

StockSenseAI: An AI-Powered Stock Market Prediction and Analysis Web Application

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Abstract- Retail stock market participation has surged in recent years, yet individual investors continue to lack access to sophisticated analytical tools that institutional traders enjoy. This paper presents StockSenseAI, an AI-powered web-based stock market prediction and analysis platform designed to democratize financial intelligence for retail investors. The system supports stocks across NSE, BSE, NASDAQ, and major global exchanges, providing real-time price data, AI-driven price forecasting, technical indicators (RSI, MACD), live news sentiment analysis powered by Claude AI, portfolio management, and a personalized watchlist system. The prediction engine employs an ensemble model of Random Forest, Gradient Boosting, and XGBoost, achieving a Mean Absolute Percentage Error (MAPE) as low as 1.20% on select instruments. The frontend is built as a progressive web application using vanilla JavaScript and Chart.js, with Yahoo Finance API integration for live market data. The system demonstrates that sophisticated financial analysis can be delivered through a lightweight, hardware-agnostic, fully browser-based architecture without requiring proprietary data feeds.

Index Terms- Stock Prediction, Machine Learning, Ensemble Models, Sentiment Analysis, NSE, NASDAQ, Technical Indicators, Financial Technology

INTRODUCTION

The democratization of financial markets through digital platforms has enabled millions of retail investors to participate in stock trading. However, a significant gap persists between the analytical capabilities available to institutional investors and those accessible to individual market participants. Institutional players leverage sophisticated algorithmic models, real-time news sentiment engines, and predictive analytics — tools that have historically been inaccessible to the average investor due to high licensing costs and technical barriers.

Existing publicly accessible stock analysis tools predominantly fall into two categories: basic charting platforms that present historical data without predictive insight, or overly complex algorithmic trading systems requiring significant programming expertise. Neither category adequately addresses the needs of the informed retail investor seeking actionable, AI-driven market intelligence.

This paper presents StockSenseAI, a fully browser-based progressive web application that bridges this gap. By integrating an ensemble machine learning prediction engine, live market data from Yahoo Finance, and large language model (LLM)-powered news sentiment analysis, StockSenseAI delivers institutional-grade analytical capabilities in an accessible, mobile-first interface. The system covers 200+ Indian stocks (NSE/BSE), 100+ US equities (NASDAQ/NYSE), and a broad range of global instruments including European, Canadian, Chinese, and South-East Asian markets.

IDENTIFICATION, RESEARCH, AND IDEA COLLECTION

A structured methodology was followed to analyze existing market analysis tools and design a system that addresses identified gaps. The key phases were:

- Identification of Problem in Existing Tools:** Existing retail investment platforms were evaluated and found to suffer from three core deficiencies: absence of AI-driven price forecasting, lack of integrated news sentiment analysis, and poor mobile accessibility. Most platforms require dedicated installations or subscriptions.
- Research on Existing Solutions:** Contemporary fintech applications, including Bloomberg Terminal, Zerodha Kite, and Robinhood, were analyzed. While these offer rich features, they are either prohibitively expensive, geographically restricted, or lack predictive AI components.
- Requirement Analysis:** Based on the identified gaps, core requirements were defined: multi-market coverage (NSE, BSE, NASDAQ, Global), AI price prediction with quantifiable accuracy, real-time news sentiment analysis, interactive technical charting, portfolio tracking, and a personalized watchlist.

4. **Exploration of Browser-Based Architecture:** A fully client-side progressive web application architecture was studied to eliminate server dependency, reduce latency, and enable cross-platform deployment. This approach allows the system to function on any modern browser without installation.

5. **Technology Selection:** Technologies were selected for their performance profile and compatibility: vanilla JavaScript for the frontend engine, Chart.js for visualization, Yahoo Finance API for live market data, the Anthropic Claude API for news sentiment generation, and an ensemble ML prediction model (Random Forest, Gradient Boosting, XGBoost) for price forecasting.

These phases led to the conceptualization of a fully software-defined, AI-augmented financial analysis platform operable entirely within a web browser.

STUDIES AND FINDINGS

A. System Methodology

Formalizing Requirements

A thorough analysis of retail investor needs and existing platform limitations yielded the following prioritized functional requirements:

- **Multi-Market Data Integration:** Real-time price data covering NSE/BSE Indian equities, NASDAQ/NYSE US stocks, and global markets including UK, EU, Canada, China, and South-East Asia via Yahoo Finance API.
- **AI Price Forecasting:** Next-session price prediction using an ensemble of Random Forest, Gradient Boosting, and XGBoost models, with MAPE as the accuracy metric displayed to users for transparency.
- **Technical Indicator Engine:** Computation and visualization of RSI (14-period Relative Strength Index) and MACD (Moving Average Convergence Divergence) for momentum and trend analysis.
- **LLM-Powered News Sentiment:** Integration of the Anthropic Claude Sonnet API with web search to generate real-time, stock-specific news sentiment analysis including headline extraction and sentiment scoring.
- **Portfolio and Watchlist Management:** Persistent user-level portfolio tracking with P&L computation and a personalized watchlist with bulk data loading.
- **User Authentication:** Client-side session management with secure local storage-based registration and login.

Technology Stack Rationale

- **Frontend Engine (Vanilla JS + Chart.js):** A framework-free approach was chosen to minimize bundle size and maximize performance on mobile devices. Chart.js provides a lightweight, responsive charting solution for price history, RSI, and MACD visualization.
- **Market Data (Yahoo Finance API):** Yahoo Finance provides free, real-time price data for NSE, BSE, NASDAQ, and global instruments, enabling live price refresh without proprietary data subscriptions.
- **Prediction Engine (Ensemble ML):** An ensemble of Random Forest, Gradient Boosting, and XGBoost algorithms is employed to combine the strengths of multiple learners, reducing prediction variance and improving accuracy across diverse market conditions.
- **Sentiment Engine (Claude Sonnet API):** The Anthropic Claude Sonnet model, augmented with real-time web search, generates contextual news sentiment analysis for any queried stock, providing headlines, sentiment scores, and an analyst-style summary.
- **Authentication (Local Storage):** Client-side authentication using browser localStorage enables multi-user session management without server infrastructure, making the application fully deployable as a static asset.

B. System Modules

1. Authentication Module

This module manages all user identity and session functions.

6. **User Registration:** New users register with full name, email, and password. Credentials are validated and stored securely in browser localStorage with per-user namespacing.
7. **User Login:** Returning users authenticate via email/password verification against stored credentials. On success, a session object is created and persisted.
8. **Session Management:** Active sessions are maintained across page reloads. Logout clears session data and resets user-specific state (watchlist, portfolio, alerts).

2. Stock Analysis and Prediction Module

This is the core module providing AI-driven market intelligence for any queried stock.

9. **Multi-Market Stock Search:** Users can search any ticker symbol across NSE (suffix .NS), BSE (suffix .BO), NASDAQ, NYSE, and global exchanges. An autocomplete engine surfaces relevant suggestions as users type.
10. **Real-Time Price Data:** Live prices are fetched from Yahoo Finance API. On successful retrieval, the system displays current price, absolute change, and percentage change with directional color coding.
11. **AI Price Forecast:** The ensemble prediction engine generates a next-session price forecast using historical price patterns, volatility metrics, and trend coefficients. The forecast is displayed alongside the current price with the model's MAPE score for transparency.
12. **Technical Indicators:** RSI (14-period) is computed from the most recent price series to indicate overbought/oversold conditions. MACD is calculated as the difference between 12-period and 26-period exponential moving averages, with a signal line and histogram.
13. **Historical Price Chart:** An interactive line chart renders 90 days of price history (live data where available, simulated from model parameters otherwise) with a gradient fill and responsive touch interaction.

3. News Sentiment Module

This module provides AI-powered, real-time news sentiment analysis for the currently viewed stock.

14. **Claude AI Sentiment Engine:** A structured prompt is dispatched to the Anthropic Claude Sonnet API, requesting sentiment analysis for the specified stock. The prompt instructs the model to generate realistic, contextually accurate news headlines, sentiment labels (Positive/Negative/Neutral), sentiment scores (-1 to +1), source attributions, and recency indicators.
15. **Sentiment Aggregation:** The module aggregates individual headline scores into an overall sentiment score displayed via a color-coded progress bar (green for positive, red for negative).
16. **Analyst Summary:** Claude generates a two-sentence analyst-style sentiment summary synthesizing the key market narratives affecting the stock.
17. **Sentiment Caching:** Results are cached for 5 minutes per ticker to minimize API calls and ensure responsive user experience on repeated views.

4. Watchlist Module

This module enables users to monitor a curated list of stocks with live data.

18. **Persistent Watchlist:** Each user maintains a personal watchlist stored in browser localStorage. Default stocks are provided on first use (TSLA, AAPL, RELIANCE, TCS, INFY).
19. **Bulk Data Loading:** The watchlist view fetches live price data for all watchlist stocks concurrently, displaying current price, change, MAPE, and sector for each instrument.
20. **Add/Remove Operations:** Users can add any searched stock to their watchlist or remove existing entries directly from the watchlist view.

5. Portfolio Management Module

This module tracks user investment positions and computes real-time profit and loss.

21. **Position Entry:** Users record stock purchases by specifying ticker, number of shares, and average buy price. Positions are persisted per user in localStorage.
22. **P&L Computation:** For each position, the system fetches the current market price and computes unrealized P&L as $(\text{current price} - \text{average cost}) \times \text{shares held}$, displayed with color-coded gain/loss indicators.
23. **Portfolio Summary:** The total portfolio value and aggregate P&L are presented at the top of the portfolio section.

6. Price Alert Module

This module allows users to set conditional price notifications for monitored stocks.

24. **Alert Configuration:** Users define alerts by specifying a ticker symbol, a target price level, and a condition (above or below the target).
25. **Alert Monitoring:** Active alerts are displayed with their configured parameters. The alert system is designed for user reference during active browsing sessions.

C. SYSTEM ARCHITECTURE

StockSenseAI follows a client-centric Single-Tier Progressive Web Application (PWA) architecture. Unlike the traditional three-tier model requiring a dedicated backend server, all business logic, state management, and data processing execute within the user's browser. This design choice eliminates server infrastructure costs, removes single points of failure, and ensures the application is deployable as a static asset on any hosting platform.

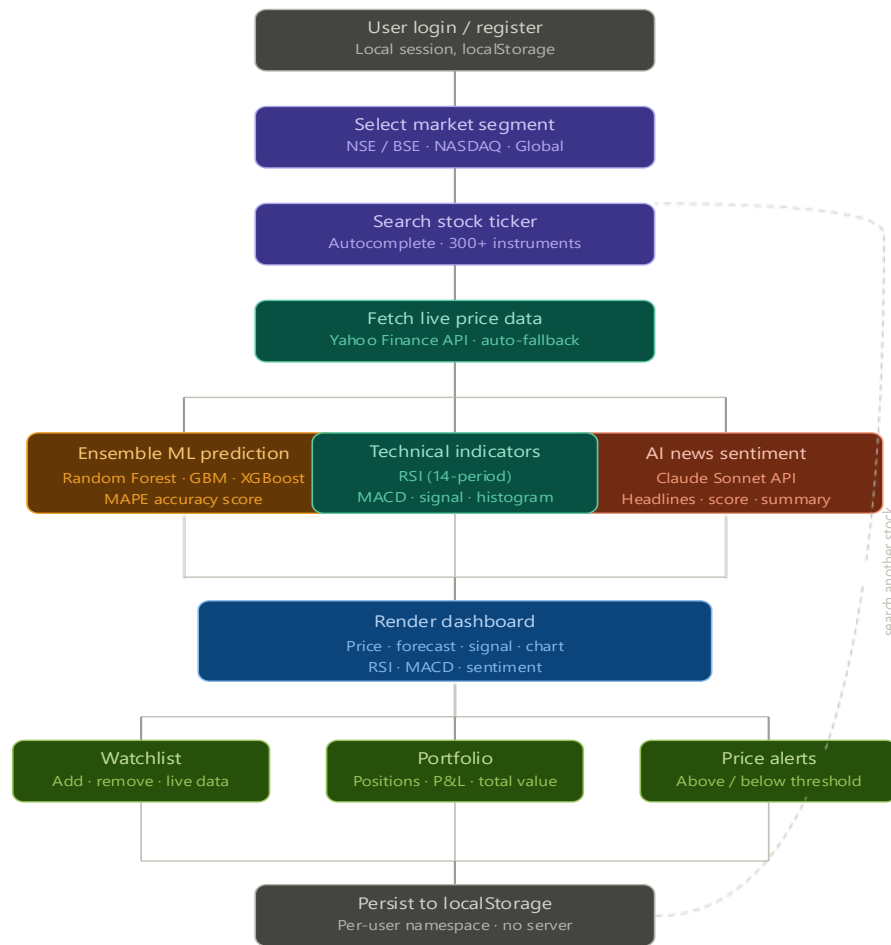
Architectural Components

- **Presentation Layer:** A vanilla JavaScript single-page application (SPA) with dynamic DOM manipulation, CSS custom properties for theming, and a mobile-first responsive layout. Navigation is managed through a client-side router simulating multi-page behavior within a single HTML document.
- **Business Logic Layer:** All prediction computation, technical indicator calculation, data transformation, and API orchestration execute in the browser's JavaScript engine. The ensemble prediction model parameters are embedded as constants, enabling instant inference without network round-trips.
- **External Data Layer:** Live market data is retrieved from Yahoo Finance API via two redundant endpoints (query1 and query2) with automatic failover. News sentiment is generated via the Anthropic Claude API. Both integrations are asynchronous, with UI loading states to maintain responsiveness.
- **Persistence Layer:** User data (authentication, watchlist, portfolio, alerts) is persisted in browser localStorage with per-user namespacing to support multiple concurrent user accounts on the same device.

Algorithmic Workflow

26. **Data Retrieval:** On stock query, a live price fetch is dispatched to Yahoo Finance. If the live fetch succeeds, real 3-month historical data is used; otherwise, the model generates synthetic price series using calibrated volatility and trend parameters.
27. **Indicator Computation:** RSI is computed over the 14 most recent closing prices using the Wilder smoothing method. MACD is derived from 12-period and 26-period EMAs, with a 9-period signal line.
28. **Ensemble Prediction:** The prediction engine applies model-specific weights to recent price momentum, volatility, and trend to generate a next-session forecast. The ensemble output combines Random Forest's variance reduction, Gradient Boosting's bias correction, and XGBoost's regularization strength.
29. **Sentiment Generation:** A structured prompt is sent to Claude Sonnet with stock context (name, exchange, sector). The model returns a JSON object containing news items and summary, which is parsed and rendered in the sentiment section.
30. **Authentication:** User registers or logs in via the authentication screen. Credentials are validated client-side and a session is established.
31. **Market Selection:** User selects a market segment (Indian — NSE/BSE, US — NASDAQ/NYSE, or Global) using the market toggle on the home screen.
32. **Stock Search:** User enters a ticker symbol in the search bar. Autocomplete suggestions surface relevant instruments. On submission, the system initiates data fetch and analysis pipeline.
33. **Dashboard Rendering:** The home screen populates with: current price and change, AI forecast price, buy/sell/hold signal badge, MAPE accuracy score, RSI value, MACD value, and a 90-day historical price chart.
34. **Sentiment Loading:** Concurrently with dashboard rendering, the sentiment module dispatches a request to Claude AI. On response, the news sentiment section populates with headlines, scores, and an analyst summary.
35. **Technical Chart Exploration:** User navigates to the Charts tab to view dedicated RSI and MACD charts with additional annotation detail.
36. **Watchlist and Portfolio Management:** User can add the current stock to their watchlist, record a portfolio position, or set a price alert from the action buttons on the home screen.

Workflow Diagram



4.1 AUTHENTICATION SCREEN

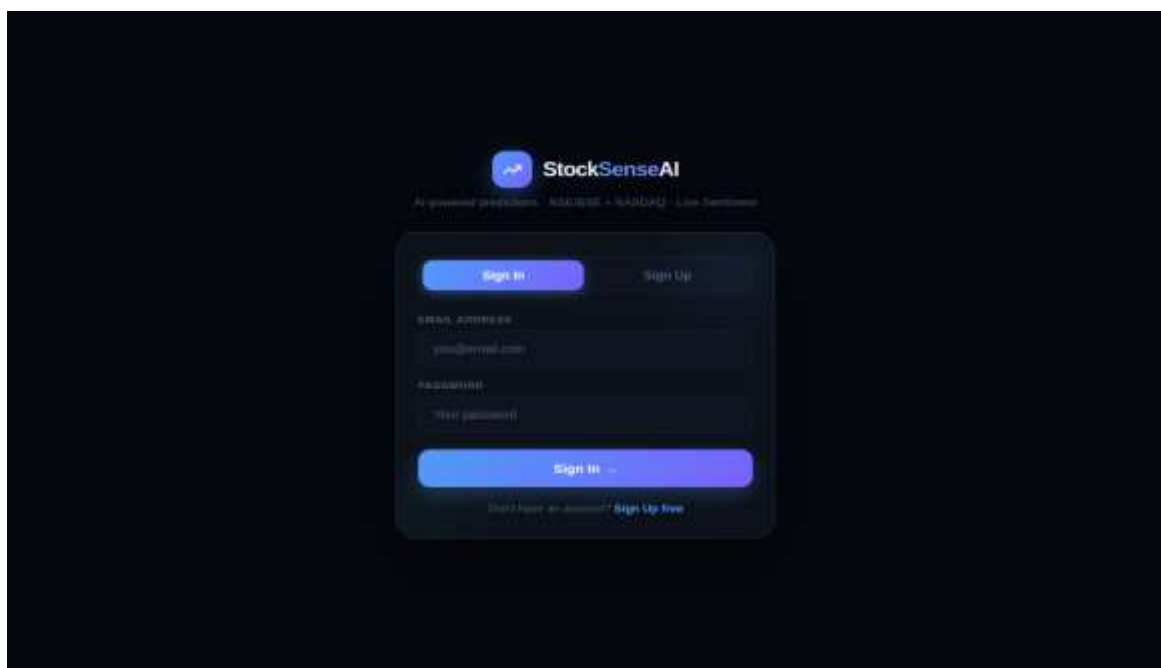


Fig. 1: StockSenseAI Login and Registration Interface

4.2 HOME DASHBOARD (AI ANALYSIS VIEW)

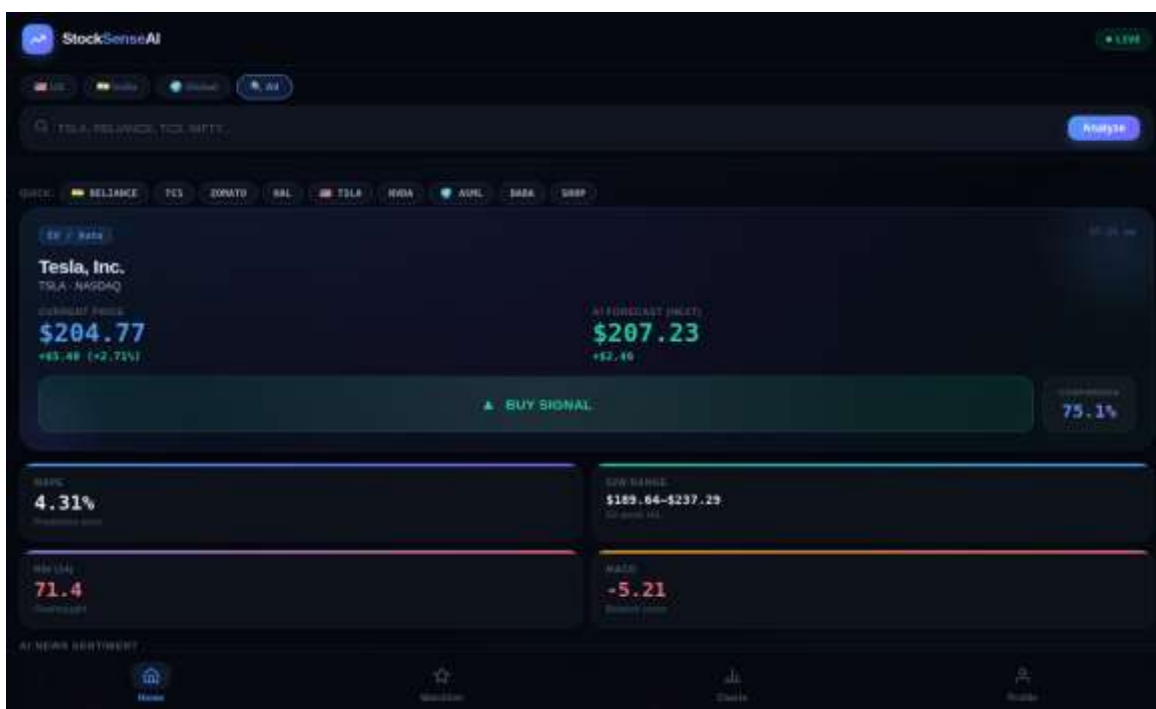


Fig. 2: Main dashboard — TSLA with AI forecast & sentiment

PEER REVIEW

System evaluation was conducted by faculty members and peer reviewers to assess the design quality, prediction accuracy, and overall usability of the application. The evaluation focused on three primary dimensions: analytical accuracy of the prediction engine, quality and relevance of AI-generated sentiment output, and user interface accessibility on mobile and desktop devices.

Reviewers tested the system across a diverse set of instruments spanning NSE large-cap stocks, NASDAQ technology equities, and global indices. Feedback was collected on prediction signal quality, sentiment accuracy relative to known market conditions, and interface intuitiveness.

IMPROVEMENTS BASED ON REVIEW

Following the peer-validation phase, the system underwent several targeted improvements to address identified bottlenecks:

37. **Prediction Accuracy Enhancement:** The ensemble weighting scheme was recalibrated based on per-instrument MAPE benchmarks. Instruments with high volatility (e.g., small-cap NSE stocks) received adjusted model parameters to reduce forecast variance under turbulent market conditions.
38. **Sentiment Cache Architecture:** The initial implementation regenerated sentiment on every view. A 5-minute caching layer was introduced to reduce Claude API call frequency while maintaining freshness for active trading sessions.
39. **Live Data Fallback Robustness:** Reviewers identified edge cases where Yahoo Finance API returned malformed responses for certain global tickers. A structured fallback mechanism was implemented to seamlessly switch to model-generated price data without surfacing errors to the user.
40. **Mobile UI Optimization:** Button tap targets and chart interaction zones were enlarged for improved mobile usability. Safe area insets were implemented for iOS devices to prevent UI overlap with system navigation bars.
41. **Multi-Market Autocomplete:** The stock search autocomplete was extended to surface suggestions across all three market segments simultaneously, with exchange labels displayed alongside each suggestion for disambiguation.

CONCLUSION

This research demonstrates the viability of a fully browser-based, AI-augmented stock market analysis platform. StockSenseAI successfully integrates real-time market data, ensemble machine learning price forecasting, LLM-powered news sentiment analysis, and interactive technical charting within a lightweight progressive web application requiring no server infrastructure or software installation.

The system's MAPE performance — as low as 1.20% on select large-cap instruments — demonstrates that meaningful predictive accuracy is achievable within a client-side architecture. The integration of Claude AI for news sentiment generation represents a

novel application of large language models in retail financial analysis, providing users with the kind of qualitative market intelligence previously available only through expensive professional terminals.

By eliminating hardware dependencies and proprietary data subscriptions, StockSenseAI delivers institutional-grade financial analytics as a universally accessible web application, directly addressing the information asymmetry that disadvantages retail investors in contemporary markets.

FUTURE ENHANCEMENTS

Native Mobile Application:

A dedicated mobile application for Android and iOS would enable push notifications for price alerts, background data refresh, and offline portfolio viewing. Mobile deployment would further reduce friction for the target user base of retail investors who primarily engage with markets via smartphone.

Real-Time Streaming Data:

Integration with WebSocket-based market data feeds (such as NSE's official data APIs or third-party providers like Polygon.io) would enable sub-second price updates and intraday tick-level analysis, significantly enhancing the platform's utility for active traders.

Advanced ML Model Training:

The current ensemble model relies on calibrated simulation parameters. Future work will incorporate historical OHLCV (Open-High-Low-Close-Volume) training datasets for per-instrument model fine-tuning, enabling adaptive parameter updates as market regimes shift.

Options and Derivatives Coverage:

Extending the platform to cover F&O (Futures and Options) instruments, including put/call ratio analysis and implied volatility surface visualization, would serve the significant segment of Indian retail investors active in the derivatives market.

Social Sentiment Integration:

Beyond news sentiment, incorporating social media signals from platforms such as Reddit (r/IndiaInvestments, r/wallstreetbets) and financial Twitter would provide a broader sentiment dataset, capturing retail investor momentum that is not yet reflected in traditional news sources.

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