Enhanced Portfolio Optimization (EPO): A Quantitative Approach for Automated Stock Analysis and Strategy Engineering

Prof. Ashish Katore[1], Mr. Swapnil Thakre[2], Shweta Singh[3]
[1]*Assistant Professor, Department of Electronics and Telecommunication Engineering, G H Raisoni College of Engineering and Management, Nagpur, India*
[2]*CEO, Pegasus Technologies and Software Pvt Ltd., Nagpur, India*
[3]*Student, Department of Electronics and Telecommunication Engineering, G H Raisoni College of Engineering and Management, Nagpur, India*
doi.org/10.64643/IJIRTV12I12-201136-459

Abstract: In today's fast-paced financial markets, manual stock analysis is becoming increasingly inefficient due to the large volume of data and rapid market fluctuations.
This paper presents an automated system based on Enhanced Portfolio Optimization (EPO) that integrates quantitative analysis and strategy engineering for effective stock monitoring and decision-making. The system utilizes real-time market data, processes it using Duck DB, and applies rule-based trading strategies to generate automated signals.
It minimizes human error, removes emotional bias, and ensures scalable analysis across multiple stocks.
Performance metrics such as profit and loss, win-rate, and drawdown are used to evaluate system efficiency. The proposed solution demonstrates improved speed, consistency, and accuracy in trading decisions.

I. INTRODUCTION

With the increasing complexity of financial markets, traditional methods of stock analysis are no longer sufficient.

Manual approaches often involve interpreting charts, tracking indicators, and making decisions based on experience, which leads to delays and inconsistencies.

The Enhanced Portfolio Optimization (EPO) system is designed to address these challenges by automating the analysis process.

It integrates quantitative methods with engineering tools to process real-time data and generate structured trading signals. The system aims to improve efficiency, reduce manual effort, and provide consistent decision-making.

II. BUSINESS CONTEXT AND OBJECTIVE

The stock market requires continuous monitoring and quick decision-making.
Investors and analysts often struggle with managing multiple stocks simultaneously and maintaining consistency in strategies. Objectives of the Project:

- To develop an automated system for stock analysis
- To implement quantitative strategies for decision-making
- To reduce human errors and emotional bias
- To enable real-time monitoring of multiple stocks
- To track performance using structured metrics

III. DATASET AND METADATA

The proposed system uses real-time and historical stock market data from NSE-based sources.

The dataset consists of time-series data where each record represents the price movement of a stock at a specific time interval.

A. Dataset Description

The dataset includes key attributes such as:

- Open, High, Low, Close prices
- Volume
- Date/Time (timestamp)

These values are used for candlestick chart formation and technical analysis.

B. Data Source and Processing

The data is collected in CSV format and processed using Duck DB for fast querying and structured analysis. Real-time updates ensure the system reflects current market conditions.

C. Metadata

Metadata defines the structure and meaning of the dataset, including:

- Data types (numeric, timestamp)
- Column definitions
- Data frequency (daily/intraday)

It helps maintain consistency and efficient data handling.

D. Data Preprocessing

Basic preprocessing steps include:

- Handling missing values
- Formatting timestamps
- Sorting data

These steps ensure accurate analysis and reliable results.

E. Role in System

The dataset supports chart generation, indicator calculation, strategy execution, and performance tracking, making it essential for the automated system

IV. METHODOLOGY

A. Data Preparation

The system collects and organizes stock market data into structured formats. Data cleaning and validation are performed to maintain accuracy.

B. Feature Design

Key features implemented include:

- Candlestick chart generation
- Moving average calculation
- CPR (Central Pivot Range) analysis
- Signal generation (Buy/Sell/Hold)

C. System Development

The system is developed using a combination of tools:

- Frontend: Visualization tools (Grafana)
- Backend: Python-based logic processing
- Database: Duck DB for fast querying

The architecture ensures smooth data flow and real-time processing.

V. PROPOSED SYSTEM

The proposed system is an automated stock analysis framework that integrates data processing, strategy engineering, and visualization.

System Workflow:

1.Real-time market data is collected
2.Data is processed using Duck DB
3.Quantitative strategies are applied
4.Trading signals are generated
5.Results are stored and visualized

The system follows a rule-based approach:

- Buy signal when conditions are satisfied
- Sell signal when conditions fail
- Hold signal otherwise

The architecture ensures scalability and efficient handling of multiple stocks.

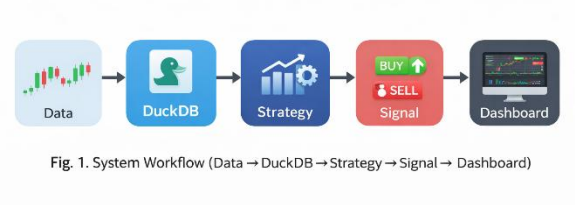

Fig. 1. System workflow

VI. EXPECTED RESULTS AND BUSINESS IMPACT

The proposed system improves stock analysis efficiency by automating the decision-making process using real-time data and rule-based strategies.

By reducing dependence on manual analysis, it minimizes human errors and enhances accuracy. The system enables faster market response, supports scalable analysis across multiple stocks, and strengthens risk management through structured rules. Additionally, it provides better performance tracking using metrics like P&L, win-rate, and drawdown,

ultimately leading to more consistent and reliable trading decisions.

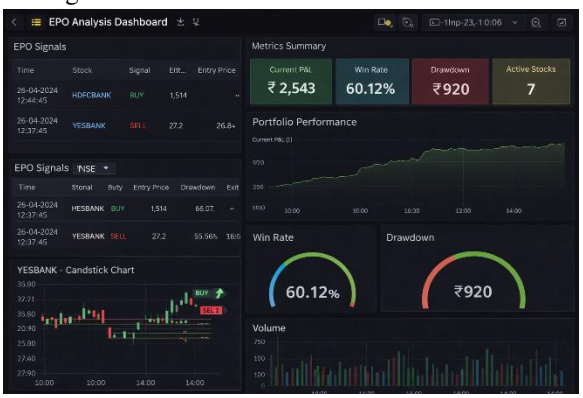

Fig. 2. Dashboard

VII. CONCLUSION

This paper presents the Enhanced Portfolio Optimization (EPO) system as an effective solution for automated stock analysis and decision-making.

The system addresses key challenges of manual trading by providing a structured, data-driven, and real-time approach using quantitative strategies and automation. The project demonstrates how engineering tools and financial concepts can be integrated to improve trading efficiency, accuracy, and consistency. The system has the potential to enhance performance tracking, risk management, and multi-stock analysis, making it suitable for modern financial applications.

The author thanks Mr. Swapnil Thakre, CEO, Pegasus Technologies and Software Pvt. Ltd., for internship supervision and industry guidance.

The author also thanks Prof. Ashish Katore, G H Raisoni College of Engineering and Management, Nagpur, for academic guidance and continuous support throughout the research work.

REFERENCES

[1] L. Mantshimuli, "Sentiment-Aware Portfolio Optimization Using Deep Reinforcement Learning," IEEE Access, 2025.

[2] G. Kalaiarasan et al., "Deep Learning Framework for Stock Prediction and Portfolio Optimization," IEEEAccess, 2025.

[3] A. Kamath et al., "Cumulative Prospect Theory and SVM Approach for Portfolio Optimization," IEEE MoSICom Conference, 2025.

[4] J. D. Das et al., "Machine Learning for Dynamic Portfolio Optimization," IEEE Conference on Financial Engineering, 2025.

[5] V. Bulani et al., "Portfolio Management using Particle Swarm Optimization," Mathematics Journal, 2025.

[6] S. Huang, "Integration of Machine Learning in Portfolio Optimization," Applied and Computational Engineering, 2024.