QuantEdge

Submitted in partial fulfillment of the requirements of the course Innovative Product Development-III

Year 3, Sem V Computer Engineering

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Designation

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DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
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University of Mumbai
2024 – 2025

CERTIFICATE

This is to certify that the project entitled **"QuantEdge"** is a bonafide work of **"Vea Ranawat (60004220235), Parth Mehta (60004220154), Purvesh Maniar (60004220254), Shanay Jariwala (60004220212) "** submitted as a project work for the course **Innovative Product Development-III, Year 3, Semester V, TY B. Tech Computer Engineering**

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IPD Project Report Approval for BTech Semester V

This project report entitled ***QuantEdge*** by ***Vea Ranawat, Parth Mehta, Purvesh Maniar, Shanay Jariwala*** is approved for the **Innovative Product Development-III, Year 3, Semester V, TY B. Tech Computer Engineering**

Examiners

1.----------

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Date:

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Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included. We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

QuantEdge is a comprehensive algorithmic trading platform designed to empower users with access to advanced financial strategies, making algorithmic trading more accessible and efficient. The platform is primarily focused on retail traders, portfolio managers, and institutional investors looking to enhance their trading performance using quantitative analysis and automated decision-making systems. By offering a user-friendly interface, robust backend architecture, and integration with global financial markets, QuantEdge aims to streamline the complex process of strategy formulation, execution, and risk management in algorithmic trading.

The core feature of QuantEdge is its ability to provide a wide array of pre-built and customizable trading strategies that cater to different market conditions and risk appetites. Users can choose from a variety of strategies such as mean reversion, momentum, trend-following, and others, or create and fine-tune their own algorithms. The platform's real-time data feeds and backtesting capabilities allow users to evaluate their strategies on historical market data before deploying them in live environments. This helps in ensuring that the strategies are robust and profitable over time.

One of the significant advantages of QuantEdge is its emphasis on transparency. Unlike traditional investment products, where investors may not have a clear understanding of the underlying decisions, QuantEdge offers full visibility into the algorithms and strategies being used. This transparency fosters trust and enables users to make informed decisions. Additionally, the platform integrates advanced risk management tools, such as Value at Risk (VaR) and stop-loss mechanisms, to mitigate potential losses while maximizing returns. The platform also supports multi-asset class trading, allowing users to execute strategies across equities, commodities, currencies, and more.

The project involves a combination of machine learning models and traditional statistical methods to build predictive models that can forecast market trends and make buy/sell decisions. By leveraging the power of these models, QuantEdge ensures that the trades are executed at optimal times, thereby enhancing profitability. Additionally, the platform features a risk analytics dashboard, where users can monitor portfolio performance, track real-time market data, and receive alerts for potential risks.

The backend architecture of QuantEdge is built to handle large volumes of market data and execute trades at high speed. This is achieved through the use of advanced cloud infrastructure and low-latency APIs, which ensure seamless integration with brokers and exchanges. The database system supports real-time updates of market data, strategies, trades, and user activity logs, enabling comprehensive analysis and reporting.

The system’s design is based on microservices, allowing for scalability and flexibility. This ensures that QuantEdge can support a growing user base and adapt to future advancements in financial technologies. As the platform continues to evolve, future enhancements will focus on incorporating artificial intelligence (AI) for predictive analytics, expanding its market coverage, and refining the risk management tools. Additionally, QuantEdge plans to integrate with more brokerages and global financial exchanges, providing users with greater access to diverse markets.

In conclusion, QuantEdge represents a significant advancement in the democratization of algorithmic trading. By offering powerful tools, an intuitive interface, and comprehensive risk management features, the platform empowers users to participate in high-frequency, data-driven trading, thus improving their chances of achieving superior returns.

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List of Abbreviations

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Sr. No.	Abbreviation	Expanded form
i	DSS	Decision Support System
ii	VaR	Value at risk
iii	BB	Ballingon Band
iv	RSI	Relative Strength Index
v	ERD	Entity Relationship Diagram
vi.	PnL	Profit and Loss

1. INTRODUCTION

The financial markets are fast-paced and driven by data, where timely decision-making determines profitability. Algorithmic trading, which uses computer programs to execute trades based on predefined strategies, has transformed financial markets by eliminating human emotions and ensuring precision.

QuantEdge is an advanced algorithmic trading platform designed to empower retail and institutional investors by leveraging technology to automate trading strategies. By combining real-time market data with quantitative models, it facilitates precise, data-driven decision-making, reducing human error and emotion-driven trading.

2. NEED OF THE PRODUCT

2.1 Why is the product needed?

The need for QuantEdge stems from several challenges faced by traders and financial institutions in traditional or semi-automated trading systems:

1. Scalability of Human Effort:
   Manual trading methods struggle with processing large volumes of data across multiple asset classes in real-time.
2. Speed and Precision:
   With market conditions changing within milliseconds, algorithmic trading ensures execution speed that human intervention cannot match.
3. Minimizing Emotional Bias:
   Emotions such as fear and greed often lead to poor trading decisions. Algorithms are immune to such biases.

2.2 Drawbacks of Existing Systems

Sr No	Existing Platform	Identified gaps
1	Platforms like MetaTrader and Interactive Brokers require programming knowledge for custom strategies	Non-technical users face difficulty in designing or modifying algorithms without coding expertise
2	Risk Management Tools are limited	Lack of dynamic, automated risk controls like VaR
3	Delays in deploying strategies, especially for live trading.	Real-time deployment capabilities are absent, increasing latency and reducing efficiency.

2.3 Applications of the Product

QuantEdge is designed for broad applications, ensuring value across different user bases:

1. **Retail Traders**:
   Provides access to automated trading tools to optimize small-scale investments.
2. **Institutional Investors**:
   Offers scalable strategy testing and execution for large portfolios.
3. **Education**:
   A valuable resource for students and researchers studying quantitative finance.

3. SURVEYS

3.1 Field Survey

The field survey involved interviews, focus groups, and online questionnaires. Participants included retail investors, financial analysts, and portfolio managers.

Key Findings:

- **User Priorities**:
    - 75% prioritized ease of use.
    - 68% wanted comprehensive backtesting tools.
    - 45% highlighted the importance of real-time risk alerts.
- **User Concerns**:
    - High costs of existing platforms.
    - Lack of user-friendly customization.

3.2 Literature Survey

Sr No.	Paper Titles	Authors	Key Findings
1	A study on Algorithm Trading/High Frequency Trading	National Institue of Financial Management	Comprehensive review on algorithmic trading and high frequency trading
2	Machine Learning in Asset Management - Trading Strategies	Derek Snow	Each trading strategy can end up using multiple machine learning frameworks. The author highlights nine different trading varieties of these learning framework
3	A Study on Algorithmic Trading	Philip Hagg	How to evaluate algorithms

3.3 Outcome of Survey

1. There is significant interest in an affordable, easy-to-use algorithmic trading platform.
2. Risk management features are non-negotiable for most traders.
3. Users value transparency in how algorithms execute trades.

4. PROBLEM FORMULATION

4.1. Problem Formulation

1) Democratizing Algorithmic Trading

Algorithmic trading, traditionally the domain of large financial institutions, requires significant technical expertise and access to expensive resources. This exclusivity has created a disparity where small traders cannot compete with institutional players.

QuantEdge seeks to level the playing field by providing:

- Affordable Access: Offering institutional-grade tools at a fraction of the cost.
- User-Friendly Interfaces: Intuitive designs that remove the complexity of coding strategies.
- Comprehensive Features: Access to advanced trading algorithms, real-time data, and broker integrations that were previously out of reach for retail investors.

2) Simplifying Strategy Design and Deployment for Non-Experts

The majority of algorithmic trading platforms require users to have a deep understanding of programming languages like Python, R, or Java. This poses a significant barrier to entry for traders who lack technical backgrounds.

3) QuantEdge embeds robust risk management capabilities to address this issue:

- Automated Stop-Loss and Take-Profit Mechanisms: Users can set predefined thresholds to exit trades automatically, ensuring losses are minimized and profits secured.
- Dynamic Risk Adjustment: The platform can adjust trade sizes dynamically based on market volatility or user-defined rules.

- Real-Time Risk Monitoring: A dedicated dashboard provides a live view of key metrics like portfolio exposure, Value at Risk (VaR), and potential drawdowns.

4.2 Product Objectives

1. Ease of Use: Allow users to create strategies without coding.
2. Real-Time Data: Provide live market feeds for decision-making.
3. Transparency: Detailed logs for trade execution and performance analysis.
4. Risk Management: Tools like stop-loss, take-profit, and portfolio hedging.

4.3 Novelty

Sr No.	Identified Gap	Resolution
1	Non-intuitive interfaces	Drag-and-Drop Strategy Builder: Allows non-technical users to build strategies visually.
2	High costs for premium tools	Offer affordable subscription plans with a freemium model for basic users and premium options for advanced users.
3	Lack of advanced risk management tools	Include dynamic risk monitoring and automated stop-loss adjustments based on market conditions.

5. Proposed Design

5.1 Proposed Model

Frontend:

1. Dashboards displaying portfolio metrics, strategy performance, and market trends.
2. Visual strategy builders for drag-and-drop creation of trading algorithms.
3. Real-time data visualization tools like candlestick charts and heatmaps.
4. Notifications for risk alerts and execution updates.
5. Technology Stack: React.js/HTML/CSS/Javascript for responsive and dynamic UIs, integrated with RESTful APIs for backend communication.

Backend:

6. Strategy Engine: Interprets and executes user-designed strategies in real-time or during backtesting.
7. Data Processor: Handles ingestion and preprocessing of live and historical market data.
8. Broker Integration API: Enables trade execution by connecting with broker systems.
9. Risk Management Module: Monitors positions and triggers safety mechanisms like stop-loss or hedging actions.
10. Technology Stack: Python (for numerical computations), Flask/Django (API handling), Kafka for real time processing, Firebase for authentication

5.2 Database Design

1. Centralized storage for user data, strategies, trade logs, and market data snapshots.
2. Requirements: High availability and speed to ensure real-time performance.
3. Technology Stack: PostgreSQL or MySQL for structured data
4. Entity-Relationship Diagram (ERD)

- Users: Represents individual traders or portfolio managers. Attributes include UserID, Name, Email, PasswordHash, and Role.

- Market Data: Stores real-time and historical prices for various instruments. Attributes include Symbol, Timestamp, Open, Close, High, Low, and Volume.
- Strategies: Contains user-designed or system-provided algorithms. Attributes include StrategyID, UserID, StrategyName, and LogicDescription.
- Trades: Logs all trades executed by users. Attributes include TradeID, UserID, StrategyID, Symbol, TradeType, Quantity, and ExecutionPrice.
- Risk Logs: Tracks risk events and mitigations. Attributes include LogID, UserID, PortfolioID, EventType, EventDetails, and Timestamp.

5.3. Use cases

1. Retail Trader Use Case

- Objective: Enable retail traders to easily access algorithmic trading without technical expertise.
- Steps:
    1. Logs in using secure credentials.
    2. Navigates to the strategy builder and selects a pre-built template (e.g., Moving Average Crossover).
    3. Customizes the parameters such as moving average windows and execution volume.
    4. Backtests the strategy using historical data.
    5. Deploys the strategy in live markets, monitoring performance via a real-time dashboard.
    6. Receives notifications for any risk events (e.g., Stop-Loss triggered).

2. Portfolio Manager Use Case

- Objective: Enable portfolio managers to handle complex portfolios with advanced strategies and real-time risk monitoring.
- Steps:
    1. Logs in with administrative access.
    2. Creates or imports multiple strategies to manage diverse portfolios.
    3. Integrates external market feeds for a comprehensive view of risk factors.

4. Monitors key metrics such as Value at Risk (VaR), drawdowns, and sectoral exposures in real-time.
5. Takes immediate action, such as hedging or rebalancing, based on risk alerts triggered by the platform.

6. IMPLEMENTATION

6.1. GUI design

fig 6.1

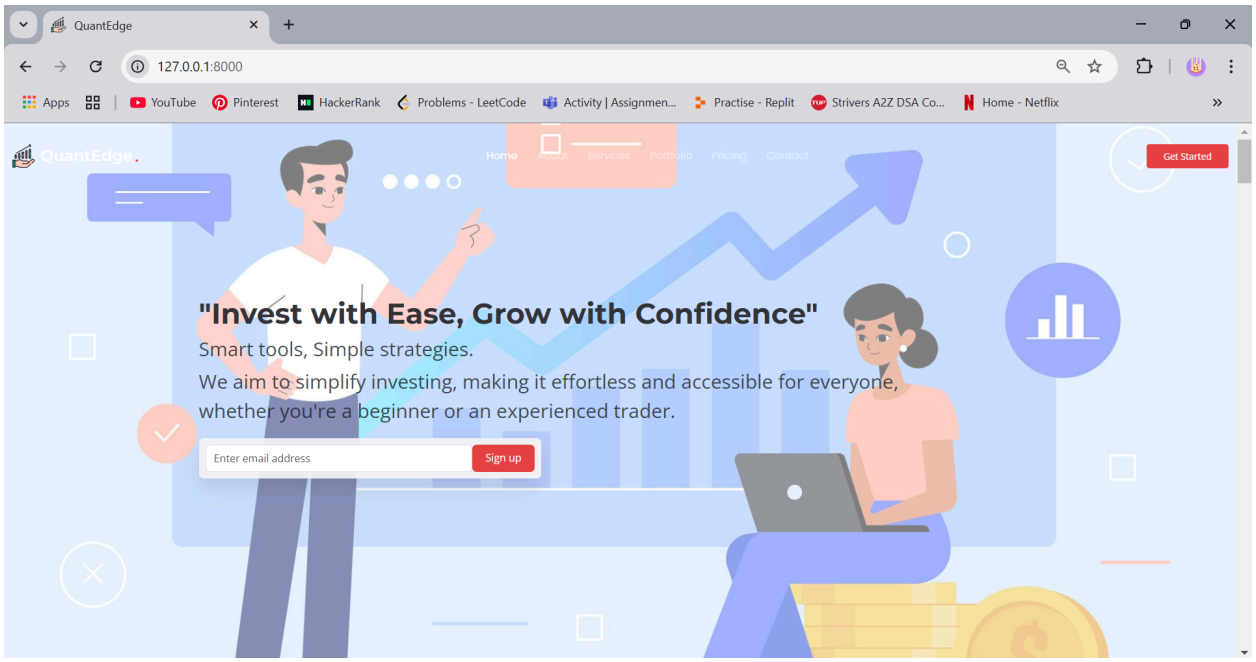
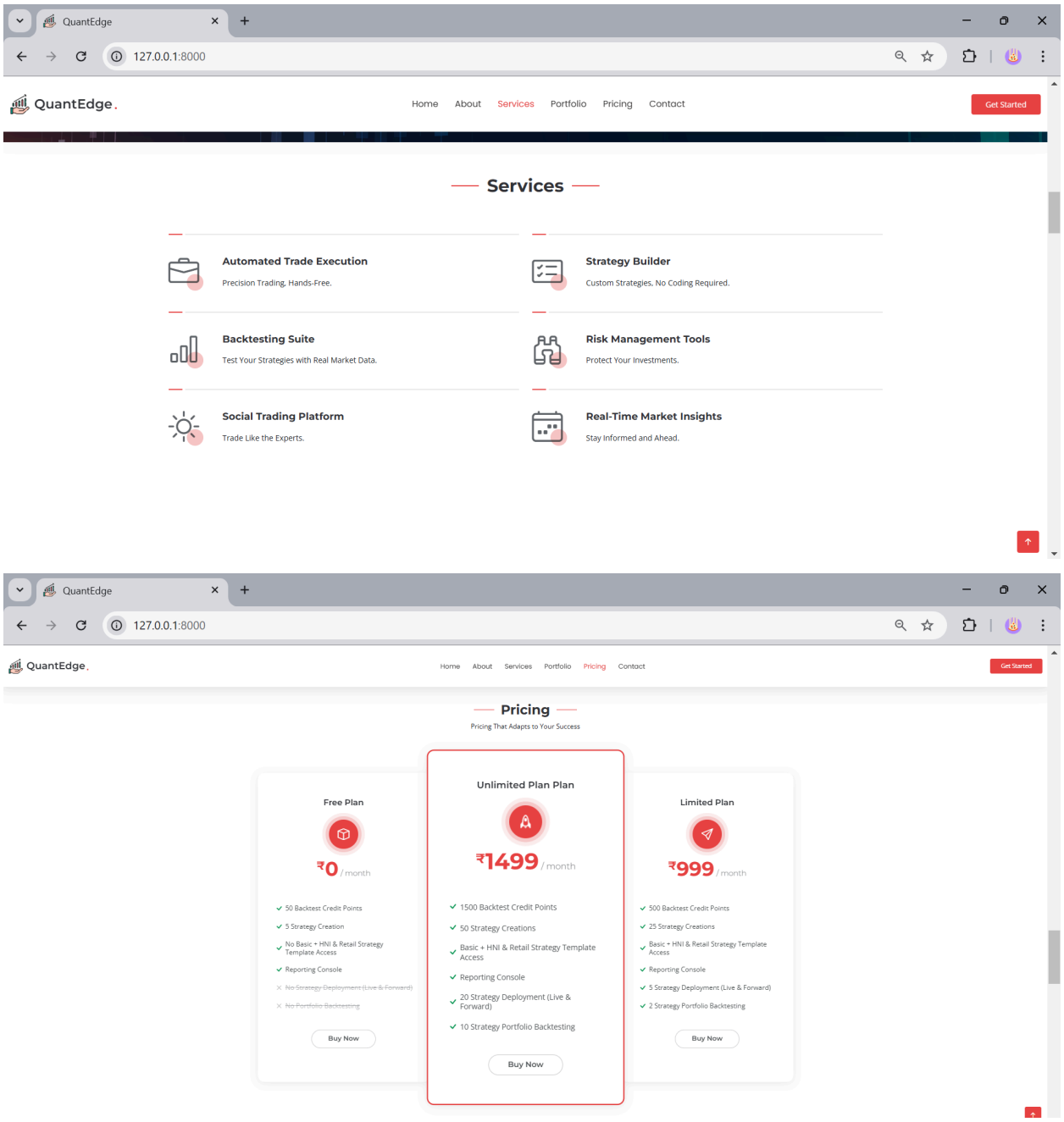


fig 6.2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Backtesting Suite
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Risk Management Tools
Protect Your Investments.
Social Trading Platform
Trade Like the Experts.
Real-Time Market Insights
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Pricing That Adapts to Your Success
Free Plan
₹0 / month
50 Backtest Credit Points
5 Strategy Creation
No Basic + HNI & Retail Strategy Template Access
Reporting Console
No Strategy Deployment (Live & Forward)
No Portfolio Backtesting
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1500 Backtest Credit Points
50 Strategy Creations
Basic + HNI & Retail Strategy Template Access
Reporting Console
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10 Strategy Portfolio Backtesting
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Limited Plan
₹999 / month
500 Backtest Credit Points
25 Strategy Creations
Basic + HNI & Retail Strategy Template Access
Reporting Console
5 Strategy Deployment (Live & Forward)
2 Strategy Portfolio Backtesting
Buy Now

fig 6.3

6.2. Modules implementation

Pseudocode:

input: Market Data, User Parameters

while (market open):

    check strategy conditions

    if conditions met:

        execute trade

        log trade details

7. EXPERIMENTATION & RESULTS

7.1. Datasets / Tables

fig 7.1

Date	Open	High	Low	Close ⓘ	Adj Close ⓘ
Nov 29, 2024	56,339.55	56,532.05	56,116.85	56,392.65	56,392.65
Nov 28, 2024	56,414.10	56,768.95	56,169.65	56,300.75	56,300.75
Nov 27, 2024	56,084.05	56,303.70	55,672.05	56,272.35	56,272.35
Nov 26, 2024	56,092.20	56,354.45	55,861.40	55,914.40	55,914.40

1. Date

- Definition: The specific calendar date and time (if intraday data) associated with the recorded trading activity.
- Usage:
    - Provides a timeline for the data, enabling time-series analysis.
    - Used to segment data for daily, weekly, or monthly trends.

2. Open

- Definition: The first traded price of the financial instrument at the start of the trading session or specific time interval.
- Usage:
    - Indicator of market sentiment at the beginning of the session.
    - Useful in candlestick patterns like Doji or Morning Star.

3. High

- Definition: The highest price the financial instrument reaches during the trading session or time interval.
- Usage:
    - Indicates the peak price achievable within the specified time.
    - Used to calculate indicators like True Range in technical analysis.

4. Low

- Definition: The lowest price the financial instrument reaches during the trading session or time interval.
- Usage:

- Indicates the minimum price at which buyers and sellers are willing to transact.
- Used alongside High to measure volatility.

5. Close

- Definition: The last traded price of the financial instrument at the end of the trading session or specific time interval.
- Usage:
  - Considered the most important price in daily trading as it reflects the final sentiment of the market.
  - Used in calculations of Moving Averages, Relative Strength Index (RSI), and other indicators.

7.2. Test cases

fig 7.2

```
def rsi_strategy(symbols, rsi_period=14, oversold=30, overbought=70):
    capital = initial_capital
    portfolio = []
    trade_log = []

    for symbol in symbols:
        data = read_stock_data(symbol)
        if data is None:
            continue

        # Calculate RSI
        delta = data['Close'].diff()
        gain = (delta.where(delta > 0, 0)).rolling(window=rsi_period).mean()
        loss = (-delta.where(delta < 0, 0)).rolling(window=rsi_period).mean()
        rs = gain / loss
        data['RSI'] = 100 - (100 / (1 + rs))

        for current_date in data.index:
            # Skip rows with insufficient data for RSI calculation
            if pd.isna(data.loc[current_date, 'RSI']):
                continue

            # Check for current positions
            if len(portfolio) > 0:
                for holding in portfolio[:]:
                    if data.loc[current_date, 'RSI'] >= overbought:  # Overbought condition
                        shares = holding['shares']
                        sell_amount = shares * data.loc[current_date, 'Close']
                        capital += sell_amount
                        trade_log.append({
                            "symbol": symbol,
                            "buy_date": holding['entry_date'],
```

7.3. Results

fig 7.3

Symbol	Buy Date	Sell Date	Entry Price (INR)	Sell Price (INR)	Profit (INR)
RELIANCE	2024-11-01	2024-11-15	2,500	2,600	100
TCS	2024-11-05	2024-11-20	3,200	3,250	50
INFY	2024-11-07	2024-11-22	1,500	1,550	50
HDFCBANK	2024-11-10	2024-11-25	1,800	1,850	50
BHARTIARTL	2024-11-12	2024-11-27	700	750	50
SBIN	2024-11-15	2024-11-30	500	550	50
ADANOGREEN	2024-11-17	2024-12-02	1,000	1,050	50
HINDUNILVR	2024-11-20	2024-12-05	2,400	2,450	50
BAJFINANCE	2024-11-22	2024-12-07	5,000	5,050	50

8. CONCLUSION

QuantEdge represents a significant step forward in democratizing algorithmic trading by addressing the barriers of affordability, accessibility, and complexity. The platform equips users with tools traditionally available only to institutional traders, allowing retail investors and small portfolio managers to leverage algorithmic strategies efficiently and effectively.

Through its intuitive interface, robust risk management features, and seamless integration with brokers, QuantEdge ensures that users can focus on strategy refinement rather than technical hurdles. The comprehensive offering of pre-built templates, drag-and-drop strategy builders, and real-time analytics provides an unparalleled trading experience, especially for those new to the domain.

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10.APPENDIX