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PARAMOUNT OF FINANCIAL ACCOUNTING FORECASTING WITH LEADING-EDGE ARTIFICIAL INTELLIGENCE (AI): A SYSTEMATIC LITERATURE REVIEW AND FUTURE RESEARCH AGENDA IN NIGERIA

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Abstract

This study explores the transformative impact of Artificial Intelligence (AI) on financial forecasting and its critical role in shaping modern investment strategies. As financial markets grow increasingly complex, conventional methods struggle to keep pace, leading to the adoption of advanced AI technologies for predicting trends, mitigating risks, and optimizing investment decisions. The paper evaluates a variety of innovative AI models, tools, and frameworks revolutionizing financial forecasting, including Machine Learning (ML) algorithms like recurrent neural networks (RNNs) and long short-term memory networks (LSTMs), which excel at identifying complex patterns in financial data to improve prediction accuracy. Additionally, the research analyzes Deep Learning approaches, such as convolutional neural networks (CNNs), for their ability to extract layered insights from diverse datasets, strengthening forecast reliability. The role of natural language processing (NLP) and sentiment analysis is also highlighted, demonstrating how they assess market sentiment and incorporate qualitative data into predictive models. The paper further investigates AI-powered tools like algorithmic trading platforms and robo-advisors, which automate investment strategies and enhance portfolio management using real-time data. Reinforcement Learning (RL) is examined for its adaptive decision-making capabilities in volatile markets. Emerging technologies, including quantum computing, are also discussed for their potential to revolutionize financial modeling by enabling sophisticated simulations and scenario analyses. Ultimately, this research provides a thorough examination of the evolving financial landscape, underscoring the need for ongoing innovation and adaptability to succeed in a rapidly changing industry.

Keywords: Artificial Intelligence, Financial Forecasting, Finance, Investment, Financial Markets, Commerce, Stock Market.

INTRODUCTION

The financial sector is undergoing a profound transformation, driven largely by the rapid advancement of Artificial Intelligence (AI). This integration of AI is revolutionizing traditional practices, unlocking new opportunities for investors and financial institutions alike [1-5].

One of the most impactful applications of AI lies in financial forecasting, where its ability to outperform conventional analytical methods has made it an indispensable tool for generating more accurate, efficient, and insightful predictions [6-9].

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This paper explores the intersection of AI-driven financial forecasting and the evolution of investment strategies, highlighting how advanced technologies, models, and frameworks are reshaping the landscape.

Financial forecasting plays a crucial role in investment decision-making, providing stakeholders with valuable insights into future market behavior, potential risks, and emerging opportunities. While traditional forecasting techniques have their strengths, they often struggle to keep pace with the complexity and volatility of today's financial markets.

AI, however, has emerged as a powerful solution, transforming not only finance but numerous other industries as well [10-14]. By bridging the gap between finance and technology, AI-powered forecasting has the potential to redefine how investments are strategized and managed [15-17].

Leading this transformation are several groundbreaking AI technologies. Machine Learning (ML), a core component of AI, allows algorithms to analyze historical data, adapt to changing market conditions, and continuously refine their predictive accuracy [18-22]. Deep Learning, an advanced branch of ML, utilizes neural networks that mimic human cognition, enabling the detection of complex patterns within vast datasets [23-25].

Additionally, Natural Language Processing (NLP) plays a vital role by interpreting human language, extracting meaningful insights from sources such as news articles, financial reports, and social media [26-29]. Figure 1 presents a co-occurrence analysis of relevant keywords found in the literature.

To enhance the precision of financial forecasts, sophisticated models have been developed. Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks, both deep learning architectures, are particularly effective at analyzing time-series data, making them ideal for predicting market movements.

Ensemble techniques, including Random Forests and Gradient Boosting, improve reliability by combining multiple algorithms to produce more robust predictions. Transformer-based models like BERT (Bidirectional Encoder Representations from Transformers) are also gaining traction, particularly in sentiment analysis for financial markets.

The practical application of AI in financial forecasting is supported by a variety of advanced tools and platforms [6,9]. Open-source frameworks such as TensorFlow and PyTorch offer scalable environments for building and deploying AI models. Specialized financial platforms like QuantConnect and QuantLib enable professionals to develop and test algorithmic trading strategies.

Additionally, cloud computing services—including AWS, Azure, and Google Cloud—provide the computational resources needed to process large datasets and train complex models efficiently. **Figure 2** illustrates a co-authorship analysis within the field.

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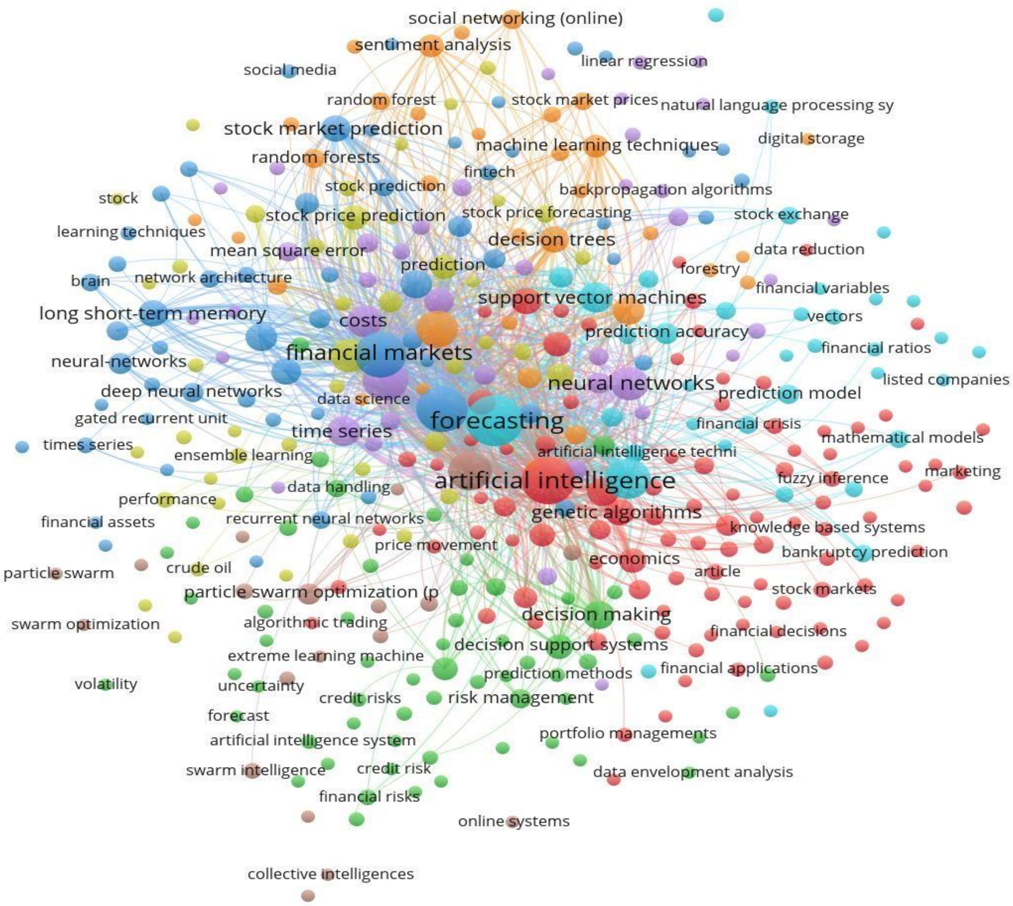

Figure 1: Displays a co-occurrence analysis of keywords found in the literature

Frameworks are essential in shaping the strategic direction of AI-driven financial forecasting. For instance, Explainable AI (XAI) methodologies such as LIME (Local Interpretable Model-agnostic Explanations) and SHAP (SHapley Additive exPlanations) improve model interpretability by offering clear insights into prediction mechanisms—a critical factor in building trust among financial professionals and regulatory bodies [30-37]. Meanwhile, Reinforcement Learning platforms like OpenAI's Gym and Stable-Baselines are increasingly used to refine trading strategies, enabling algorithms to learn iteratively within simulated market conditions. However, despite AI's significant potential in financial forecasting, several challenges and ethical concerns persist [38-43]. The opacity of complex AI models, often referred to as "black box" systems, creates issues related to accountability and decision-making transparency. Moreover, AI systems may reinforce biases present in historical financial data, leading to potentially discriminatory outcomes. Balancing technological advancement with ethical considerations is crucial to ensure AI is deployed responsibly in finance. This study seeks to examine the complexities of this evolution, addressing both the transformative opportunities and the ethical dilemmas posed by AI in redefining investment strategies.

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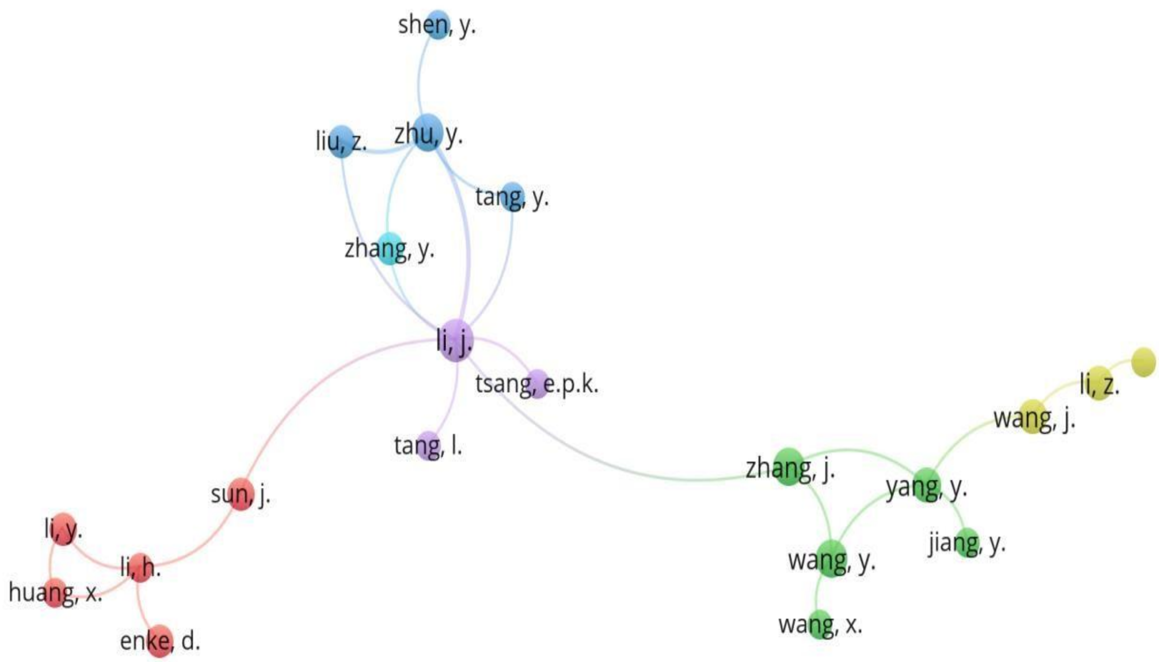

Figure 2: Co-authorship Analysis

METHODOLOGY

This study aims to analyze how Artificial Intelligence (AI) shapes the development of investment strategies, particularly in financial forecasting. To achieve this, the research integrates a comprehensive literature review with bibliometric analysis. These methods help synthesize current findings, uncover trends, pinpoint research gaps, and explore new themes in AI-driven financial forecasting. The literature review begins by defining the scope of AI's applications in financial forecasting and investment decision-making. This stage focused on identifying key terms such as *"Artificial Intelligence," "financial forecasting,"* and *"investment strategies"* to streamline the search for relevant academic literature. To ensure a broad and balanced selection of sources, the research systematically examined prominent databases, including *PubMed, IEEE Xplore, Scopus, and Google Scholar*. Clear inclusion and exclusion criteria were applied to prioritize studies closely related to AI-driven financial forecasting and investment decision-making.

Additionally, a detailed bibliometric analysis was performed using *Scopus* and *Web of Science* data, employing advanced analytical tools to examine publication trends, citation metrics, and collaborative research networks. This approach provided valuable insights into the evolution of research in this field.

By integrating a thorough literature review with bibliometric evaluation, the study lays a solid groundwork for understanding AI's role in advancing investment methodologies. The findings offer meaningful contributions to both academic discourse and real-world financial applications, guiding future research and innovation in this domain.

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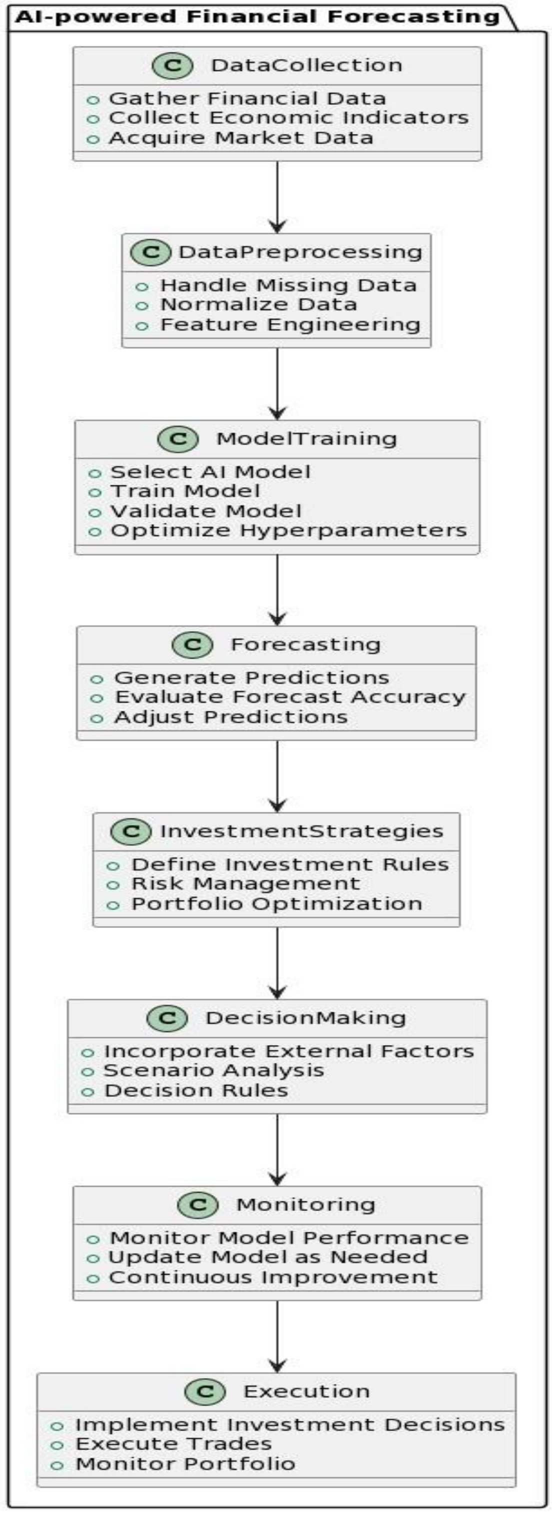

Figure 3: Artificial intelligence (AI)-powered financial forecasting for investment strategies

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RESULTS AND DISCUSSION

The Role of AI in Financial Forecasting for Investment Strategies

In recent years, artificial intelligence (AI) has become a cornerstone of financial forecasting, transforming how investment strategies are developed and decisions are made [2,7,9].

I. Machine Learning and Predictive Analytics

Machine learning (ML), a branch of artificial intelligence (AI), plays a transformative role in financial forecasting by enabling systems to improve their accuracy through iterative learning [19,24]. By analyzing past financial data, ML algorithms identify underlying patterns and trends, enhancing the reliability of future projections. Predictive analytics, powered by ML, is essential for anticipating market fluctuations, evaluating asset values, and managing risks. Common ML techniques used in financial forecasting include regression models, decision trees, and neural networks. These methods dynamically adjust to evolving market dynamics, ensuring continuous improvement in predictive accuracy. Their capacity to rapidly process large datasets allows for deeper market insights, making them invaluable for investors and financial analysts.

II. Natural Language Processing (NLP) in Financial Forecasting

Natural Language Processing (NLP) is a cutting-edge AI technology revolutionizing financial forecasting by interpreting and extracting meaning from human language. By analyzing unstructured data—such as news articles, social media content, and financial documents—NLP helps uncover critical insights for investment decisions [27,29]. A key application of NLP in finance is sentiment analysis, which evaluates public opinions on platforms like Twitter or financial forums to gauge market sentiment in real time.

These insights allow investors to detect emerging trends, assess risks, and refine their strategies proactively [44-48]. Additionally, NLP algorithms scan vast amounts of text to identify significant events, opinions, and contextual cues that may influence stock prices or economic trends. This capability enhances predictive accuracy and supports data-driven decision-making in volatile markets.

III. Robotic Process Automation (RPA) in Finance

Robotic Process Automation (RPA) utilizes software bots to perform repetitive, rule-based tasks automatically. Within finance, RPA improves operational efficiency by handling activities such as data input, report creation, and other routine processes.

This allows employees to dedicate more time to higher-value responsibilities, such as strategic planning and analysis [49-55]. By automating data aggregation and analysis, RPA minimizes manual errors in financial forecasting, ensuring that investment analysts work with precise and timely data. As a result, financial predictions and models become more dependable.

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IV. Quantum Computing

Quantum computing represents a cutting-edge advancement that could transform the field of financial forecasting [56–59]. While classical computers rely on binary bits (0 or 1), quantum computers utilize qubits, which allow for parallel data processing and significantly faster problem-solving capabilities. This technology excels at analyzing complex mathematical models and simulations, leading to more precise financial predictions [60–62]. Additionally, quantum algorithms enhance optimization tasks, portfolio management, and risk evaluation, facilitating real-time decision-making with greater accuracy. Although still in its developmental phase, quantum computing shows immense promise for revolutionizing financial forecasting.

V. Deep Learning

Deep learning, an advanced branch of machine learning, employs multi-layered neural networks to process and interpret large datasets. It has proven particularly effective in financial forecasting due to its ability to autonomously extract meaningful features from raw financial data, uncovering complex nonlinear relationships that conventional analytical methods often miss. For instance, deep neural networks can detect intricate market trends and subtle interdependencies between variables that influence stock prices. By leveraging these capabilities, deep learning enhances predictive accuracy, enabling investors to make better-informed, data-backed decisions [63–67].

VI. Blockchain Technology

While often linked to cryptocurrencies, blockchain technology is increasingly being adopted across the financial sector [69-73]. Its decentralized and transparent framework offers transformative potential for financial forecasting, particularly in areas such as risk assessment, fraud detection, and transaction settlement. Smart contracts—self-executing agreements with predefined coded terms—further improve efficiency by automating financial workflows. In investment management, blockchain increases transparency while minimizing counterparty risks [74-75]. Additionally, the tamper-proof nature of blockchain ledgers ensures data reliability, creating a trustworthy basis for precise financial forecasts.

VII. Explainable AI (XAI)

With the rapid evolution of artificial intelligence (AI), ensuring transparency in AI-driven decisions has become increasingly important. Explainable AI (XAI) tackles this issue by making AI model reasoning more understandable, allowing users to see how decisions are derived [30,31].

In financial forecasting, interpretability is essential—stakeholders must trust predictions and comprehend their underlying logic to make sound judgments. Methods such as rule-based systems and model-agnostic interpretability tools help demystify AI outputs, improving validation and trust. By fostering accountability, XAI strengthens the synergy between AI and human expertise, a key factor in meeting regulatory standards and managing risks in finance.

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VIII. Cognitive Computing

Cognitive computing integrates artificial intelligence (AI), machine learning, and natural language processing (NLP) to develop systems that replicate human cognitive functions. In financial forecasting, this technology improves decision-making by mimicking human reasoning and adaptive learning [76–85]. By processing large volumes of financial data, historical trends, and market variables, cognitive systems generate valuable insights for investors. Additionally, they evolve with new information, refining their predictive accuracy over time [77,80]. The application of cognitive computing in investment strategies enables more flexible and responsive approaches in volatile financial markets. The following equations represent key AI algorithms, including Principal Component Analysis (PCA):

PCA Objective Function:

$$J \quad \bar{x}^{(i)}|| \quad = \frac{1}{m}\sum_{i=1}^{m} ||x^{(i)} - \quad {}^{2}$$

Where,
J Objective function (mean squared reconstruction error)
m Number of data points
$x^{(i)}$ Original data point
$\bar{x}^{(i)}$ Reconstructed data point

Reinforcement Learning - Q-Learning Update Rule:

$$Q(s,a) = (1-\alpha)Q(s,a) + \alpha(R + \gamma\, max_{a'}\, Q\,(s', a'))$$

Where,
$Q(s,a)$ Value of state-action pair (s,a)
α Learning rate
R Immediate reward
γ Discount factor
$max_{a'}\, Q\,(s', a')$ Maximum value of the next state-action pair Softmax

Function (Multiclass Classification):

$$\text{softmax}(z)_i = \frac{e_{zi}}{\sum_{j=1}^{K} e_{zj}}$$

Where,

$\text{softmax}(z)_i$ Probability of class i in a multiclass classification
e^z Exponential of the input for class i
$\sum^{K}{}_{j=1} e^{zj}$ Sum of exponentials over all classes

ReLU (Rectified Linear Unit) Activation Function:

$$f(x) = ma\,x(0, x)$$

Where,
$f(x)$ Output of the ReLU activation function
x Input to the activation function

Gaussian Distribution Probability Density Function:

$$f(x|\mu, \sigma\ {}^{2})ex\,p\,(-\ (x2-\sigma\mu_2)^2) \quad = \frac{1}{\sqrt{2\pi\sigma^2}}$$

Where,
$f(x|\mu, \sigma^2)$ Probability density function of the Gaussian distribution μ
Mean of the distribution
σ^2 Variance of the distribution.
K-Means Clustering Objective Function:

$$J = \sum_{i=1}^{k} \sum_{j=1}^{n} ||x_j - \mu_i||^2$$

Where,

y Dependent variable
X Independent variable
m Slope of the regression line b Y-intercept of the regression line.

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Advanced AI Models for Financial Forecasting

A. Leveraging Recurrent Neural Networks (RNNs) for Time Series Analysis

RNNs are widely used in financial time series prediction due to their ability to model sequential data and temporal patterns [89-94]. Their architecture is especially effective for analyzing stock price movements and estimating market volatility, as financial data often exhibits time-dependent trends. A key variant of RNNs, Long Short-Term Memory (LSTM) networks, overcomes the vanishing gradient problem, enabling more reliable learning of long-range dependencies in financial datasets.

B. The Rise of Transformer Models

Transformer-based models, such as BERT and GPT, have revolutionized financial forecasting by enhancing the ability to interpret complex market trends [95–102]. These models are particularly adept at capturing contextual relationships, making them invaluable for sentiment analysis—a critical component in understanding market behavior. By utilizing pretrained language models, this advanced approach extracts subtle insights from various textual sources, including financial news, social media, and other unstructured data.

Table 1 highlights the most advanced AI technologies, models, tools, and frameworks currently shaping financial forecasting for investment strategies.

Table 1: Cutting-edge AI technologies, models, tools, and frameworks for financial forecasting in investment strategies

Sr No.	Category	Technology/ Model / Framework	Description	Key Features/ Advantages	Application in Financial Forecasting
1	Machine Learning	LSTM (Long Short-Term Memory)	Neural network for sequence prediction	Captures long-term dependencies, crucial for time series	Time series forecasting, e.g., stock prices
		Random Forest	Ensemble learning method	Handles non-linear relationships, feature importance analysis	Risk assessment, credit scoring
		Gradient Boosting	Ensemble learning for boosting weak learners	Improved accuracy, handles missing data	Portfolio optimization, fraud detection
2	Deep Learning	GPT (Generative Pre-trained Transformer)	Transformer based language model	Context-aware predictions, language understanding	Sentiment analysis, market impact of news
		CNN (Convolutional Neural Network)	Deep learning model for image analysis	Extracts hierarchical features, applicable to financial data	Pattern recognition in financial charts

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3	Natural Language Processing (NLP)	BERT (Bidirectional Encoder Representations)	Pre-trained language model	Understands context, relationships in textual data	Financial news sentiment analysis, document summarization
		Word Embeddings	Technique for representing words as vectors	Captures semantic relationships in language	Document clustering, sentiment analysis
4	Reinforcement Learning	DQN (Deep Q-Network)	Deep learning model for decision-making in sequential tasks	Learns optimal actions through trial and error	Algorithmic trading strategies
		Proximal Policy Optimization (PPO)	Policy optimization algorithm	Stable learning, suitable for continuous action spaces	Portfolio management, risk control
5	Forecasting Tools	Prophet	Open-source forecasting tool by Facebook	Handles seasonality, holidays, and outliers	Time series forecasting with daily observations
		ARIMA (Auto Regressive Integrated Moving Average)	Statistical method for time series forecasting	Captures trend, seasonality, and noise in data	Short-term financial prediction, market trends
6	Frameworks	TensorFlow	Open-source machine learning framework by Google	Scalable, supports deep learning and neural networks	Building and training complex financial models
		PyTorch	Open-source machine learning library by Facebook	Dynamic computational graph, popular for research	Developing and experimenting with new AI models

C. Ensemble Learning Techniques

Ensemble learning techniques, such as random forests and gradient boosting, have become increasingly vital in financial forecasting. These methods combine predictions from multiple models to compensate for individual limitations, thereby improving overall predictive performance. Their ability to handle data noise and uncertainty makes them particularly valuable in financial applications [103-107].

Empowering Financial Forecasting with Advanced Tools

A. TensorFlow and PyTorch

TensorFlow and PyTorch are leading open-source deep learning frameworks that have significantly advanced AI-driven financial forecasting. Known for their intuitive design, strong developer communities, and seamless integration with hardware accelerators, these tools are essential for financial analysts and data scientists.

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B. QuantLib and QuantConnect

Quantitative finance requires advanced tools for modeling and backtesting investment strategies. **QuantLib**, an open-source library, provides extensive functionality for derivatives pricing, risk analysis, and quantitative modeling. On the other hand, **QuantConnect** is a cloud-based platform that streamlines the development, backtesting, and execution of algorithmic trading strategies.

C. Tableau and Power BI

Data visualization plays a crucial role in financial forecasting, and tools like **Tableau** and **Power BI** are widely used for this purpose. These platforms enable analysts to create dynamic, interactive dashboards, making it easier to present complex financial data to stakeholders. Additionally, integrating AI-powered forecasting into these tools further enhances their analytical capabilities.

Frameworks Enabling Advanced Financial Forecasting

A. Interpretable AI (XAI) Frameworks

In financial forecasting, where decisions have substantial implications, the ability to interpret AI models is critical. Explainable AI techniques, such as SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-agnostic Explanations), help demystify complex models by revealing their decision-making processes. These frameworks enhance transparency, build trust, and clarify the key drivers behind predictions [108-115].

B. Reinforcement Learning in Financial Applications

Reinforcement learning has emerged as a powerful tool for financial forecasting and portfolio management [116-125]. Platforms like OpenAI's Gym and RLlib provide robust environments for designing and deploying reinforcement learning algorithms. These models refine decision-making strategies through continuous interaction with dynamic environments, allowing them to adapt to changing market conditions [126-130].

C. Cloud Computing for Scalable Forecasting

Cloud-based solutions have transformed financial forecasting by offering unmatched scalability and flexibility. Leading platforms such as AWS, Microsoft Azure, and Google Cloud deliver the necessary infrastructure for large-scale AI model training and deployment. This accelerates development cycles while optimizing resource efficiency and cost-effectiveness.

Challenges

A. Data Quality and Bias

The performance of AI models in financial forecasting depends heavily on the accuracy and diversity of the training data. Issues such as biased datasets or limited historical records can undermine prediction reliability. Addressing these challenges requires

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industry-wide collaboration to develop comprehensive, unbiased datasets for training AI systems.

B. Regulatory Compliance

With AI playing an increasingly critical role in financial decision-making, regulatory standards must adapt to promote transparency, fairness, and accountability. Achieving a balance between fostering innovation and maintaining compliance is essential for the long-term adoption of AI in finance.

C. Continuous Model Improvement

Financial markets are highly dynamic, requiring AI models to evolve alongside shifting conditions. Establishing effective feedback mechanisms and processes for regular model updates is key to maintaining the precision and applicability of AI-powered forecasts.

D. Ethical Considerations

The integration of AI in finance introduces critical ethical challenges, particularly regarding data privacy, security, and the responsible application of technology [137-142]. To maintain public confidence and promote ethical AI adoption, it is essential to develop clear guidelines and regulatory standards for AI model deployment in financial forecasting [142-145].

CONCLUSIONS

The financial sector, characterized by inherent uncertainty and constant market fluctuations, has experienced a significant transformation due to the rise of Artificial Intelligence (AI). AI is revolutionizing how investment strategies are designed and implemented. This study has examined the broad scope of AI-powered financial forecasting and its far-reaching impact on the evolution of investment methodologies. As we reflect on these findings, it is clear that advanced AI technologies—including sophisticated models, tools, and analytical frameworks—are poised to fundamentally alter financial decision-making. Among these innovations, machine learning (ML) stands out as a groundbreaking development. ML algorithms excel at processing vast datasets, identifying hidden patterns and trends that traditional analysis might overlook. Reinforcement learning, a specialized branch of ML, has shown particular promise in refining investment strategies by adapting to real-time market behavior. Additionally, deep learning architectures such as deep neural networks (DNNs), convolutional neural networks (CNNs), and recurrent neural networks (RNNs) have proven effective in modeling complex financial data relationships, leading to more accurate forecasts.

The Transformative Role of NLP in Financial Forecasting Natural Language Processing (NLP) is revolutionizing financial forecasting by enabling data-driven insights from unstructured text. A key application, sentiment analysis, evaluates market mood by processing sources like news reports and social media posts, helping investors gauge public opinion and refine strategies. Advanced NLP frameworks, including BERT (Bidirectional Encoder Representations from Transformers) and GPT-3 (Generative Pre-

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trained Transformer 3), excel in contextual language interpretation, allowing for sophisticated financial data analysis. **Explainable AI (XAI) for Transparent Decision-Making** as AI-driven financial models become more prevalent, Explainable AI (XAI) plays a crucial role in ensuring clarity and accountability. Tools like LIME (Local Interpretable Model-agnostic Explanations) and SHAP (SHapley Additive exPlanations) demystify complex algorithms, offering stakeholders actionable insights into prediction logic. This transparency fosters trust, particularly when AI informs high-stakes investment choices. **Ensemble Learning for Robust Predictions** to improve forecast accuracy and reduce model-specific biases, ensemble learning combines multiple algorithms into a unified predictive system. Methods such as Random Forests, Gradient Boosting Machines, and AdaBoost leverage diverse models to enhance reliability. By aggregating these outputs, financial analysts can achieve more stable and precise market predictions.

The use of AI-driven tools in portfolio management has transformed traditional asset allocation, making it more adaptive and data-driven. Robo-advisors, powered by advanced algorithms, process real-time market data to adjust investment strategies, maximizing returns while mitigating risks. Beyond conventional methods, innovative approaches like genetic algorithms and swarm intelligence—modeled after biological evolution and group behavior—further refine portfolio optimization. Blockchain, commonly linked to cryptocurrencies, also plays a pivotal role in finance beyond digital assets. Its decentralized framework and robust security enhance transaction transparency and auditability. Smart contracts—self-executing agreements with embedded terms—automate processes, cutting reliance on intermediaries and improving operational efficiency in investments. As these technologies advance, their ethical and responsible application will be key to not only boosting profitability but also building a more secure and open financial landscape.

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