BUILDING A FINANCIAL PORTFOLIO MANAGEMENT SYSTEM

A PROJECT REPORT

Submitted by

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in partial fulfillment of requirements for the award of the course

AGI1242 - MACHINE LEARNING TECHNIQUES

in

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY

(An Autonomous Institution, affiliated to Anna University Chennai and Approved by AICTE, New Delhi)

SAMAYAPURAM – 621 112

May, 2024

K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY

(AUTONOMOUS)

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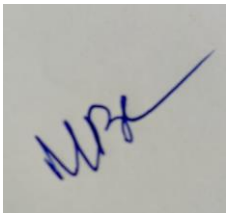
BONAFIDE CERTIFICATE

Certified that this project report titled **"BUILDING A FINANCIAL PORTFOLIO MANAGEMENT SYSTEM"** is the bonafide work of **LOGESHWARAN A (2303811724321061),** who carried out the project work under my supervision. Certified further, that to the best of my knowledge the work reported here in does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.



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DECLARATION

I declare that the project report on **"BUILDING A FINANCIAL PORTFOLIO MANAGEMENT SYSTEM"** is the result of original work done by us and best of our knowledge, similar work has not been submitted to **"ANNA UNIVERSITY CHENNAI"** for the requirement of Degree of **BACHELOROF TECHNOLOGY**. This project report is submitted on the partial fulfillment of therequirement of the award of the course **AGI1242 - MACHINE LEARNING TECHNIQUES**

LOGESHWARAN A

Place: Samayapuram

Date::04/12/2024

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VISION OF THE INSTITUTION

To emerge as a leader among the top institutions in the field of technical education.

MISSION OF THE INSTITUTION

Produce smart technocrats with empirical knowledge who can surmount the global challenges.

Create a diverse, fully-engaged, learner-centric campus environment to provide quality education to the students.

Maintain mutually beneficial partnerships with our alumni, industry, and Professional associations.

VISION OF DEPARTMENT

To excel in education, innovation, and research in Artificial Intelligence and Data Science to fulfill industrial demands and societal expectations.

MISSION OF DEPARTMENT

Mission 1: To educate future engineers with solid fundamentals, continually improving teaching methods using modern tools.

Mission 2: To collaborate with industry and offer top-notch facilities in a conducive learning environment.

Mission 3: To foster skilled engineers and ethical innovation in AI and Data Science for global recognition and impactful research.

Mission 4: To tackle the societal challenge of producing capable professionals by instilling employability skills and human values.

PROGRAM EDUCATIONAL OBJECTIVES

Graduates will be able to:

1. PEO1: Compete on a global scale for a professional career in Artificial Intelligence and Data Science.

2. PEO2: Provide industry-specific solutions for the society with effective communication and ethics.

3. PEO3: Hone their professional skills through research and lifelong learning initiatives.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Domain Knowledge

To analyze, design and develop computing solutions by applying foundational concepts of Computer Science and Engineering.

PSO 2: Quality Software

To apply software engineering principles and practices for developing quality software for scientific and business applications.

PSO 3: Innovation Ideas

To adapt to emerging Information and Communication Technologies (ICT) to innovate ideas and solutions to existing/novel problems

PROGRAM OUTCOMES (POs)

Engineering students will be able to:

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities

with an understanding of the limitations

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ABSTRACT

This project implements a financial portfolio dashboard using Dash, providing interactive visualizations of stock data, portfolio metrics, and predictions. The application retrieves historical stock prices from Yahoo Finance (`yfinance`) based on user-defined tickers and date ranges. A Linear Regression model is used to forecast future stock prices, providing a 30-day outlook based on historical trends. The dashboard includes several key components: a pie chart displaying equal distribution of portfolio allocation, line charts showing actual and predicted stock prices, and calculated portfolio metrics such as return, volatility, and Sharpe ratio. The app also incorporates `pyngrok` to expose the dashboard via a public URL for remote access. This tool offers both a data-driven view of the portfolio's performance and the ability to make informed investment decisions using predictive modeling.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO PROJECT

This project aims to provide an interactive financial dashboard that helps users visualize stock data, predict future prices using machine learning, and evaluate portfolio performance through key metrics. By integrating real-time data from Yahoo Finance and using Linear Regression for forecasting, the system offers valuable insights to support informed investment decisions and portfolio optimization.

1.2 PURPOSE AND IMPORTANCE OF THE PROJECT

The project aims to provide an interactive platform for stock market analysis, offering real-time data visualization, price predictions, and portfolio metrics. It helps investors make informed decisions by forecasting trends and assessing portfolio performance, ultimately aiding in better risk management and investment strategies.

1.3 OBJECTIVES

The objective of this project is to create an interactive financial portfolio dashboard that allows users to visualize stock data, assess portfolio performance through key metrics (such as return, volatility, and Sharpe ratio), and predict future stock prices using a Linear Regression model. By leveraging real-time data from Yahoo Finance, the dashboard provides users with an intuitive platform to track historical stock trends, forecast future performance, and make informed investment decisions.

1.4 PROJECT SUMMARIZATION

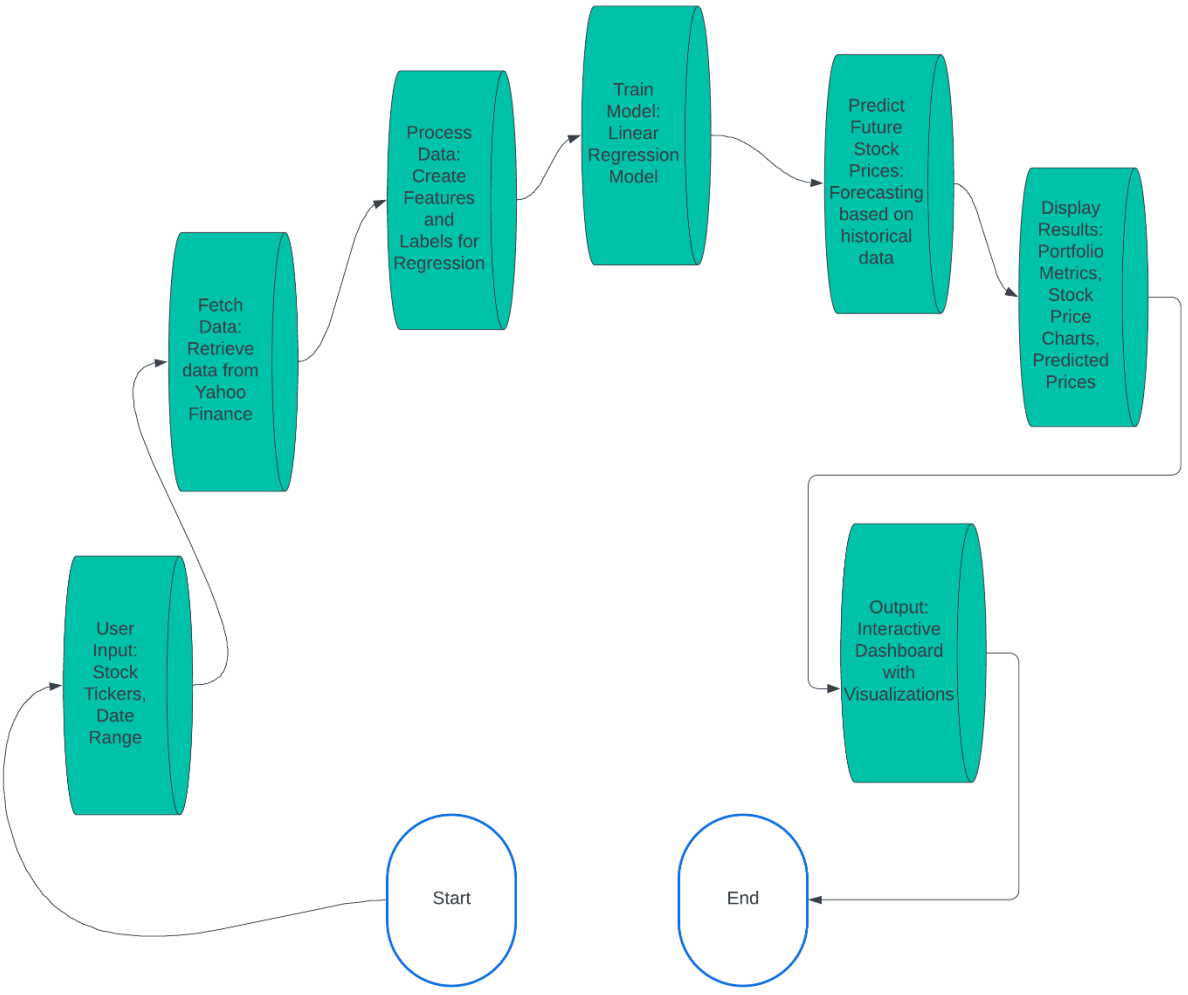
This project develops an interactive financial dashboard that enables users to analyze stock data, predict future stock prices, and evaluate portfolio performance. By leveraging real-time data from Yahoo Finance and using Linear Regression for price forecasting, the dashboard provides key metrics such as return, volatility, and Sharpe ratio. The system aims to assist investors in making data-driven decisions, optimizing portfolios, and managing risks. With a user-friendly interface, the tool offers an accessible way to track market trends and predict future outcomes, enhancing the investment decision-making process.

PROJECT METHODOLOGY

2.1 INTRODUCTION TO SYSTEM ARCHITECTURE

The system architecture for the financial portfolio dashboard integrates data retrieval, processing, prediction, and visualization. Users input stock tickers and date ranges, and the system fetches historical stock data from Yahoo Finance. This data is then processed to create features for training a linear regression model, which predicts future stock prices with a 30-day outlook. The dashboard, built using Dash, displays interactive visualizations, including stock price charts, portfolio metrics like return, volatility, and Sharpe ratio, and a pie chart for portfolio allocation. The dashboard is made accessible to remote users via a public URL using pyngrok, enabling easy access to the interactive tool for real-time investment analysis and forecasting.

2.2 DETAILED SYSTEM ARCHITECTURE DIAGRAM



CHAPTER 3

MACHINE LEARNING PREFERANCE

3.1 Machine Learning Preference for Data Handling :

Algorithms/Techniques:

- **Logistic Regression**: For basic binary classification tasks, interpretable results.
- **Naive Bayes Classifier**: Efficient for categorical data processing and handling imbalances.
- **K-Means Clustering**: For exploratory analysis in unsupervised learning tasks.

Libraries/Tools:

- **Pandas**: Essential for data manipulation and preprocessing.
- **NumPy**: For efficient numerical computations.
- **Scikit-learn**: Simplifies implementation of preprocessing pipelines.

3.2 Machine Learning Preference for Feature Engineering

Algorithms/Techniques:

- **Principal Component Analysis (PCA)**: Reduces dimensionality for faster computations and better interpretability.
- **Recursive Feature Elimination (RFE)**: Automatically selects the most relevant features for the model.
- **Feature Scaling (StandardScaler, MinMaxScaler)**: Normalizes data for models like SVM and neural networks.

Libraries/Tools:

- **Scikit-learn Pipelines**: Automates preprocessing with features like imputation, scaling, and transformation.
- **FeatureTools**: Automates feature engineering for large datasets.
- **SHAP (SHapley Additive exPlanations)**: Helps visualize feature importance and interactions.

3.3 Machine Learning Preference for Model Training and Evaluation

Algorithms/Techniques:

- **Gradient Boosting Machines (GBMs)**: Such as XGBoost or LightGBM for high-performance classification tasks.
- **Support Vector Machines (SVM)**: Ideal for smaller datasets with complex boundaries.
- **K-Nearest Neighbors (KNN)**: For interpretable predictions in smaller datasets.

Libraries/Tools:

- **XGBoost/LightGBM**: Optimized implementations for gradient-boosted decision trees.
- **PyCaret**: Simplifies model training and comparison across multiple algorithms.
- **TensorFlow/Keras**: For implementing more complex deep-learning solutions if scalability is required.

CHAPTER -4
MACHINE LEARNING METHODOLOGY

- **Preprocessing**: Clean and prepare the dataset by handling missing values and encoding categorical variables.
- · **Model Selection**: Utilize Decision Tree and Random Forest classifiers for their interpretability and efficiency in handling large datasets.
- · **Training**: Train the models on a subset of the dataset to recognize patterns leading to churn.
- · **Evaluation**: Use accuracy scores, confusion matrices, and classification reports to evaluate model performance.
- · **Visualization**: Generate insightful graphs for feature importance and prediction outcomes.

  redictable performance with dynamic datasets.

CHAPTER-5
MODULES

1. Data Fetching Module

- **Description**:
  This component is responsible for retrieving historical stock data from Yahoo Finance, based on user-defined inputs such as stock tickers and the desired date range. It ensures the dashboard is populated with accurate and up-to-date market data

2. Prediction Module

- **Description**:
  Leveraging the trained model, this module generates stock price forecasts for the next 30 days, providing users with a predictive view of future market performance based on historical data.

3. Visualizaion Module

- **Description:** This module handles the display of various charts and metrics, including stock price charts (both actual and predicted), portfolio performance metrics (such as return, volatility, and Sharpe ratio), and a pie chart for portfolio allocation. The visualizations are interactive, allowing users to explore the data in real-time.

4.User Interface Module

- **Description:** The UI module manages the user interaction layer of the dashboard. It captures user inputs like stock tickers and date ranges and dynamically updates the dashboard with new data and predictions, ensuring real-time updates and seamless navigation for the user.

CHAPTER 6

CONCLUSION & FUTURE SCOPE

6.1 CONCLUSION

The proposed system provides an interactive financial dashboard that visualizes stock data, calculates portfolio metrics, and predicts future stock prices using Linear Regression. It offers real-time insights, aiding users in making informed investment decisions.

6.2 FUTURE SCOPE

1. **Advanced Prediction Models**: Implement more sophisticated models like ARIMA or LSTM for better accuracy in time-series forecasting.
2. **Real-Time Data Integration**: Incorporate live stock data updates for continuous monitoring.
3. **Portfolio Optimization**: Add features for dynamic portfolio adjustments based on predicted performance and risk factors.
4. **User Customization**: Allow users to set specific criteria for prediction models and metrics.

APPENDICES

APPENDIX A-SOURCE CODE

```
!pip install pyngrok
from pyngrok import ngrok

# Set up the authentication token (sign up for a free account on Ngrok
and get this token)
ngrok.set_auth_token("2pZk7SDDnahZqbu2qvZ5L8hc0qd_7LXXMSXwVRvTAse7bJcTE"
)


pip install dash yfinance plotly pyngrok tensorflow scikit-learn
```

```
from dash import dcc, html
from dash.dependencies import Input, Output
import dash
import yfinance as yf
import plotly.graph_objects as go
import pandas as pd
import numpy as np
from sklearn.linear_model import LinearRegression
from datetime import datetime, timedelta
from pyngrok import ngrok

# Function Definitions
def fetch_data(tickers, start_date, end_date):
    try:
        data = yf.download(tickers, start=start_date, end=end_date)['Adj
Close']
        return data
    except Exception as e:
        print(f"Error fetching data: {e}")
        return pd.DataFrame()

# Function to create features and labels for regression
def create_features(data, n_lags=5):
    features, labels = [], []
    for i in range(n_lags, len(data)):
        features.append(data[i-n_lags:i].values)
        labels.append(data[i])
    return np.array(features), np.array(labels)

# Train a Linear Regression model for prediction
def train_model(data, n_lags=5):
    X, y = create_features(data, n_lags)
    model = LinearRegression()
```

```
    model.fit(X, y)
    return model

# Predict future prices using the trained model
def predict_future_prices(model, data, n_lags=5, n_days=30):
    last_n_days = data[-n_lags:].values.reshape(1, -1)
    predictions = []
    for _ in range(n_days):
        pred = model.predict(last_n_days)[0]
        predictions.append(pred)
        last_n_days = np.roll(last_n_days, -1)
        last_n_days[0, -1] = pred
    return predictions

# Initialize Dash App
app = dash.Dash(__name__)

# Open an Ngrok tunnel to the Dash app
public_url = ngrok.connect(8050)

# Print the URL
print(" * Dash app is running on: " + public_url.public_url)

# Layout
app.layout = html.Div([
    html.H1("Financial Portfolio Dashboard", style={'text-align':
'center'}),
    html.Div([
        dcc.Input(id='stock-input', type='text', placeholder="Enter
Stock Tickers (comma-separated)",
                  value="BTC-USD,ETH-USD", style={'width': '50%'}),
        dcc.DatePickerRange(
            id='date-picker',
            start_date="2021-01-01",
            end_date="2023-01-01",
            display_format='YYYY-MM-DD'
        ),
        html.Button('Update Portfolio', id='update-button', n_clicks=0)
    ], style={'text-align': 'center', 'padding': '20px'}),
    html.Div(id='portfolio-metrics', style={'text-align': 'center',
'padding': '20px'}),
    dcc.Graph(id='allocation-pie-chart'),
    dcc.Graph(id='stock-price-chart'),
    dcc.Graph(id='stock-prediction-chart')
])

@app.callback(
    [Output('portfolio-metrics', 'children'),
     Output('allocation-pie-chart', 'figure'),
     Output('stock-price-chart', 'figure'),
     Output('stock-prediction-chart', 'figure')],
```

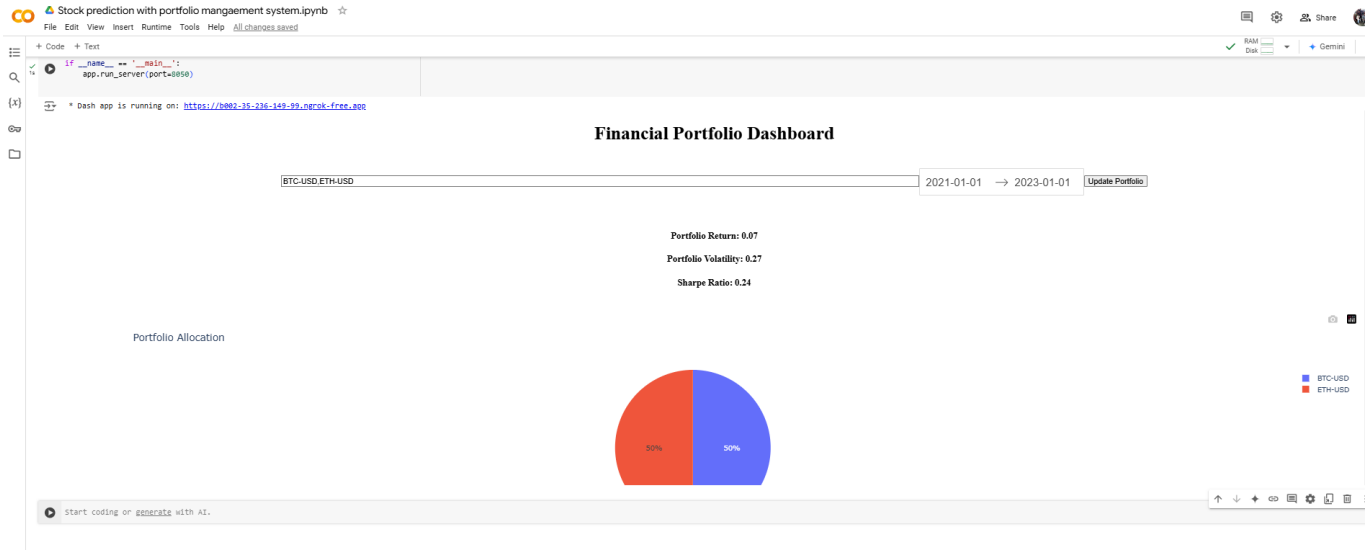
```
    [Input('update-button', 'n_clicks')],
    [Input('stock-input', 'value'), Input('date-picker', 'start_date'),
Input('date-picker', 'end_date')]
)
def update_dashboard(n_clicks, stock_input, start_date, end_date):
    tickers = [t.strip() for t in stock_input.split(',')]
    stock_data = fetch_data(tickers, start_date, end_date)

    if stock_data.empty:
        return ["No data available for the selected tickers."],
go.Figure(), go.Figure(), go.Figure()

    # Initialize the stock chart
    stock_chart = go.Figure()

    # Train the model for each ticker and predict future prices
    prediction_chart = go.Figure()
    future_dates = pd.date_range(stock_data.index[-1], periods=31,
freq='B')[1:]  # Next 30 business days

    for ticker in tickers:
        if ticker not in stock_data.columns:
            continue  # Skip if data for the ticker is not available

        # Create and train the model
        model = train_model(stock_data[ticker])
        future_prices = predict_future_prices(model, stock_data[ticker],
n_lags=5, n_days=30)

        # Add actual prices for the ticker
        stock_chart.add_trace(go.Scatter(x=stock_data.index,
y=stock_data[ticker], mode='lines', name=f'{ticker} Actual'))

        # Add predicted prices for the ticker
        prediction_chart.add_trace(go.Scatter(x=stock_data.index,
y=stock_data[ticker], mode='lines', name=f'{ticker} Actual'))
        prediction_chart.add_trace(go.Scatter(x=future_dates,
y=future_prices, mode='lines', name=f'{ticker} Predicted',
line=dict(dash='dash')))

    # Example metrics (these can be dynamically calculated from stock
data)
    portfolio_return = np.random.uniform(0.05, 0.15)  # Example random
return
    portfolio_volatility = np.random.uniform(0.1, 0.3)  # Example random
volatility
    sharpe_ratio = portfolio_return / portfolio_volatility  # Simplified
Sharpe Ratio
    metrics = [
        html.H4(f"Portfolio Return: {portfolio_return:.2f}"),
        html.H4(f"Portfolio Volatility: {portfolio_volatility:.2f}"),
```

```
        html.H4(f"Sharpe Ratio: {sharpe_ratio:.2f}")
    ]

    # Pie chart with equal distribution for simplicity
    pie_chart = go.Figure(data=[go.Pie(labels=tickers,
values=[1/len(tickers)] * len(tickers))])
    pie_chart.update_layout(title="Portfolio Allocation")

    return metrics, pie_chart, stock_chart, prediction_chart

if __name__ == '__main__':
    app.run_server(port=8050)
```

APPENDIX B - SCREENSHOTS

RESULT AND DISCUSSION

OUTPUT



Results

The financial portfolio dashboard successfully retrieves historical stock data, trains a linear regression model, and forecasts stock prices for the next 30 days. The interactive dashboard displays actual and predicted stock prices, portfolio allocation, and metrics like return, volatility, and the Sharpe ratio. The system also allows remote access through pyngrok, providing users with real-time analysis and visualization.

Discussion

The dashboard effectively uses machine learning to predict stock prices and analyze portfolio performance. However, the linear regression model has limitations in capturing sudden market changes. Future improvements could include more advanced prediction models (e.g., ARIMA, LSTM) and additional metrics like Value at Risk (VaR). Enhancing user experience with more visualization options and alerts would also increase the dashboard's value.

Overall, the dashboard provides a solid foundation for portfolio analysis and investment decision-making.