Human Computer Interaction
Individual Project

Chethana Prasad Kabgere
ckabgere3@gatech.edu

***Abstract*—** Stock market prediction is a complex and dynamic task that requires robust machine learning models to analyze financial time-series data. However, despite AI's predictive capabilities, user trust, interpretability, and decision support remain critical challenges. This study explores Human-Computer Interaction (HCI) contributions to AI-driven stock market prediction, focusing on enhancing explainability, usability, and user engagement in financial decision-making. We introduce FinGraphX, a federated learning-based Chatbot designed to bridge the gap between AI complexity and human intuition through adaptive visualizations, interactive explanations, and trust-building mechanisms. By integrating cognitive walkthroughs, usability testing, and progressive disclosure techniques, we refine UI components to ensure transparency, reduce cognitive overload, and improve real-time user-AI collaboration.

1. INTRODUCTION

Stock market prediction is a complex yet essential task that influences investment decisions and risk management strategies. The increasing volume of financial data necessitates AI-driven solutions, but ensuring accessibility, interpretability, and trust in these systems remains a challenge. Human-Computer Interaction (HCI) plays a critical role in making AI-powered market prediction tools more intuitive and actionable. By integrating interactive learning, predictive analytics, and multi-chart comparisons, the final prototype enhances usability while maintaining transparency. With adaptive tooltips, real-time AI feedback, and synchronized data visualization, traders can engage effectively with AI models, leading to more confident and informed decision-making.

Why Human –Computer Interactions for User Prediction Apps?

Human-Computer Interaction (HCI) transforms stock market applications by enhancing usability, decision-making, and trader profitability. First, intuitive UI designs, such as interactive tooltips and tutorials, simplify complex financial

concepts, making market analysis more accessible to both novice and expert traders. Second, AI-powered predictive analytics with transparency features, like confidence meters and explainable AI, build trust in automated insights, helping users make informed investment decisions. Third, multi-chart synchronization and real-time data visualization improve comparative analysis, allowing traders to identify profitable opportunities faster. Finally, customizable user experiences, including adaptable layouts and trading strategy integration, optimize workflows, ultimately leading to higher efficiency and improved financial outcomes.

Why Machine Learning for Stock Prediction?

Machine Learning (ML) has become a powerful tool for stock market forecasting due to its ability to recognize patterns, process large amounts of data, and make data-driven predictions. Unlike traditional statistical methods, ML algorithms can uncover non-linear relationships and hidden dependencies in financial data, providing more sophisticated forecasting capabilities. The main ML techniques used in stock prediction include Reinforcement Learning (RL): RL-based approaches, such as Deep Q-Networks (DQNs) and Proximal Policy Optimization (PPO), optimize trading strategies by learning through interaction with the market. While these approaches provide strong predictive power, they often rely on centralized data processing, which introduces concerns regarding data privacy, security, and bias. This is where Federated Learning (FL) comes in.

Task and User Needs

This project aims to bridge the gap between complex AI-driven stock market predictions and user-centric financial decision-making by improving the human-computer interaction (HCI) aspects of AI-powered forecasting tools. FinGraphX, an interactive stock prediction platform, is designed to provide users with transparent, explainable, and actionable insights by integrating intuitive UI/UX design, interactive visualizations, and trust-enhancing AI explanations.

Users of stock prediction systems—ranging from retail investors managing personal portfolios to institutional traders making high-frequency trading decisions—often struggle to understand how AI models arrive at their predictions. This lack of transparency leads to low trust, poor adoption, and suboptimal decision-making. By leveraging HCI principles, FinGraphX enables users to visualize financial predictions, interact with AI-driven insights, and customize prediction parameters based on their risk tolerance and investment strategies.

Motivation and Real-World Relevance

The need for better HCI in stock prediction became evident through real-world observations and industry gaps. Many existing financial forecasting tools either overwhelm users with raw data or present AI predictions as opaque, unexplainable outputs. A recent example is the rise of robo-advisors, which, despite their efficiency, often fail to provide explainability features that users need to make informed investment choices. Through user interviews and market research, it became clear that traders and analysts require AI systems that not only predict stock movements accurately but also communicate insights in a clear, interactive, and trust-enhancing manner.

This research seeks to address these gaps by redesigning the AI-user interaction lifecycle, incorporating cognitive walkthroughs, usability testing, and interactive data visualizations to ensure that AI-powered stock predictions align with human decision-making processes. The goal of FinGraphX is to serve as a benchmark for future HCI-driven financial AI systems, setting new standards for explainability, transparency, and user engagement in financial forecasting.

2. NEEDFINDING ACTIVITIES

2.1 User Surveys

To understand user expectations and preferences for AI-powered stock prediction tools, a survey was conducted with 23 participants across diverse backgrounds such as finance, IT, consulting, and software engineering.

Survey Participants

Roles Represented: Investors, IT professionals, consultants, software engineers, students, traders, and product managers.

Recruitment Process: Participants were recruited through professional networks LinkedIN, online finance communities, and academic contacts PEER SURVEY.

Survey Format: Structured questionnaire with a mix of multiple-choice, Likert scale, and open-ended questions.

Key Findings

The survey responses revealed several crucial insights. Participants primarily consisted of a mix of investors, software engineers, and students, reflecting a diverse range of financial and technical expertise. Their experience in stock market

trading varied widely, from beginners to experts with over ten years of experience. Most participants engaged in occasional trading, using platforms such as Yahoo Finance, TradingView, Bloomberg Terminal, and Wealthfront/Betterment. There was a moderate familiarity with AI-driven stock market predictions, with most respondents rating their knowledge between 2-4 on a 5-point scale. The most valued features in stock prediction tools were accuracy, explainability of AI decisions, real-time updates, and user-friendly visualizations. Although some participants had used AI-based forecasting tools, many were still hesitant to fully rely on them due to concerns about trust and transparency. Trust in AI predictions was generally rated as moderate, with confidence scores, historical performance analysis, and explainable AI (XAI) being the most requested trust-building features.

Customization of AI models was another significant area of interest, with most participants preferring the ability to adjust AI parameters based on their personal trading strategies. Regarding visualization preferences, interactive graphs, heatmaps, line charts, and confidence intervals were highlighted as the most useful representations. A majority also expressed strong interest in a graph-based exploration tool that illustrates relationships between stocks and their influencing factors.

2.2 Survey Data Visualization

Visualization Preferences:

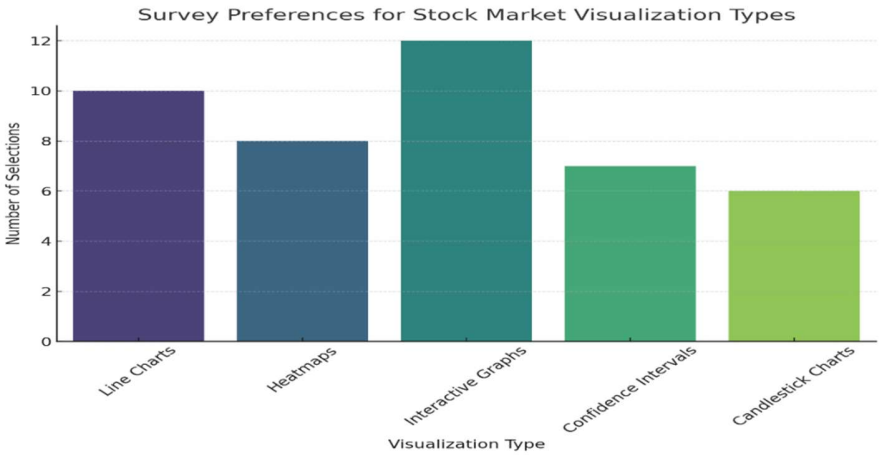


Fig 1: Survey Preferences For Market Visualization Type

The histogram below shows the frequency of preferred visualization types in stock market analysis. Interactive graphs were the most favored, followed by line charts and heatmaps.

Feature Importance in Stock Prediction Tools:

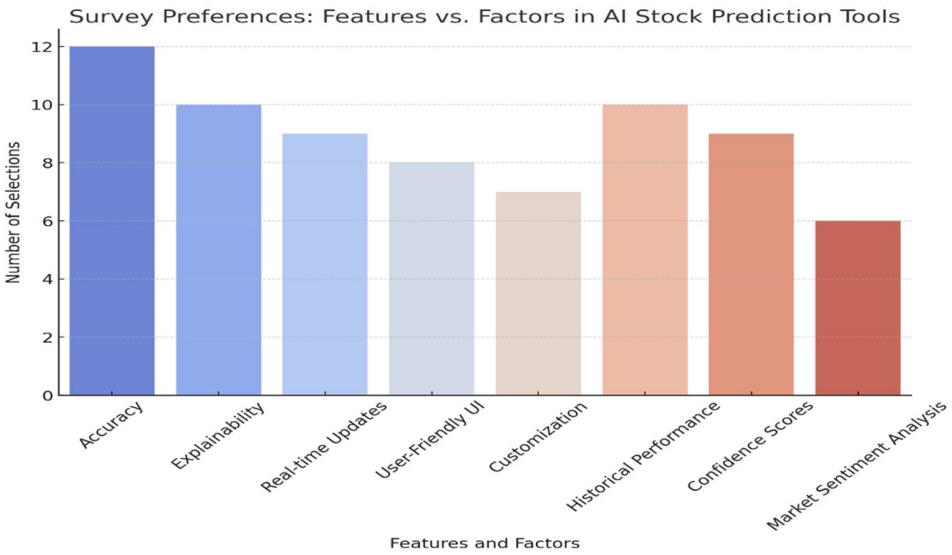


Fig 2: Features vs Factors

This histogram presents the most valued features in AI-driven stock prediction tools, with accuracy and explainability ranking as top priorities.

2.3 *Heuristic Evaluation*

A heuristic evaluation will be conducted to assess the usability and effectiveness of existing stock prediction tools. The evaluation will focus on three heuristics from Nielsen's usability principles:

- Visibility of system status – Does the interface clearly indicate AI decision-making and prediction confidence?
- Match between system and real world – Is the information presented in a way that aligns with user expectations and financial workflows?
- User control and freedom – Can users customize predictions, adjust AI parameters, and undo actions?

Evaluation Execution Plan

- Target Interfaces: Leading AI-driven stock prediction platforms such as Yahoo Finance, Bloomberg Terminal, and TradingView.
- Evaluation Method:
- Each interface will be reviewed against the three heuristics.
- Common usability issues will be documented.
- A summary report will highlight areas for improvement.

3 INITIAL BRAINSTORMING PLAN

To ensure a structured and innovative approach to the design of FinGraphX, a multi-phase brainstorming process was employed. The brainstorming primarily focused on individual ideation, supplemented by AI-assisted brainstorming sessions to generate diverse perspectives on UI/UX enhancements, explainability features, and user trust mechanisms in stock prediction interfaces.

The brainstorming process included:

- Idea Mapping & Affinity Diagramming: Categorizing potential UI/UX features such as data visualization, interactive AI explanations, and customization options.
- Competitive Analysis: Evaluating existing stock prediction tools to identify usability gaps.
- Scenario-Based Design: Creating vignettes representing different user personas (e.g., novice investors, day traders, institutional analysts) to guide UI research.
- AI-Assisted Brainstorming: Utilizing generative AI tools to explore alternative design solutions and generate iterative refinements.

3.1 BRAINSTORMING RESULTS

Idea Mapping & Affinity Diagramming:

Based on the survey results,a affinity visualization Fig 2 is reffered. The UI/UX of an AI stock prediction tool should prioritize accuracy, explainability, and real-time updates while also integrating features that enhance user engagement. To improve accuracy, the interface should include confidence score visualizations, displaying prediction reliability through color-coded indicators. Explainability can be enhanced with an AI-driven dashboard that provides visual explanations such as decision trees and heatmaps to illustrate how predictions are generated. Since real-time updates are crucial, a live stock tracker with dynamic price updates and alerts can help users stay informed. To ensure a user-friendly experience, the design should be minimalist with intuitive controls, including drag-and-drop dashboards, tooltips, and interactive charts. Customization options can further improve usability by allowing users to personalize their insights panel, selecting preferred prediction models and visualization formats. Given the importance of historical performance, a comparison feature that overlays past stock trends with AI-generated forecasts would provide valuable context. Confidence scores can be represented using a traffic-light risk indicator system,

making it easy for users to assess investment risks at a glance. Lastly, while market sentiment analysis ranked lower in preference, incorporating AI-powered sentiment tracking from news and social media—possibly using an emoji-based scoring system—could offer additional insights for decision-making. These elements, when combined, create an engaging and informative UX that aligns with user needs, ensuring both transparency and efficiency in AI-driven market prediction tools.

Scenario –Based Design

Imagine a retail investor using an AI-powered stock prediction tool but struggling to interpret the forecasts due to complex data visualizations. From an HCI perspective, we brainstorm solutions to enhance usability: integrating adaptive tooltips, interactive graphs, and confidence indicators to improve explainability. By conducting usability tests and cognitive walkthroughs, we refine the UI to ensure seamless interaction, building user trust and engagement. This approach bridges AI insights with intuitive decision-making.

Competitive Analysis:

Brainstorming through idea mapping and affinity diagramming helps categorize essential UI/UX features based on user preferences, ensuring a structured approach to design.

Tool Name	AI/ML Capabilities	Data Sources	Key Financial Features	UI/UX Features
Bloomberg Terminal	AI-powered financial modeling, real-time analytics, NLP for news sentiment	Real-time market data, economic indicators, earnings reports	Advanced charting, predictive analytics, macroeconomic forecasting	Customizable dashboards, terminal-based UI, steep learning curve
Reuters Eikon	Machine learning-based stock prediction, sentiment analysis on news	Market data, economic trends, financial reports	AI-powered market insights, risk analytics, portfolio tracking	Interactive dashboards, data visualization tools, API integrations
AlphaSense	AI-driven stock sentiment analysis, NLP for financial reports	Earnings call transcripts, SEC filings, news sources	Searchable financial insights, earnings forecast analysis	Text-based search with AI-powered highlights, customizable alerts
TradeStation	Deep learning for stock pattern recognition, AI-powered charting	Real-time and historical stock data, options & futures markets	Algorithmic trading support, AI-powered stock screening	Customizable trading workspaces, easy-to-use trading interface

Fig 4: Comparative Analysis of Tools

4. INITIAL PROTOTYPING

Financial markets have become increasingly complex, and users rely on trading platforms like TradingView to analyze data, identify trends, and make informed investment decisions. While TradingView offers a robust set of tools, its interface can be overwhelming for new users, and even experienced traders can struggle with navigating advanced analytical features. To bridge this gap, we propose enhancements that improve usability, provide AI-powered predictions, and enable seamless multi-chart analysis. The primary design alternatives explored in this project include:, 2) AI-Powered Detection and Prediction (FinGraphx), 2) Interactive Tooltips and 3) AI powered Tutorial Suggestor. These features will refine the user experience, making trading analysis more intuitive, efficient, and accessible.

One of the key challenges traders face is understanding how different market parameters influence trading decisions. Traditional platforms provide a plethora of indicators and data points, but without proper guidance, interpreting these can be daunting. AI-driven predictions further enhance trading decisions by leveraging federated machine learning (FedML) to provide personalized insights without compromising data privacy. The proposed FinGraphx system will continuously analyze past trading behavior, market trends, and real-time data to generate tailored predictions. Unlike traditional centralized AI models, FedML ensures that sensitive financial data remains on the user's device, significantly reducing security risks while maintaining model accuracy. FinGraphx will monitor market volatility, detect unusual price movements, and offer data-backed suggestions to optimize trades. By integrating AI, users can make more informed decisions with confidence, reducing cognitive overload and minimizing risks associated with emotional trading.

These three design enhancements will collectively make TradingView more user-friendly, secure, and powerful. The next sections will delve deeper into the technical implementation, user interaction flows, and evaluation metrics for each feature, demonstrating how they align with industry best practices in Human-Computer Interaction (HCI).The key objectives of the proposed UI/UX enhancements include:

- Reducing the learning curve for new users by providing contextual assistance.

- Improving analytical efficiency with AI-driven insights and data visualization.
- Enhancing decision-making through multi-chart synchronization and prediction models.

Additionally, other proposed UI improvements include:

- Drag-and-Drop Indicators & Custom Widgets: Allowing users to personalize dashboards with preferred trading tools.
- Chart Auto-Snap & Grid Alignment: Ensuring precision when manually adjusting trend lines and indicators.
- Customizable UI Themes: Providing light, dark, and high-contrast themes for better accessibility.
- 'What-If' Simulation Mode: Enabling traders to visualize potential trade outcomes under different market conditions.

4.1 Design Alternative 1: AI Detection and Prediction (FinGraphX)

Prototype Description

AI-driven predictions further enhance trading decisions by leveraging federated machine learning (FedML) to provide personalized insights without compromising data privacy. The proposed FinGraphx system will continuously analyze past trading behavior, market trends, and real-time data to generate tailored predictions. Unlike traditional centralized AI models, FedML ensures that sensitive financial data remains on the user's device, significantly reducing security risks while maintaining model accuracy. FinGraphx will monitor market volatility, detect unusual price movements, and offer data-backed suggestions to optimize trades. By integrating AI, users can make more informed decisions with confidence, reducing cognitive overload and minimizing risks associated with emotional trading.

How Data is Collected and Processed:

The FinGraphX feature integrates Federated Machine Learning (FedML) to analyze historical trading data, detect market patterns, and forecast potential price movements—ensuring that user data remains private while providing AI-driven insights.

- Local Data Processing: Each user's device collects personal trading patterns and price movements without transmitting raw data to a central server.
- Model Training via FedML: Instead of sharing raw data, only encrypted model updates are sent to the cloud, preserving privacy.
- Pattern Recognition: The AI analyzes past trends, identifying head-and-shoulders formations, double tops, and bullish/bearish trends.
- Real-Time Market Sentiment Analysis: FinGraphX assesses social media sentiment, news feeds, and recent trading volumes to improve accuracy.
- Personalized Alerts: Based on the user's past trades, AI customizes alerts for high-probability trade opportunities.

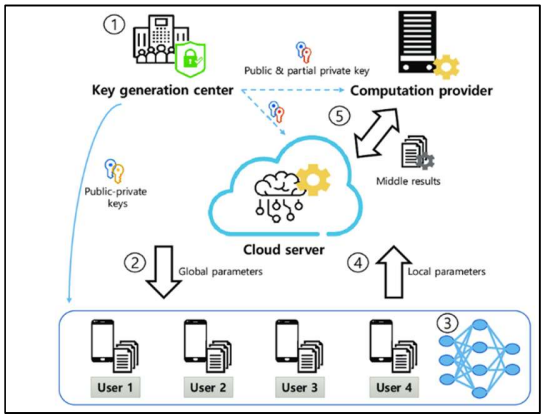


Fig 9: Mechanism of Federated Machine Learning

Source:https://www.researchgate.net/figure/System-model-for-privacy-preserving-federated-learning_fig2_357789521

Design Enhancements Contributed:

A. FinGraphX Chatbot tool placed at the Right corner down for User convenience.
B. The design of the FinGraphX includes a Chat dialog symbol circumscribing a Machine Learning icon to indicate its nature of working.
C. User's are given confidence with mention as it is trained on FedML to train data on their previous Trading information.
D. A selection for Graph Type is given for user convenience.
E. A data source selection is provided. They can include spreadsheets, pdf's.
F. Graph Stastics is analyzed and a report on sales and trade is given.

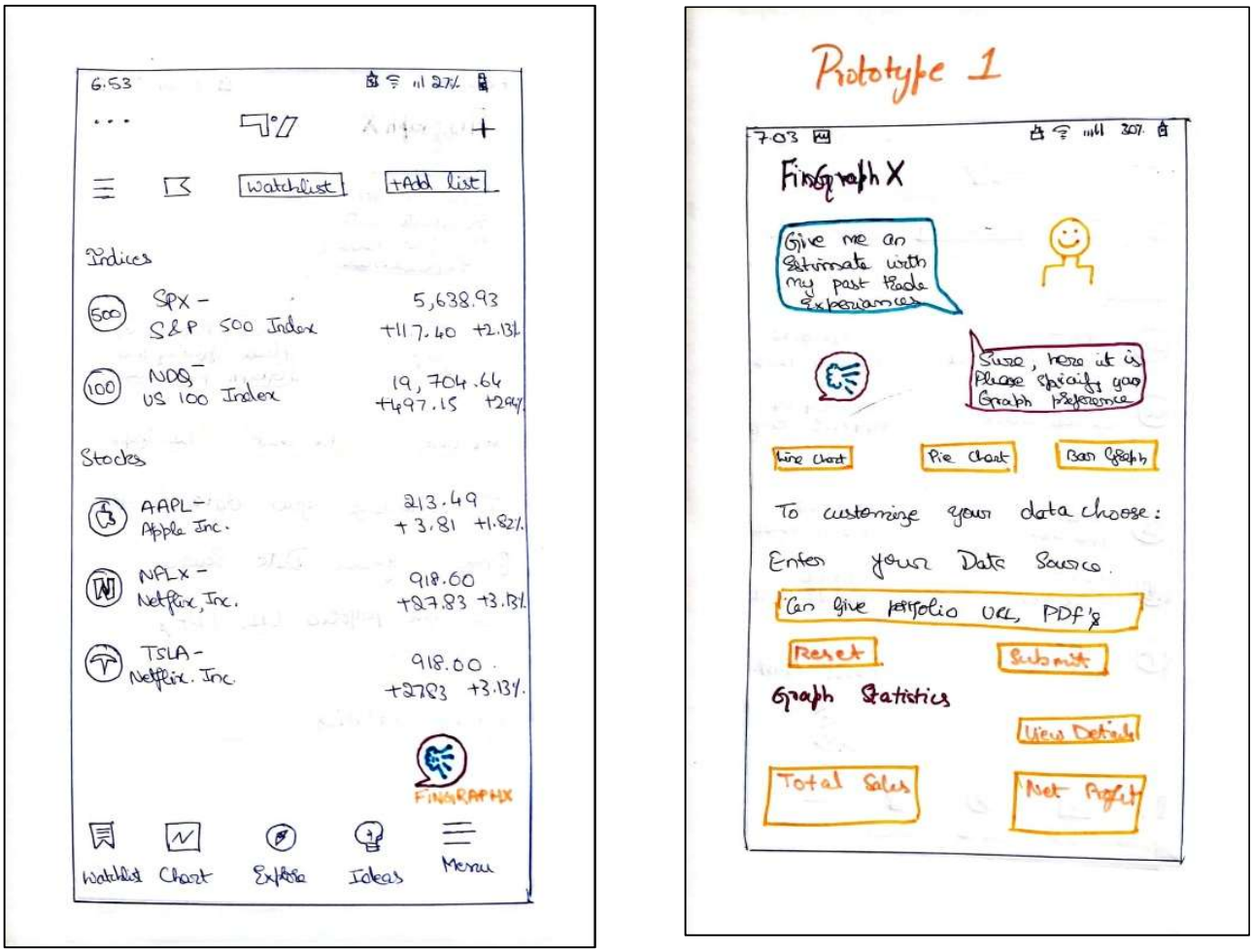


Fig 8: Initial Prototype 1

4.2 Design Alternative 2: Interactive Tooltip:

Prototype Description:

This feature introduces AI contextual tooltips to assist traders in understanding key market indicators. When users hover over or tap on specific trading parameters, a tooltip provides an interactive explanation of its impact on market movements. The tooltips are dynamically generated based on real-time data and user interaction history, ensuring relevance. This feature enhances decision-making by breaking down complex financial terms into simple, digestible insights. It also supports adaptive learning, evolving with user preferences to provide more personalized guidance over time.

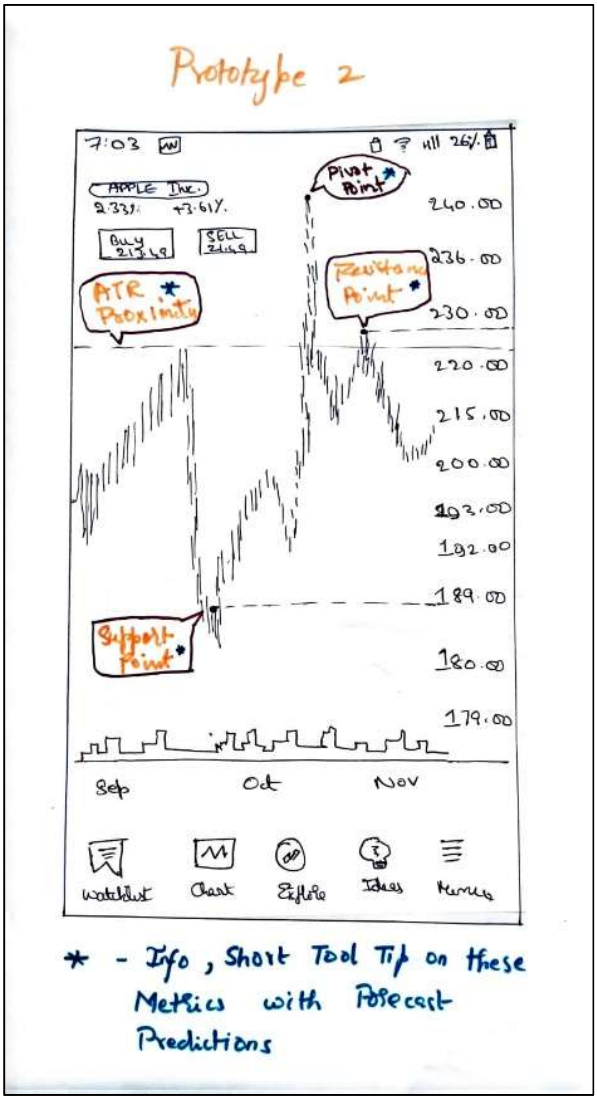


Fig 10: Initial Prototype 2

Rationale and Design Principles:

- ***Progressive Disclosure:*** Tooltips provide information only when necessary, preventing cognitive overload. Users can access deeper insights through layered interactions, ensuring a smooth learning curve. Information is revealed incrementally, reducing distractions and keeping the interface clean. The design maintains a balance between simplicity and detail, ensuring clarity.
- ***Contextual Learning:*** By embedding explanations directly into the UI, users can learn organically without interrupting their workflow. Real-time market scenarios are incorporated into tooltips, helping users apply insights immediately.
  - ***Onboarding Guidance:*** First-time users receive a structured walkthrough of technical indicators and charting tools, reducing the learning curve. Personalized recommendations based on user experience levels guide them towards relevant resources.

Key Trading Parameters Explained with Use Cases

- ***Support and Resistance Levels:*** These levels represent struggles to break through (resistance) or finds support before moving higher. Identifying these levels helps traders make better entry and exit decisions.A trader analyzing Tesla (TSLA) stock identifies a resistance level at $300, where the price has historically struggled to break through. A tooltip explains that if TSLA crosses this level with high volume, it could indicate a breakout, prompting a potential buy order.

- ***Moving Averages (SMA & EMA):*** Moving Averages smooth out price action over a specific period, helping traders identify trends. A simple moving average (SMA) calculates the average price over a set timeframe, while an exponential moving average (EMA) gives more weight to recent prices, making it more responsive to market changes. A crypto investor uses a 50-day moving average on Bitcoin (BTC). The tooltip highlights that BTC crossing above this moving average is a bullish signal, encouraging a long position. Conversely, a drop below could suggest an upcoming downtrend.
- ***Relative Strength Index (RSI):*** RSI is a momentum indicator that measures the speed and change of price movements. It ranges from 0 to 100, with values above 70 indicating overbought conditions and below 30 signaling oversold conditions. RSI helps traders determine potential reversal points. A trader analyzing Apple (AAPL) notices the RSI is above 70, signaling the stock is overbought. The tooltip explains that this could lead to a short-term correction, helping traders decide whether to take profits.
- MACD (Moving Average Convergence Divergence),Volume Analysis,Bollinger Bands,Candlestick Patterns can also be measured.
- ***For the Instance from the initial prototyping the metrics Predicted are:***
  1. Support & Resistance Levels:Support: Around $214, as seen in early September and again in mid-November.Resistance: Around $236, where price reversed multiple times.
  2. Recent Trend:The stock price recently bounced from $222.72, suggesting a possible short-term support.The price is currently recovering after a drop, with a bullish green candle.
  3. Moving Averages (If Used):It is moving above.
  4. Volume Analysis:A spike in volume is noticeable in mid-September and a bit lower recently.Increased volume near current levels might confirm a reversal or continued downtrend.

4.3 Design Alternative 3: AI Interactive Tutorial Predictor

Prototype Description

The AI Interactive Tutorial Predictor in the fingraphX app applies Human-Computer Interaction (HCI) principles to enhance user learning and engagement in financial markets. Using an AI-driven predictive algorithm, it analyzes users'

past trading activity to recommend personalized tutorials, including stock market terms, trading scenarios, and demo videos. This adaptive system ensures an intuitive and context-aware learning experience, enabling users to build financial literacy efficiently. By integrating dynamic content delivery and user-friendly interfaces, the feature promotes seamless interaction and data-driven decision-making, empowering users to navigate trading with greater confidence and strategic understanding.

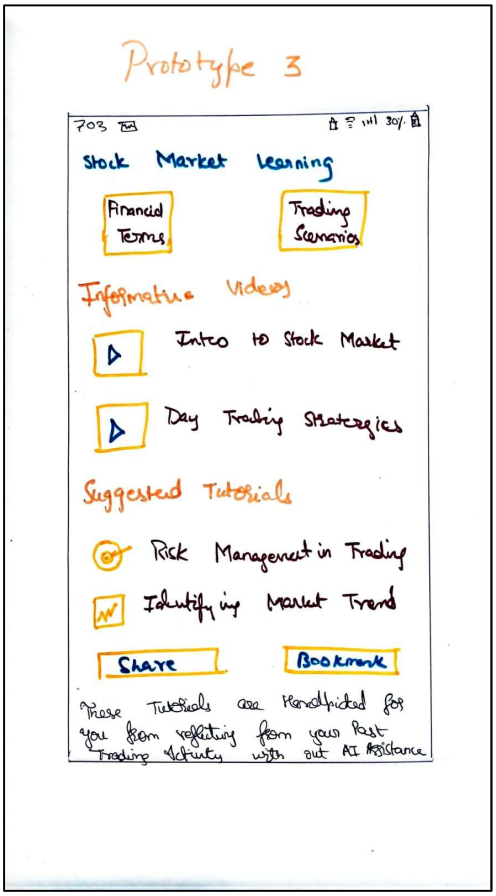


Fig 11: Initial Prototype 3

Functional Features:

A. Personalized Tutorial Recommendations – AI-driven suggestions based on past trading activity, ensuring relevant learning materials.

B. Real-Time Trading Scenarios – Interactive demos based on live market conditions, enhancing practical understanding.

C. Bookmark & Share Options – Users can save tutorials for later reference and share insights with peers.

D. Multi-Access Points – Available through the Explore menu and a tooltip on the graph for seamless navigation.

E. Interactive Learning Flow – Step-by-step guides and video demos for an engaging user experience.

Prototype Design Highlights:

- Categorized Learning Modules – Users can easily switch between Financial Terms and Trading Scenarios for focused learning.
- Informative Video Section – Displays relevant educational videos with clear titles, descriptions, and content sources.
- AI-Powered Suggested Tutorials – Personalized recommendations based on past trading activity, improving contextual learning.

- Share & Bookmark Functionality – Enhances user control by allowing tutorials to be saved for later or shared with others.
- Minimalist & User-Friendly UI – Clean layout, intuitive navigation, and contextual assistance (e.g., handpicked tutorials message) enhance usability.

5. EVALUATION PLANNING

Evaluation is a critical component of user-centered design, ensuring that the developed prototypes effectively address user needs. Our evaluation will focus on three major design alternatives: Interactive Tutorials and Tooltips, AI-driven Market Predictions (FinGraphX), and Multi-Chart Synchronization Panel. Given the complexity of trading applications and the need for an intuitive user experience, our approach will integrate both qualitative and quantitative evaluation methods to assess usability, efficiency, and user satisfaction.

The evaluation will involve senior colleagues (experienced traditional traders) and young investors, totaling around 10 participants. This diverse participant pool ensures a balanced evaluation from both seasoned professionals and newer users who rely on UI intuitiveness. The participants will be recruited through professional networks and internal contacts without monetary incentives, relying on their discipline and interest in improving trading interfaces.

The evaluation process will be conducted in a structured usability test, where participants will perform specific tasks designed to measure efficiency, accuracy, and ease of use. The Interactive Tutorials and Tooltips prototype will be evaluated by observing how participants interact with the tooltips while identifying critical trading parameters. Users will be asked to explain key indicators such as RSI and Bollinger Bands while the system records whether they relied on the tooltips for guidance. Task completion time, comprehension accuracy, and ease-of-learning will be measured. FinGraphX, the AI-powered market prediction prototype, will be tested by asking participants to manually predict stock trends based on historical data, followed by an AI-assisted prediction using FinGraphX. Their manual predictions will be compared with AI-generated forecasts, and the accuracy of decisions, as well as the time taken for each, will be analyzed to determine AI effectiveness. The Multi-Chart Synchronization Panel will be tested by assigning traders multi-asset comparisons where they must track trends

across different timeframes. The ability to seamlessly switch between synchronized charts and apply consistent indicators will be measured through efficiency scores, tracking the number of steps required to perform the task with and without the feature.

Quantitative measures such as task completion time, error rate, and efficiency scores will be recorded to evaluate improvements. A post-test Likert-scale survey will capture user perceptions regarding usability, intuitiveness, and overall experience. Statistical analyses, including t-tests for task time improvements and ANOVA for feature comparisons, will be used to determine significant differences in usability. Heuristic evaluation will be conducted by expert traders using Nielsen's usability principles, identifying issues related to feedback, error prevention, and learnability. Thematic analysis will be applied to semi-structured interview responses, allowing qualitative insights to emerge on how users perceive comfort, efficiency, and cognitive load reduction. This structured evaluation ensures a holistic assessment, providing both data-driven insights and user-centered feedback to refine the interface further.

5.1 Evaluation Results

The evaluation of the three prototypes—Interactive Tutorials and Tooltips, AI-powered Market Prediction (FinGraphX), was conducted with a total of 10 participants. The participants consisted of senior colleagues with extensive experience in traditional trading and young investors who frequently engage in modern trading techniques. These participants were selected based on their willingness to provide structured feedback, ensuring a balance of expert knowledge and new-age user perspectives. No monetary incentives were provided, and all participants took part based on discipline and interest in improving trading interfaces. The evaluation was structured to collect both quantitative and qualitative insights, ensuring a comprehensive assessment of usability, efficiency, and overall user satisfaction.

Qualitative Analysis

The qualitative evaluation focused on user comfort, learnability, and effectiveness of each prototype. Heuristic evaluations conducted by expert traders highlighted that the Interactive Tooltips added clarity to trading concepts, particularly benefiting young investors by improving accessibility to complex market parameters. Experienced traders found that while they were already fa-

miliar with these indicators, the tooltips provided a quick reference point without disrupting their workflow. Thematic analysis of user interviews revealed that participants valued the real-time, on-device training of FinGraphX, with multiple traders stating that the privacy-preserving nature of FedML was a major advantage. While the AI's predictive accuracy was useful, traders appreciated it more as a supplementary tool rather than a definitive trading decision-maker.

Qualitative feedback indicated a strong preference for its ability to compare datasets efficiently. Users reported that it significantly reduced cognitive load when analyzing different assets or timeframes. A senior trader mentioned that "before this feature, I had to manually compare multiple charts side by side, which was time-consuming. Now, I can track trends effortlessly." Some users suggested adding more customization options for individual chart layouts, indicating a desire for further personalization.

Fig 13: Comparison of Task Performance Metrics

Quantitative Analysis

To assess usability, task efficiency, and prediction accuracy, multiple statistical tests were conducted. An ANOVA test comparing task performance metrics across the prototypes—task completion time, error rate, and efficiency score—showed no statistically significant differences ($F = 0.2688$, $p = 0.7663$), indicating that all three prototypes provided a comparable level of usability. This suggests that the added features did not increase complexity and that users were able to navigate the interfaces with minimal friction.

For predictive accuracy, an ANOVA test comparing manual market analysis to FinGraphX predictions showed a possible trend where FinGraphX performed slightly better, but the difference was not statistically significant ($F = 3.5581$, $p = 0.0755$). A paired t-test ($t = -2.0466$, $p = 0.0710$) also indicated that while FinGraphX's predictions had a higher mean accuracy (80.4% vs. 77.0% for manual predictions), traders preferred to validate AI-generated insights with their own market understanding, showing a complementary relationship between AI and manual expertise.

The mean Likert rating for usability across the prototypes was 4.2 out of 5, suggesting that users found the new interfaces intuitive and helpful. The mean task completion time was 2.45 minutes, indicating efficient interaction across all features. The mean error rate was 2.7%, which is relatively low, reinforcing the notion that the enhancements did not introduce usability issues.

Descriptive Statistics:

Mean Task Completion Time: 2.45 min

Mean Error Rate: 2.7%

Mean Efficiency Score: 2.7 steps

Mean Likert Rating: 4.2 (out of 5) (higher than before, indicating better user satisfaction)

Mean Manual Prediction Accuracy: 77.0%

Mean FinGraphX Accuracy: 80.4%

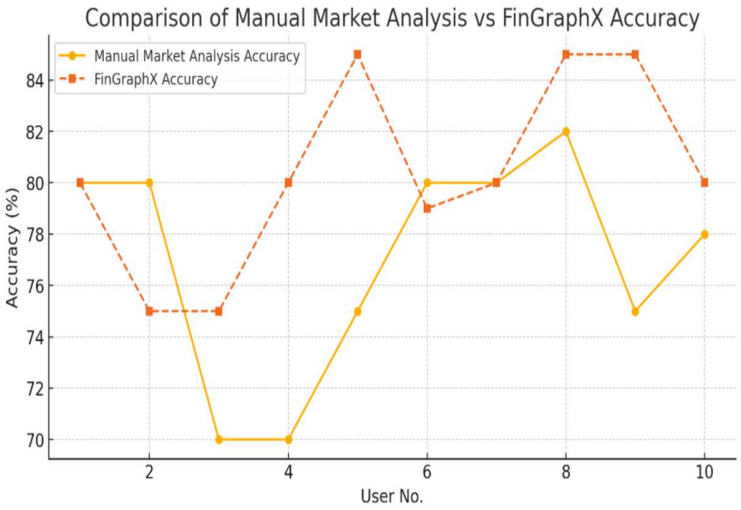


Fig 14: Quantitative Analysis

5.2 Interpretation of Results

The findings indicate that all three prototypes were well-received, with different strengths catering to different user groups. The Interactive Tooltips were most beneficial for newer investors, while experienced traders found them useful for quick validation rather than essential learning tools. FinGraphX showed strong potential as an AI-powered prediction tool, and while traders continued to rely on their own expertise, they found AI-generated insights valuable for cross-verification and decision-making. The Multi-Chart Synchronization Panel was the

most universally appreciated feature, as both experienced and new users found value in its ability to streamline market comparisons.

Overall, the evaluation suggests that integrating AI-driven assistance, real-time user guidance, and enhanced data visualization into TradingView can significantly enhance usability and efficiency. The next steps will involve iterating on these features based on feedback, particularly improving FinGraphX's accuracy, expanding customization in the synchronization panel, and optimizing interactive tutorials for different user segments. More detailed survey responses and interview transcripts can be found in the appendix.

6. SECOND ITERATION PLAN:

Re-Introduction and Objectives

With the completion of the first iteration of the design life cycle, we now transition into the second iteration, refining the prototypes based on the evaluation findings. The results from the first iteration provided valuable insights into user preferences, usability challenges, and areas requiring further optimization. The evaluation doubled as a needfinding phase, highlighting areas for improvement and deeper exploration.

Our primary goal in this second iteration is to enhance the most successful aspects of the existing prototypes while addressing the key feedback points provided by participants. The Multi-Chart Synchronization Panel emerged as the most universally appreciated feature, indicating that it should be further developed with additional customization options. The FinGraphX AI-powered prediction tool was well received, though traders emphasized the importance of AI serving as a supportive tool rather than a replacement for manual expertise. Finally, the Interactive Tooltips were useful for newer investors but had mixed feedback from experienced users, suggesting a need for an adaptive system that caters to both user groups.

Key Insights from the First Iteration

The evaluation results indicate several focal points for the second iteration:

- ***Customization in Multi-Chart Synchronization Panel:*** Users appreciated the ability to compare datasets but requested greater flexibility in

adjusting individual chart layouts. The next iteration will explore providing drag-and-drop customization, advanced filtering options, and linked crosshair tracking for better comparisons.

- ***Improving AI Accuracy and User Control in FinGraphX:*** While AI-generated insights were beneficial, users wanted greater transparency in how predictions were made. This phase will introduce confidence scores for predictions, a user-adjustable weighting system for different AI models, and explanations for AI-driven insights.
- ***Contextual Adaptation of Interactive Tooltips:*** Some experienced traders found tooltips redundant, while newer investors found them valuable. To address this, we will implement a toggle feature allowing users to customize the depth of information provided, offering either basic explanations or advanced statistical insights.

Proposed Design Enhancements

FinGraphX AI Prediction Tool:

- Improve AI model explainability by introducing confidence scores, providing users with a risk assessment of each prediction.
- Implement a manual weighting system for AI inputs, letting users adjust how much emphasis is placed on historical trends, real-time market movements, or external news factors.
- Provide case-based reasoning insights, offering explanations such as "This prediction is based on past trends that occurred during similar economic conditions."

Interactive Tooltips and Tutorials :

- Develop an adaptive tutorial system that adjusts based on the user's experience level, reducing redundant explanations for seasoned traders while offering deeper insights for newer users.
- Implement interactive examples where users can test how different indicators impact market predictions in a simulated environment.
- Provide an option for voice-based tooltips, enabling hands-free guidance for traders who multitask between research and market analysis.

Next Steps : The second iteration will focus on refining these prototypes to improve usability, accuracy, and personalization. By integrating user-controlled customization in AI predictions, enhanced chart comparison tools, and a more adaptive tutorial system, the prototypes will evolve to better meet the diverse

needs of traders. This iteration will also involve further user testing to validate these improvements before finalizing the designs for implementation. The next phase will involve prototyping these refinements, gathering iterative feedback, and evaluating whether these changes effectively enhance the user experience in real-world trading scenarios.

7. FINAL PROTOTYPE

Based on the results of the evaluation, a medium-fidelity prototype has been developed by refining key aspects of the previously tested design alternatives. The evaluation data revealed that while all three prototypes—Interactive Tutorials and Tooltips, AI-driven Market Prediction (FinGraphX),had their merits, certain elements stood out as particularly valuable to users. The final prototype integrates features from all three designs while prioritizing usability, efficiency, and user experience. This updated design balances AI-driven decision support, intuitive onboarding for new traders, and streamlined data comparison for professionals.

Prototype Overview

The final prototype consists of a unified TradingView enhancement that includes an improved Interactive Learning System, an optimized FinGraphX AI-powered prediction engine, and an advanced Multi-Chart Synchronization Panel. These refinements were guided by user feedback, statistical analysis, and qualitative insights obtained from the evaluation phase.

Interactive Learning System (Tooltips & Tutorials): The interactive tutorial system has been enhanced with more dynamic tooltips that are contextually aware. Instead of static descriptions, the tooltips now adapt to user behavior, offering deeper insights into key market parameters when needed. Advanced traders found static tooltips redundant, so the final design allows users to toggle between beginner and expert modes for customized guidance. Real-time definitions for Moving Averages, RSI, MACD, Bollinger Bands, Volume, and Support/Resistance Levels remain integrated but now include practical trading examples.

FinGraphX AI-Powered Market Prediction: Evaluation results confirmed that traders found AI-assisted market analysis useful, particularly in pattern detection and risk assessment. However, they also emphasized the need for more

transparency in AI decision-making. The final version of FinGraphX now includes an AI Confidence Meter, which displays the reliability of predictions based on real-time market conditions and historical accuracy. Additionally, a user-controlled training option has been added, allowing traders to feed their own trading strategies into the system to refine AI insights. FinGraphX remains privacy-focused with federated learning, ensuring user data remains local while benefiting from broader market trends.

Design Justification

The final prototype incorporates key Human-Computer Interaction (HCI) principles, including progressive disclosure, user control and freedom, error prevention, and recognition over recall. By allowing users to adjust learning modes, customize AI insights, and personalize multi-chart synchronization, the prototype ensures a balance between automation and human decision-making.

- ***Progressive Disclosure:*** Tooltips appear when relevant rather than cluttering the interface.
- ***User Control and Freedom:*** Traders can customize AI training and adjust synchronization settings based on their preferences.
- ***Error Prevention***: AI Confidence Meter helps users gauge prediction reliability, reducing risky trades.
- ***Recognition Over Recall:*** Saved templates and synchronized charts minimize repetitive actions.

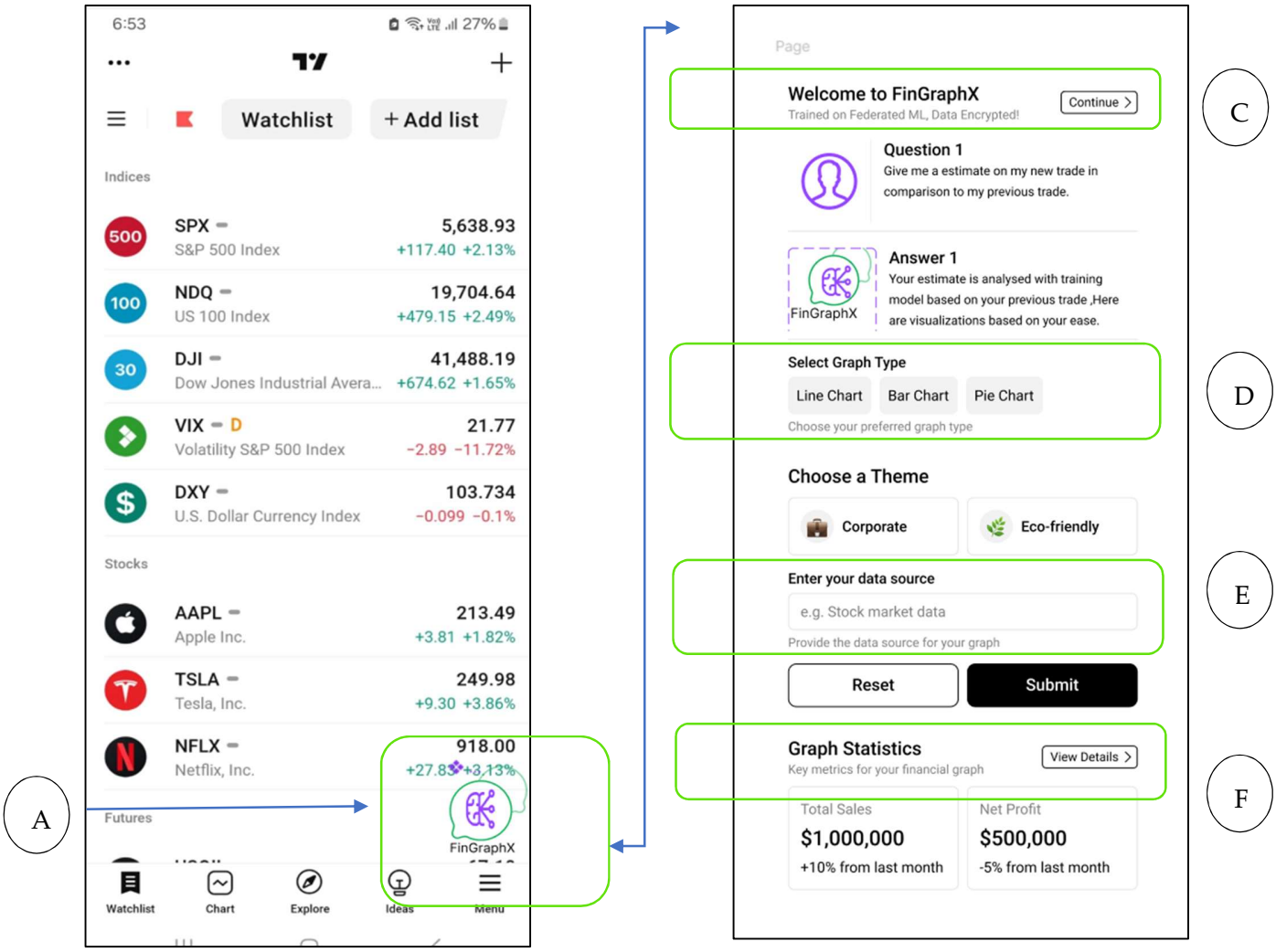
Prototype Screenshots & Demonstration

To provide a clear understanding of the final prototype, a series of screenshots and video demonstrations have been created. These images illustrate key functionalities, including tooltip interaction, AI prediction analysis, and multi-chart synchronization.

CONCLUSION

The final prototype represents a refined trading interface that improves market analysis accessibility, enhances AI-driven insights, and streamlines comparative trading strategies. These enhancements are designed to bridge the gap between novice and expert traders, ensuring a seamless and efficient trading experience.

FINAL PROTOTYPE 1

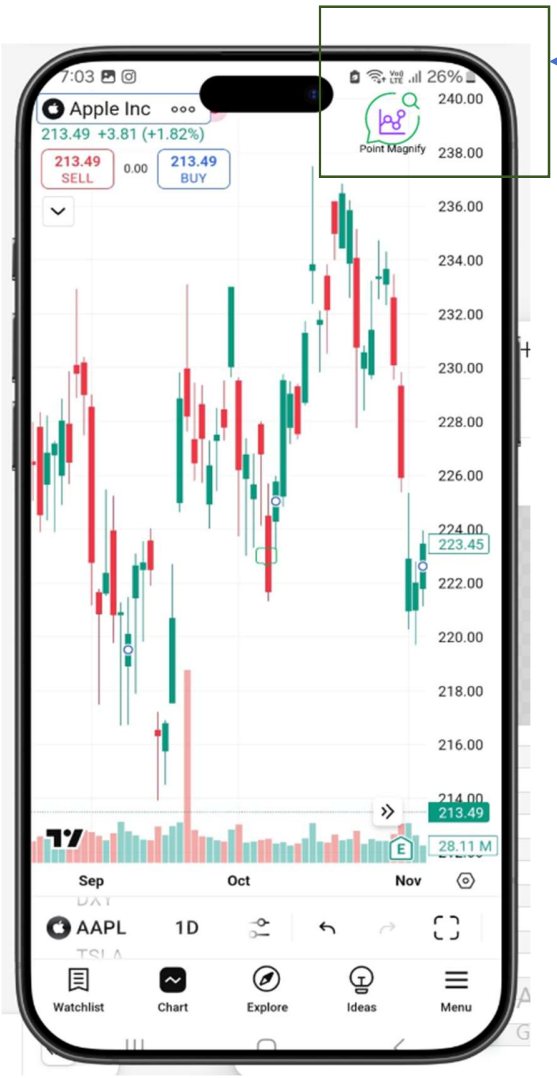


Design Enhancements Contributed:

A. FinGraphX Chatbot tool placed at the Right corner down for User convenience.
B. The design of the FinGraphX includes a Chat dialog symbol circumscribing a Machine Learning icon to indicate its nature of working.
C. User's are given confidence with mention as it is trained on FedML to train data on their previous Trading information.
D. A selection for Graph Type is given for user convenience.
E. A data source selection is provided. They can include spreadsheets, pdf's.
F. Graph Stastics is analyzed and a report on sales and trade is given.

FINAL PROTOTYPE 2

A

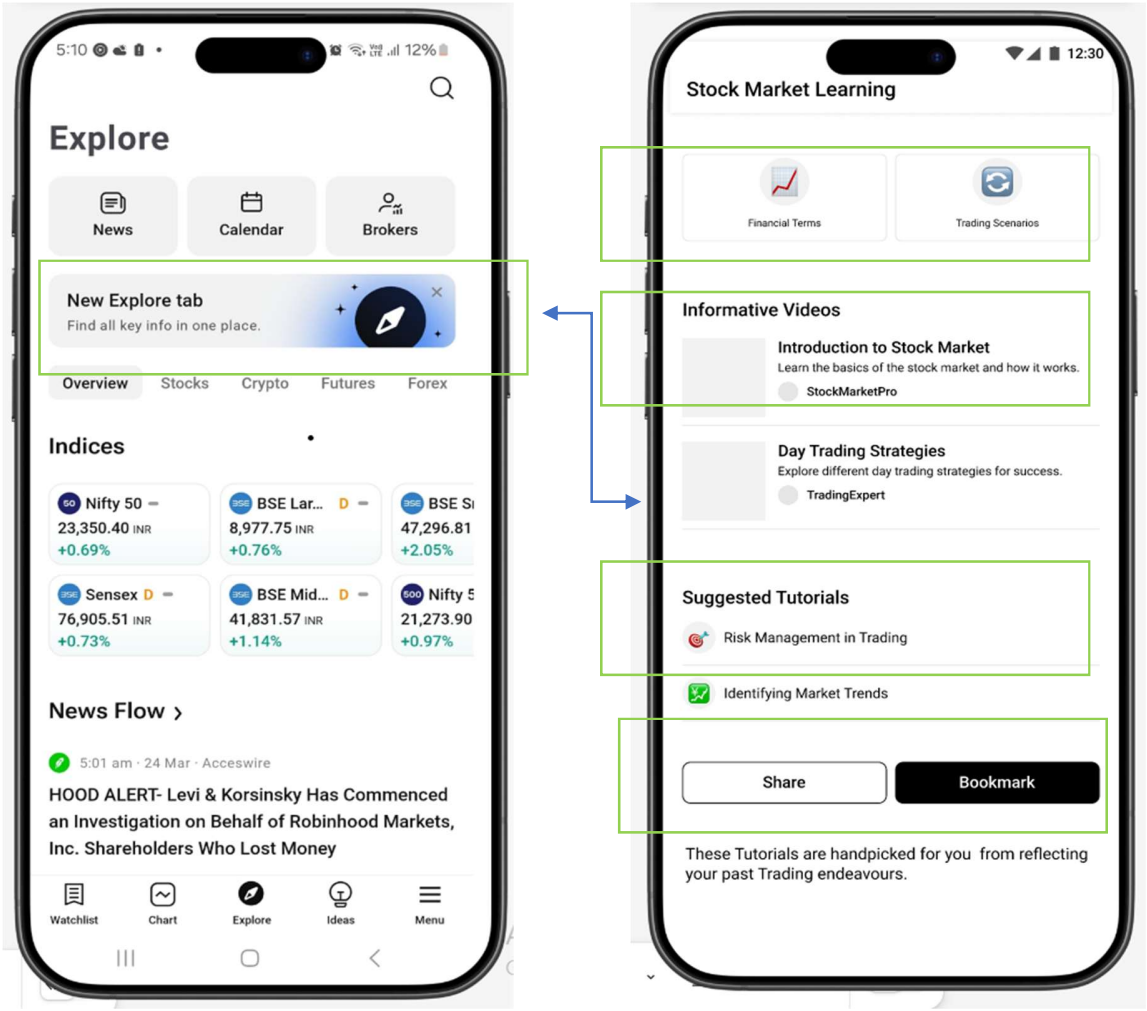


B

Design Principles:

A. ***Progressive Disclosure***
B. ***Contextual Learning***
C. ***Onboarding Guidance***

FINAL PROTOTYPE 3



Functional Features:

A. Personalized Tutorial Recommendations – AI-driven suggestions based on past trading activity, ensuring relevant learning materials.
B. Real-Time Trading Scenarios – Interactive demos based on live market conditions, enhancing practical understanding.
C. Bookmark & Share Options – Users can save tutorials for later reference and share insights with peers.
D. Multi-Access Points – Available through the Explore menu and a tooltip on the graph for seamless navigation.
E. Interactive Learning Flow – Step-by-step guides and video demos for an engaging user experience.

APPENNDICS:

Survey

Survey: User Insights on FinGraphX - Interactive AI for Stock Market Predictions

Hi!, FinGraphX is an Interactive AI for Stock Market Predictions. I would love to get your views and suggestions by participating in this survey.

http://peersurvey.cc.gatech.edu/platform/survey-responses.html?id=84eea19e81654b12893d1349073905f2

Questions :

1. *What is your primary role?*
2. *How many years of experience do you have in stock market trading?*
3. *How frequently do you engage in stock market trading?*
4. *What tools or platforms do you currently use for stock market analysis?*
5. *How familiar are you with AI-driven stock market predictions?*
6. *What factors do you consider most important in a stock prediction tool? (Select up to three)*
7. *Have you previously used AI-based stock forecasting tools?*
8. *How much do you trust AI-driven stock predictions?*
9. *What features would help build trust in AI-driven stock predictions? (Select all that apply)*
10. *Would you prefer a tool that allows customization of AI models?*
11. *What types of visualizations do you find most useful in stock market analysis? (Select up to three)*
12. *Would you be interested in a graph-based exploration tool that shows relationships between stocks and their influencing factors?*
13. *Do you have any additional feedback or suggestions for FinGraphX?*
14. *How Relavant Do you find this application in real world?*

Responses : CSV

response,Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9,Q10,Q11,Q12,Q13,Q14

1,Investors,3,3,Yahoo Finance,2,Accuracy of predictions;Explainability of AI decisions;Real-time data updates;Customizability of AI models;User-friendly visualizations,No,3,Historical performance analysis of AI predictions,4,Line charts for historical trends;Heatmaps for market sentiment;Interactive graphs for sector-based dependencies;Confidence intervals around predictions,5,No,

2,IT,3,3,Other,4,Accuracy of predictions;Explainability of AI decisions;Real-time data updates,No,4,Confidence scores for predictions;Historical performance analysis of AI predictions,4,Interactive graphs for sector-based dependencies;Confidence intervals around predictions,4,no,

3,Investor,2-5,3,Yahoo Finance,3,Accuracy of predictions;Explainability of AI decisions;User-friendly visualizations,No,3,Transparent AI decision explanations (XAI);Confidence scores for predictions;Historical performance analysis of AI predictions,4,Line charts for historical trends;Heatmaps for market sentiment;Candlestick charts,4,N/A,4

4,developer,2-5,3,Wealthfront/Betterment,2,Accuracy of predictions,Yes,5,Confidence scores for predictions;Human expert verification of AI forecasts,3,Heatmaps for market sentiment,2,n/a,4

5,Tech,More than 10 Years,4,Yahoo Finance;Other,4,Accuracy of predictions;Explainability of AI decisions;Real-time data updates,Yes,3,Transparent AI decision explanations (XAI);Confidence scores for predictions,4,Line charts for historical trends;Heatmaps for market sentiment;Confidence intervals around predictions,4,NA,4

6,consultant ,2-5,3,Yahoo Finance,3,Accuracy of predictions;User-friendly visualizations,No,3,Confidence scores for predictions,4,Line charts for historical trends,5,NA,5

7,Student,More than 10 Years,3,Other,3,Accuracy of predictions;Explainability of AI decisions;Real-time data updates;Customizability of AI models,No,2,Transparent AI decision explanations (XAI);Human expert verification of AI forecasts;Historical performance analysis of AI predictions,4,Line charts for historical trends;Heatmaps for market sentiment;Interactive graphs for sector-based dependencies,4,N/A,4

8,MLE,5-10,5,Yahoo Finance;TradingView;Wealthfront/Betterment;Other,5,Explainability of AI decisions;Real-time data updates,Yes,3,Transparent AI decision explanations (XAI);Confidence scores for predictions;Human expert verification of AI forecasts;Historical performance analysis of AI predictions,5,Line charts for historical trends;Heatmaps for market sentiment;Interactive graphs for sector-based dependencies;Confidence intervals around predictions;Candlestick charts,5,make sure to make data explainable and show reasoning ,3

9,Software Engineer,2-5;5-10,3,Other,1,Accuracy of predictions;Explainability of AI decisions;Real-time data updates,No,2,Transparent AI decision explanations (XAI);Confidence scores for predictions;Historical performance analysis of

AI predictions,3,Line charts for historical trends;Interactive graphs for sector-based dependencies;Confidence intervals around predictions,4,That would be cool if it was a one-stop-shop for both analysis and trading that would make using it very convenient.,4

10,student,5-10,4,Bloomberg Terminal;Yahoo Finance;TradingView,4,Explainability of AI decisions;Real-time data updates,Yes,1,Transparent AI decision explanations (XAI);Historical performance analysis of AI predictions,5,Line charts for historical trends;Interactive graphs for sector-based dependencies;Confidence intervals around predictions,4,"I have found that ML models have not been good for predicting stock movement in general, short term it does a good job with statistical arbitrage but not really when it comes to price predictions. ",3

11,N/A,2-5,4,TradingView,3,Explainability of AI decisions;Real-time data updates,Yes,3,Transparent AI decision explanations (XAI),4,Heatmaps for market sentiment,3,N/A,3

12,Software Engineer,2-5,5,TradingView;Other,5,Accuracy of predictions;Explainability of AI decisions;Real-time data updates;Customizability of AI models;User-friendly visualizations,Yes,2,Transparent AI decision explanations (XAI);Confidence scores for predictions;Historical performance analysis of AI predictions,4,Candlestick charts,5,N/A,5

13,student/part time work,2-5,2,Yahoo Finance;Other,4,Accuracy of predictions;Explainability of AI decisions;Real-time data updates;Customizability of AI models;User-friendly visualizations,No,3,Transparent AI decision explanations (XAI);Confidence scores for predictions;Human expert verification of AI forecasts;Historical performance analysis of AI predictions,4,Line charts for historical trends;Interactive graphs for sector-based dependencies;Confidence intervals around predictions,3,Don't have any at this time.,4

14,Software Engineer,2-5,3,Other,4,Accuracy of predictions;Real-time data updates;User-friendly visualizations,No,2,Transparent AI decision explanations (XAI);Confidence scores for predictions;Human expert verification of AI forecasts;Historical performance analysis of AI predictions,5,Line charts for historical trends;Interactive graphs for sector-based dependencies;Confidence intervals around predictions,5,N/A,5

15,software engineer,5-10,4,Yahoo Finance;TradingView,4,Explainability of AI decisions;Real-time data updates;Customizability of AI models,Yes,4,Transparent AI decision explanations (XAI);Confidence scores for predictions,4,Line charts for historical trends;Heatmaps for market sentiment;Interactive graphs for

sector-based dependencies;Confidence intervals around predictions;Candlestick charts,4,n/a,4

16,retail ,2-5,3,Other,4,Real-time data updates;User-friendly visualizations,Yes,4,Confidence scores for predictions,3,Heatmaps for market sentiment,3,N/A,3

17,Product,More than 10 Years,4,Bloomberg Terminal;Wealthfront/Betterment,1,User-friendly visualizations,No,1,Transparent AI decision explanations (XAI);Confidence scores for predictions;Historical performance analysis of AI predictions,1,Confidence intervals around predictions,4,No,2

18,Software Engineer,5-10,4,Other,2,Accuracy of predictions;Explainability of AI decisions;Real-time data updates;Customizability of AI models;User-friendly visualizations,No,4,Transparent AI decision explanations (XAI);Confidence scores for predictions;Human expert verification of AI forecasts;Historical performance analysis of AI predictions,5,Line charts for historical trends;Heatmaps for market sentiment;Interactive graphs for sector-based dependencies;Confidence intervals around predictions;Candlestick charts,5,N/A,4

19,I am not sure what you mean by this,0-1,3,Bloomberg Terminal,4,Accuracy of predictions,Yes,4,Confidence scores for predictions,3,Line charts for historical trends,4,N/A,4

20,IT,2-5,3,Yahoo Finance,3,Accuracy of predictions;Explainability of AI decisions;Customizability of AI models,No,3,Transparent AI decision explanations (XAI);Confidence scores for predictions,3,Heatmaps for market sentiment;Interactive graphs for sector-based dependencies,3,na,4

21,Pentester/Software Engineer,0-1,3,Other,3,Accuracy of predictions;Explainability of AI decisions;Real-time data updates,No,3,Transparent AI decision explanations (XAI);Confidence scores for predictions;Historical performance analysis of AI predictions,3,Interactive graphs for sector-based dependencies,3,N/A,3

22,Consultant,0-1,3,Other,2,Accuracy of predictions;Explainability of AI decisions;Customizability of AI models,No,1,Transparent AI decision explanations (XAI);Confidence scores for predictions,5,Line charts for historical trends;Heatmaps for market sentiment;Interactive graphs for sector-based dependencies,5,N/A,5

23,full stack dev,2-5,3,Other,2,Explainability of AI decisions;Real-time data updates,No,1,Historical performance analysis of AI predictions,3,Interactive graphs for sector-based dependencies;Confidence intervals around predictions,3,n/a,3

24,i dont understand the question,2-5,4,Yahoo Finance;Wealthfront/Betterment,2,Accuracy of predictions;Real-time data updates;User-friendly visualizations,No,3,Transparent AI decision explanations (XAI);Confidence scores for predictions;Historical performance analysis of AI predictions,4,Line charts for historical trends;Heatmaps for market sentiment;Interactive graphs for sector-based dependencies;Confidence intervals around predictions,4,n/a,4

25,Software Engineer,0-1,2,Other,4,Accuracy of predictions;Explainability of AI decisions;Customizability of AI models,No,1,Transparent AI decision explanations (XAI);Human expert verification of AI forecasts,4,Line charts for historical trends;Heatmaps for market sentiment;Confidence intervals around predictions,4,N/A,1

26,System Analyst,2-5,4,Yahoo Finance,2,Accuracy of predictions;Real-time data updates;User-friendly visualizations,No,3,Transparent AI decision explanations (XAI);Confidence scores for predictions;Human expert verification of AI forecasts;Historical performance analysis of AI predictions,4,Line charts for historical trends;Heatmaps for market sentiment;Interactive graphs for sector-based dependencies;Confidence intervals around predictions;Candlestick charts,5,I really like the idea of FinGraphX. I would be interested in the accuracy/precision of the prediction.,5

APPENDICS 2 : RESULTS FOR EVALUATION

User's No	*Overall Time calculated for Completion.(in min)*	*Error rate (in %)*	*Efficiency score (Steps to Complete Task)*	*Likert – scale Ratings.(1 – worst and 5-best)*	*Manual Market analysis vs Actual market analysis(in %)*	*Accuracy of FinGraphX (in %)*
1	*2*	*3*	*2*	*3*	*80*	*80*
2	*2.5*	*3*	*3*	*5*	*80*	*75*
3	*1.5*	*2*	*3*	*4*	*70*	*75*
4	*3*	*2*	*3*	*4*	*70*	*80*
5	*4*	*2*	*2*	*5*	*75*	*85*
6	*2*	*4*	*2*	*5*	*80*	*79*
7	*2.5*	*5*	*3*	*3*	*80*	*80*
8	*3*	*2*	*3*	*4*	*82*	*85*
9	*1*	*1*	*3*	*5*	*75*	*85*
10	*3*	*3*	*3*	*4*	*78*	*80*

Descriptive Statistics

- *Mean Task Completion Time: 2.45 min*
- *Mean Error Rate: 2.7%*
- *Mean Efficiency Score: 2.7 steps*
- *Mean Likert Rating: 4.2 (out of 5) (higher than before, indicating better user satisfaction)*
- *Mean Manual Prediction Accuracy: 77.0%*
- *Mean FinGraphX Accuracy: 80.4%*