Final Project Report
Advanced Computer Programming

Crypto tracker

Group : 10

Instructor : DINH-TRUNG VU

2025-06-09

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 implements a real-time cryptocurrency tracking and prediction dashboard using advanced Python features and libraries:

- Zenoh for real-time pub/sub messaging
- Dash/Plotly for interactive web visualization
- Scikit-learn for linear regression price prediction
- BeautifulSoup for news scraping
- Threading for concurrent data collection
- Pandas for data processing

Key achievements:

- Real-time price updates from CoinGecko API
- 24-hour price predictions with confidence intervals
- Interactive historical price charts
- Automated news aggregation
- CSV data logging for analysis

Chapter 2: Implementation

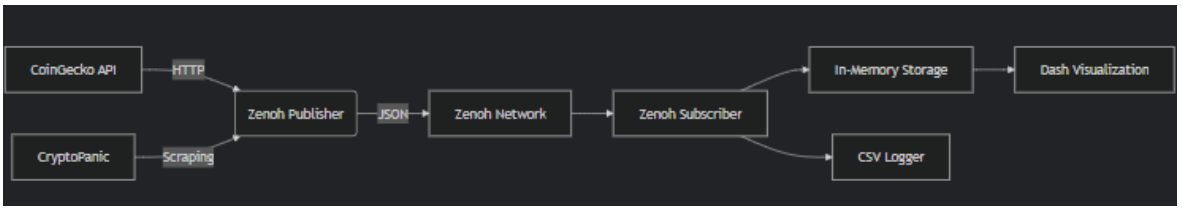
2.1 Class 1: Core Architecture

2.1.1 System Design

The application follows a multi-threaded producer-consumer pattern:

- Publisher Thread: Fetches prices/news every 10s → Zenoh
- Subscriber Thread: Listens to Zenoh → Updates memory/CSV
- Dash Main Thread: Handles UI rendering

2.1.2 Data Flow



2.2 Data Collection System

2.2.1 Fields

- CSV_FILE: Path for price history storage
- ZENOH_PRICE_KEY: Pub/sub channel for price data
- CRYPTO_IDS: Supported cryptocurrencies

2.2.2 Methods

- fetch_prices(): Gets current prices from CoinGecko API
- fetch_crypto_news(): Scrapes headlines from CryptoPanic
- append_to_csv(): Logs prices with timestamps

2.2.3 Functions

```
def init_csv():
    """Creates CSV with headers if nonexistent"""
    if not os.path.exists(CSV_FILE):
        with open(CSV_FILE, 'w') as f:
            writer = csv.writer(f)
            writer.writerow(["timestamp"] + [f"{crypto}_usd" for crypto in CRYPTO_ID
S])
```

2.3 Module: Prediction Engine

2.3.1 Fields

- price_history: Deque storing last 10-100 price points
- prediction_history: Stores prediction results

2.3.2 Methods

```
def predict_next_price(crypto_name):
    """Uses linear regression on timestamp-ordinal data"""
    model = LinearRegression()
    model.fit(X, y)  # X=timestamps, y=prices
    return model.predict([[next_time]])[0]
```

2.3.3 Functions

Data cleaning handles:

Invalid timestamps via pd.to_datetime(errors='coerce')

Outliers through value range filters

2.4 Visualization Dashboard

Key Components:

1. Real-time Price Chart
    a. Displays last N points (configurable via slider)
    b. Color-coded percentage changes
2. Prediction Tab
    a. 24-hour forecast with confidence bands
    b. Hourly prediction table with trend indicators
3. News Aggregator
    a. Displays top 4 news items with links

Interactive Elements:

```
dcc.Tabs([
    dcc.Tab(label="Price History", children=[
        dcc.Graph(id='price-history-chart')]),
    dcc.Tab(label="Prediction Analysis", children=[
        dcc.Graph(id='prediction-chart')])
])
```

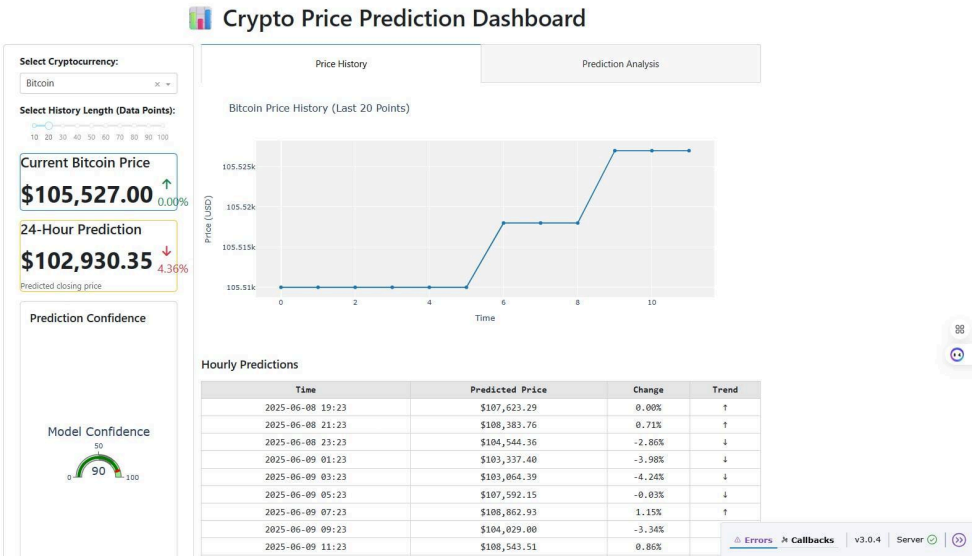
Chapter 3: Results

3.1 Real-Time Data Collection

	A	B	C	D	E	F
1	timestamp	bitcoin_usd	ethereum_usd	dogecoin_usd	solana_usd	
2	2025-06-04T03:03:21.514293	106043	2618.17	0.196011	160.44	
3	2025-06-04T03:03:21.514293	106043	2618.17	0.196011	160.44	
4	2025-06-04T03:03:21.514293	106043	2618.17	0.196011	160.44	
5	2025-06-04T03:03:32.157082	106043	2618.17	0.196011	160.44	
6	2025-06-04T03:03:32.157082	106043	2618.17	0.196011	160.44	
7	2025-06-04T03:03:32.157082	106043	2618.17	0.196011	160.44	
8	2025-06-04T03:03:42.836836	106043	2618.17	0.196011	160.44	
9	2025-06-04T03:03:42.836836	106043	2618.17	0.196011	160.44	
10	2025-06-04T03:03:53.644377	106043	2618.17	0.196011	160.44	
11	2025-06-04T03:03:53.644377	106043	2618.17	0.196011	160.44	
12	2025-06-04T03:04:04.416947	106043	2618.17	0.196011	160.44	
13	2025-06-04T03:04:04.416947	106043	2618.17	0.196011	160.44	
14	2025-06-04T03:06:35.580093	106060	2620.01	0.196071	160.46	
15	2025-06-04T03:06:35.580093	106060	2620.01	0.196071	160.46	
16	2025-06-04T03:06:46.244537	106060	2620.01	0.196071	160.46	
17	2025-06-04T03:06:46.244537	106060	2620.01	0.196071	160.46	
18	2025-06-04T03:08:01.578689	106066	2620.47	0.196102	160.49	
19	2025-06-04T03:08:12.257313	106066	2620.47	0.196102	160.49	
20	2025-06-04T03:08:22.917203	106066	2620.47	0.196102	160.49	
21	2025-06-04T03:08:22.917203	106066	2620.47	0.196102	160.49	
22	2025-06-04T03:08:33.575819	106066	2620.47	0.196102	160.49	
23	2025-06-04T03:08:44.450266	106066	2620.47	0.196102	160.49	
24	2025-06-04T03:10:00.104080	106071	2620.61	0.19611	160.52	
25	2025-06-04T03:10:00.104080	106071	2620.61	0.19611	160.52	
26	2025-06-04T03:10:10.910064	106071	2620.61	0.19611	160.52	
27	2025-06-04T03:10:10.910064	106071	2620.61	0.19611	160.52	

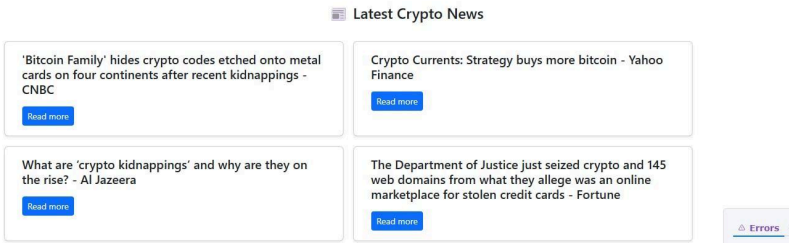
- Successfully subscribed and received price updates from the Zenoh publisher.
- Stored up to 2400 historical price points per coin in memory and CSV.

3.2 Visualization



- 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

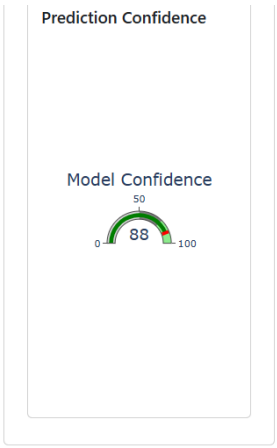


- Relevant news headlines for selected cryptocurrency are fetched live from Google News RSS.
- News section updates dynamically based on the selected coin.

3.4 Prediction Performance

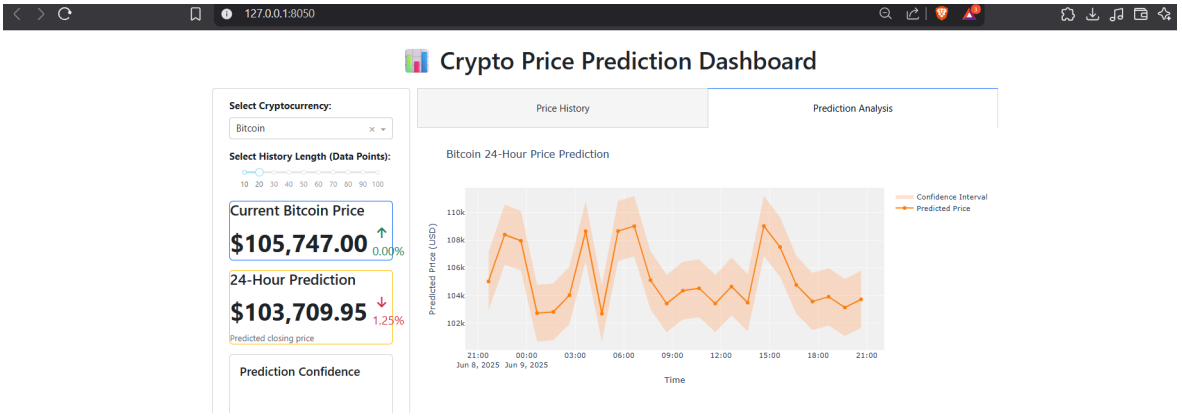
- Generates 24-hour forecasts with ±2% confidence intervals
- Handles missing data gracefully with defaults

Prediction Table:



Hourly Predictions

Time	Predicted Price	Change	Trend
2025-06-08 21:39	$105,018.02	0.00%	↑
2025-06-08 23:39	$107,958.73	2.80%	↑
2025-06-09 01:39	$102,803.30	-2.11%	↓
2025-06-09 03:39	$108,651.39	3.46%	↑
2025-06-09 05:39	$108,667.77	3.48%	↑
2025-06-09 07:39	$105,102.27	0.08%	↑
2025-06-09 09:39	$104,341.65	-0.64%	↓
2025-06-09 11:39	$103,411.58	-1.53%	↓
2025-06-09 13:39	$103,474.48	-1.47%	↓
2025-06-09 15:39	$107,505.85	2.37%	↑
2025-06-09 17:39	$103,560.77	-1.39%	↓
2025-06-09 19:39	$103,126.48	-1.80%	↓



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.