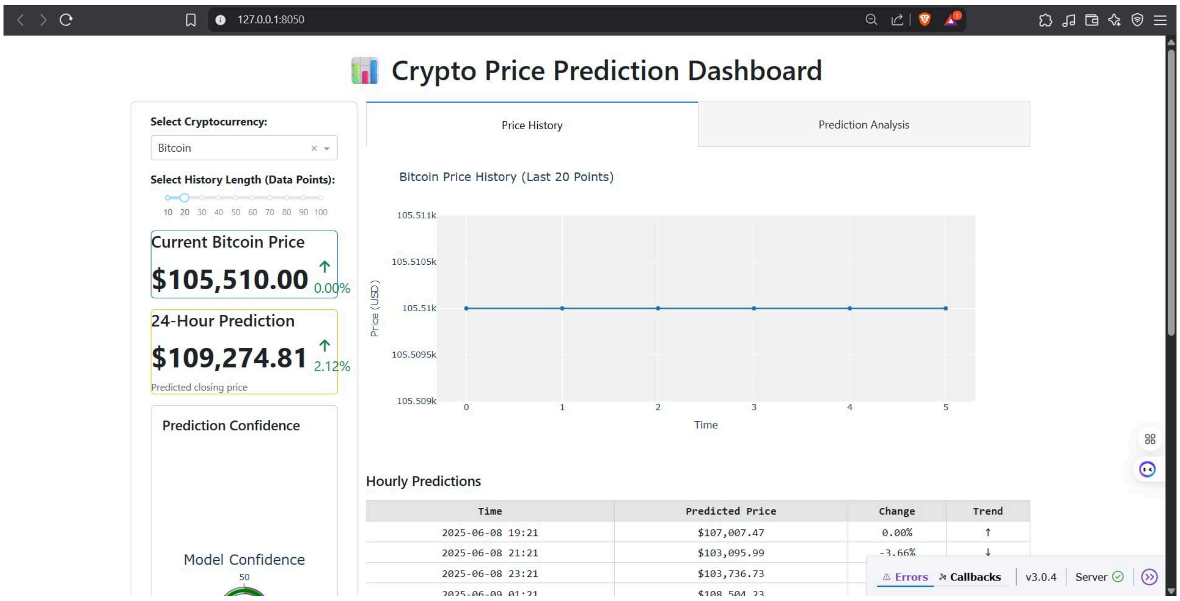
- Plots historical price line charts and 24-hour synthetic prediction charts.
- Displays current prices and predicted closing price summaries with color-coded indicators.
- Generates a prediction table showing price forecasts every 2 hours with trend arrows.
- Fetches and parses news headlines from Google News RSS feeds using Beautiful Soup.

2.5 Prediction Model

- Function `get_predicted_prices(current_price)` simulates 24 future hourly prices.
- Combines a small linear trend with random noise and volatility.
- Clamps predicted values within ±10% of the current price.
- Returns predicted prices and a confidence score.

Chapter 3: Results

3.1 Real-Time Data Collection



📊 Crypto Price Prediction Dashboard

Select Cryptocurrency: Bitcoin

Select History Length (Data Points): 20

Current Bitcoin Price
$105,510.00 ↑ 0.00%

24-Hour Prediction
$109,274.81 ↑ 2.12%
Predicted closing price

Prediction Confidence

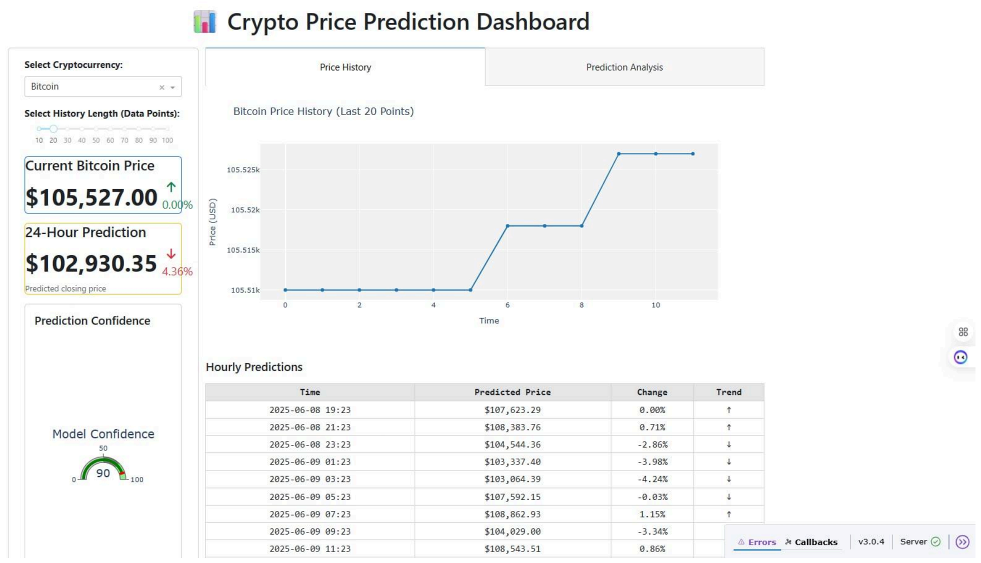
Model Confidence
50

Hourly Predictions

Time	Predicted Price	Change	Trend
2025-06-08 19:21	$107,007.47	0.00%	↑
2025-06-08 21:21	$103,095.99	-3.66%	↓
2025-06-08 23:21	$103,736.73		
2025-06-09 01:21	$108,504.23		

- Successfully subscribed and received price updates from the Zenoh publisher.
- Stored up to 100 historical price points per coin in memory and CSV.

3.2 Visualization



Current Bitcoin Price
$105,527.00 ↑ 0.00%

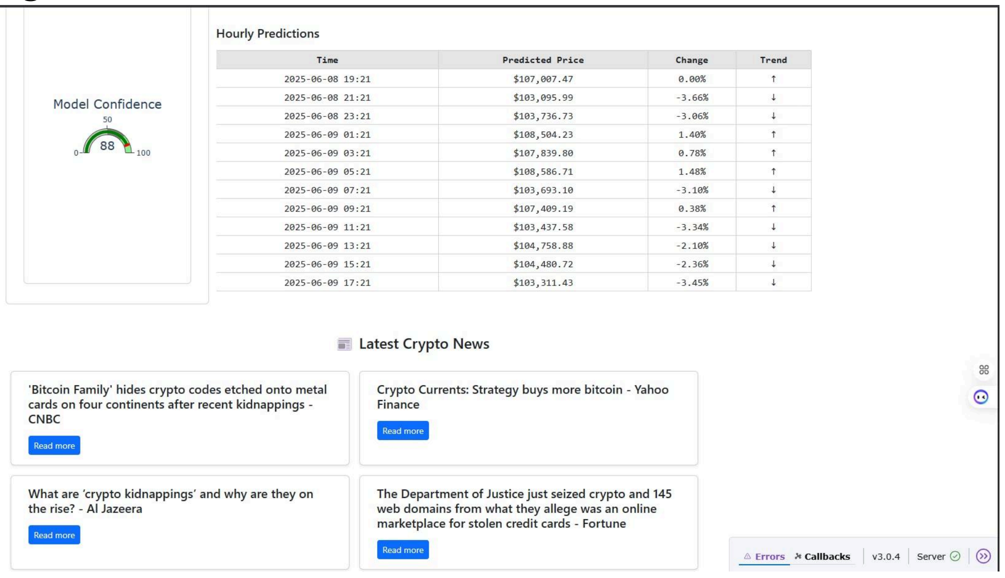
24-Hour Prediction
$102,930.35 ↓ 4.36%
Predicted closing price

Hourly Predictions

Time	Predicted Price	Change	Trend
2025-06-08 19:23	$107,623.29	0.00%	↑
2025-06-08 21:23	$108,383.76	0.71%	↑
2025-06-08 23:23	$104,544.36	-2.86%	↓
2025-06-09 01:23	$103,337.40	-3.98%	↓
2025-06-09 03:23	$103,064.39	-4.24%	↓
2025-06-09 05:23	$107,592.15	-0.03%	↓
2025-06-09 07:23	$108,862.93	1.15%	↑
2025-06-09 09:23	$104,029.00	-3.34%	
2025-06-09 11:23	$108,543.51	0.86%	

- Interactive line charts show price history and 24-hour forecasts.
- Dashboard updates every minute with fresh data.
- Confidence gauge indicates model prediction reliability.
- The prediction table provides hourly forecast summaries with intuitive trend arrows.

3.3 News Integration



Hourly Predictions

Time	Predicted Price	Change	Trend
2025-06-08 19:21	$107,007.47	0.00%	↑
2025-06-08 21:21	$103,095.99	-3.66%	↓
2025-06-08 23:21	$103,736.73	-3.06%	↓
2025-06-09 01:21	$108,504.23	1.40%	↑
2025-06-09 03:21	$107,839.80	0.78%	↑
2025-06-09 05:21	$108,586.71	1.48%	↑
2025-06-09 07:21	$103,693.10	-3.10%	↓
2025-06-09 09:21	$107,409.19	0.38%	↑
2025-06-09 11:21	$103,437.58	-3.34%	↓
2025-06-09 13:21	$104,758.88	-2.10%	↓
2025-06-09 15:21	$104,480.72	-2.36%	↓
2025-06-09 17:21	$103,311.43	-3.45%	↓

Latest Crypto News

'Bitcoin Family' hides crypto codes etched onto metal cards on four continents after recent kidnappings - CNBC

Crypto Currents: Strategy buys more bitcoin - Yahoo Finance

What are ‘crypto kidnappings’ and why are they on the rise? - Al Jazeera

The Department of Justice just seized crypto and 145 web domains from what they allege was an online marketplace for stolen credit cards - Fortune

- Relevant news headlines for selected cryptocurrency are fetched live from Google News RSS.
- News section updates dynamically based on the selected coin.

Chapter 4: Conclusions

The project demonstrates an effective integration of real-time data streaming, web visualization, and synthetic forecasting for cryptocurrency prices. Using Python's rich ecosystem—Zenoh for messaging, Dash for UI, and Beautiful Soup for web scraping—enabled rapid development of a functional dashboard.

While the prediction model is simple, it provides valuable insights and a foundation for future enhancements such as machine learning-based forecasting and more comprehensive data persistence.

The project is modular and extensible, ready to incorporate additional features like more coins, advanced models, user management, and database-backed storage.