Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/GC02.20240141
Published: December 01, 2024

Predicting Stock Prices Based on Sentiment Analysis and Machine Learning Techniques: A literature Review

Abdelkhaleq El Haddad and Said Achchab
ENSIAS, Mohammed V University
Rabat, Morocco
abdelkhaleq_elhaddad@um5.ac.ma, s.achchab@um5s.net.ma

Younès Lahrichi
ISCAE Group
Casablanca, Morocco
ylahrichi@groupeiscae.ma

Abstract

This study intends to present a new approach to predicting stock prices via sentiment analysis and deep learning techniques within a dynamic framework. The approach addresses the inherent volatility and unpredictability of financial markets by incorporating the influence of both market sentiment and investor emotions on stock price changes. In today's rapidly changing financial markets, the ability to accurately forecast stock prices is highly valued. Traders and investors continually search for new strategies to gain an advantage and make well-informed decisions. A prominent approach that has attracted significant attention involves integrating sentiment analysis with machine learning techniques. Through analyzing social media sentiment, articles, and pertinent data, researchers and analysts can provide significant insights into market movements and investor's state of mind machine learning methods are exploited in sentiment analysis to find out the text's emotional tone.

Keywords
Machine Learning, Sentiment Analysis, Stock Prices, Financial Market.

1. Introduction

Stock market price fluctuations have long-confounded financial experts, whose efforts to accurately predict these variations have achieved only modest success. Verma et al. (2020) introduced a method noted for its simplicity and practicality, offering a more accessible approach to stock market prediction. Simultaneously, Sebastian et al. (2020) investigated the integration of Machine Learning models with sentiment analysis for predicting future stock prices. Their work significantly advanced the field by evaluating different forecasting methods to enhance prediction accuracy. As artificial intelligence continues to advance, there has been a notable increase in research focused on stock market prediction, further affirming its potential viability.

For example, Gurav et al. (2020) presented a sentiment-aware forecasting model that employs a Log Bilinear model to capture and learn short-term sentiment patterns in stock data. Further, Wang et al. (2021) explored the potential of combining social media analytics with sentiment analysis to forecast market trends, offering a knowledge-based approach to trend prediction. Munde et al. (2021) extended this line of inquiry by examining automated methods for stock market analysis, further highlighting the evolving landscape of predictive techniques in financial markets.

Moreover, the forecasting of stock markets may be enhanced by integrating machine learning with fundamental and/or technical analysis. Business, computer science, statistics, and finance are among the disciplines that often address the

issue of stock price movement. Ezzeddine et al. (2021) enhance the field by integrating sentiment, technical, and fundamental analysis with machine learning models to predict beneficial actions. Numerous investors employ various analytical methods and time series assessments to forecast movements. According to Yelne et al. (2021), machine learning algorithms are trained to leverage publicly available stock market data to derive insights, subsequently used to provide accurate predictions.

For accuracy of stock prediction, regression, and classification methods are implemented by choosing the Kaggle dataset, a machine learning approach utilized under supervised learning: regression, random forest, and decision trees. Logistic regression to forecast stock prices assigned to a particular company's previous-year data, utilizing daily trade prices. Sutradhar et al. (2021) established a model-based independent technique to anticipate stock prices. Sutradhar et al. (2021) demonstrate that stock performance, sentiment, and social data are highly associated with current historical data, and they affect and foresee the relationship between trading patterns.

Predicting the stock market with deep learning presents a significant challenge in the financial industry. Zhang et al. (2022) evaluate works associated with decision gathering for stock market forecasting, emphasizing the traits of foundational learners and aggregation methods to achieve this goal. Their study combines the technologies utilized by stock traders with deep learning techniques. Mndawe et al. (2022) introduce a sentiment classifier to extract opinions from recent headlines and tweets for the African context.

Here in this table, we present a selection of the criteria for the Literature Review in Table 1:

Table 1. Criteria selected for Literature Review

Criterion	**Details**	**Relevance to Theme**
Relevance to the Topic	Focused on stock market prediction, machine learning, sentiment analysis, and sarcasm detection.	Key to ensuring alignment with research objectives.
Scientific Quality	Publications from indexed sources, ensure high-quality research.	Guarantees credibility and scientific rigor.
Recency	Emphasis on studies published within the last 5 years.	Reflects current advancements in the field.
Robust Methodology	Preference for research with detailed model designs	Ensures methodological strength and relevance.
Diversity of Approaches	Inclusion of various machine learning techniques and sentiment analysis methods.	Promotes comprehensive coverage of techniques.
Impact and Practical Application	Studies showcasing real-world application to financial forecasting and investment decision-making.	Demonstrates practical value and applicability.
Reproducibility and Open Data	Priority for publications with accessible datasets and reproducible code or protocols.	Facilitates validation and further exploration.
Analytical Depth	Comparative analysis, insights into limitations, or improvements to existing models.	Supports critical evaluation of techniques.

2. Machine Learning in Stock Market Prediction

2.1 Outline of Machine Learning Techniques

Four primary machine learning methods are commonly implemented for stock market forecasting, emphasizing preprocessing techniques to improve accuracy in projections. By converting technical indicators into discrete forms, predictive models tend to achieve higher precision. Patel et al. (2015) examined this approach to predict stock price trends within the Indian market context.

By the impact of multiple variables, the complexity of stock price prediction is heightened creating significant challenges. Machine learning algorithms are designed to manage these complexities and provide reliable stock price forecasts. Additionally, several researchers have incorporated sentiment analysis from social media and news sources to capture external factors affecting stock prices. Financial data, as time-series data, poses unique difficulties due to its volatility and dynamic patterns. The Long Short-Term Memory and Support Vector Machines, models are two of the most commonly used and reliable methods for stock market prediction.

Selvamuthu et al. (2019), for example, applied neural networks with three distinct training techniques Bayesian Regularization, and Levenberg-Marquardt to achieve a 99.9% accuracy rate while using data with high frequencies from an Indian corporation. Much of the research in this area utilizes machine learning techniques, though often with limited specialized indicators. Predicting stock prices remains challenging due to the high degree of volatility in financial markets. To assist investors in decision-making, Sarode et al. (2019) introduced a dual-layered analytical approach to analyze trading data.

Consistently applying extracted prediction rules is crucial for improving long-term accuracy. Recent advancements in machine learning have introduced techniques like artificial neural networks, neuro-fuzzy systems, Recurrent Neural Network, and Long Short-Term Memory, each with distinct strengths and limitations (Rao et al., 2020).

These models are designed to analyze stock data, enabling more accurate predictions of market behavior. Advanced algorithms, including boosted regression, perceptron models, and vector machines, have become reliable tools for forecasting stock trends. Enhanced models and computational advancements now offer improved accuracy, with Artificial Neural Networks and Random Forest models being widely used to predict closing prices across diverse industry sectors, as shown in the work of (Vijh et al. 2020).

2.2 Summary of Related Work

Review of findings and methods presented by different authors (2019-2024) is presented in Table 2.

Table 2. Review of findings and methods presented by different authors (2019-2024)

Author(s)	Year	Method /Technique	Data source / Dataset	Findings / Results
Saloni Mohan et al.	2019	Naïve Bayes Regression and Support Vector Machines,	Stock prices for S&P500	The accuracy of stock price predictions is improved.
Asad Abdi et al.	2019	Pre-processing module Sentiment analysis using Recurrent Neural Network-Long short-term memory algorithm	Opinions and reviews on the Internet	The Recurrent Neural Network model enhances sentiment analysis efficacy, and the neural model demonstrates excellent performance improvements relative to alternative methods.
Kostadin et al.	2020	Financial sentiment analysis using lexicon words and sentence encoders Natural Language Processing transformers	Wikipedia's new discussion forums, and question-answer pages.	Compared to the University lexicon, Loughran-McDonald features perform better. Domain-specific dictionaries are superior for sentiment analysis.
Mehmet Umut Salur and Ilhan Aydin	2020	hybrid deep learning model combines with deep learning methods	social media	The proposed hybrid deep learning model offers better sentiment classification performance compared with past studies.
Nan Jing et al.	2021	Convolutional Neural Network, Neural Network, Long Short-Term Memory,	Technical indicators from the stock market.	A hybrid method does more effectively predict stock prices than a single model.

Noemi da Paixao Pinto et al.	2021	Text mining, Sentiment analysis, and Time series	social media	Exploiting data from social media and internet sites enhances the best prediction.
Shanshan Dong and Chang Liu	2021	Domain classification subnetwork, Domain-adaptation, Cross-Domain, Transfer Learning	The reviews of electronics, DVDs, Amazon Books,	Classification accuracy rates for sentiment classification: 65.0%, 61.2%, 61.6%, and 66.3%Improvement in classification accuracy rates compared to non-transfer learning: 11.0%, 7.6%, 11.4%, and 13.4%
Pooja Mehta et al.	2021	Long Short-Term Memory, Multinomial Naive Bayes Classifier, Naive Bayes, Support Vector Machine, linear regression,	Social media	The suggested technique predicts stock values utilizing deep learning and Machine Learning methodologies applied.
Sibusiso T. Mndawe et al.	2022	Long Short Term Memory architectures and technical indicators	Yahoo Finance. Vodacom stock, news sites, and tweets from Twitter,	Experiment 1: Achieved 96% accuracy in predicted closing price movement via a linear discriminant regression model. Experiment 2: Encoder-decoder Long Short Term Memory model closing price prediction Root Mean Square Error 0.023.
Mohammad Kamel Daradkeh	2022	Hybrid Convolutional Neural Network--Long Short Term Memory	the Dubai Financial Market,	The suggested technique predicts stock values utilizing deep learning, stock fluctuations are more accurate when quantitative financial data is incorporated. When headlines news and emotional trends are blended, Convolutional Neural Network-Long Short Term Memory assures a boost of 25.6% in communications and 11.6% in real estate.
Zhaoxia Wang et al.	2023	Random Forest, Convolutional Neural Networks., multi-layer perceptron, Naïve Bayes, logistic regression, long short-term memory, decision tree, extreme gradient boosting,	Twitter	F1-score of 84.19% and accuracy of 73.41%
Lin et al.	2023	Spatial-temporal attention-based convolutional network.	Market news and stock price data	Accurately integrated multi-source inputs (news and market data) for price predictions.
Zhao et al.	2023	Ensemble of Random Forest and Gradient Boosting Decision Trees (GBDT).	S&P 500 historical data	Delivered robust performance in trend classification with ensemble learning.
Xiao et al.	2024	Multi-view learning and Support Vector Machine (SVM).	Heterogeneous datasets (news, market data)	Enhanced prediction accuracy by fusing structured (price data) and unstructured (textual) data.
Chen et al.	2024	Graph neural networks (GNNs) for modeling interdependencies between stock sectors.	Market data from multiple stock exchanges	Outperformed traditional approaches in predicting sectoral trends and correlations.

According to a review of the literature currently available on machine learning techniques for stock price prediction, there is growing interest in their application. In this regard, Al-Alawi (2023) illustrates the potential of the Long Short Term Memory model and gated repeating unit techniques, while Strader (2020) focuses on genetic algorithms, support vector machines, artificial neural networks, etc.

To categorize hybrid or other approaches to artificial intelligence. Wiranata (2021) focuses on the use of technical indicator datasets and the adoption of different machine-learning techniques, highlighting the significance of dataset types and learning algorithms. Taken together, these studies highlight the perspective of machine learning in stock price prediction while pointing out areas that require more investigation and development.

3. Sentiment Analysis and the Stock Market prediction

3.1 Outline of Sentiment Analysis Applications

Many researchers have looked into utilizing sentiment analysis to anticipate stock market changes. Both Bourezk (2019) and Ma (2021) underline the potential of social media data to collect investor sentiment that can impact market behavior. Lexicon-based methods categorize sentiment based on vocabulary databases whereas machine-learning approaches train algorithms on labeled data (Chen and Liu 2022). Financial applications of sentiment research include news, social media, earnings calls, and regulatory filings. Overall, these studies highlight the value of sentiment research in stock market forecasting, especially when combining social media data to evaluate investor attitudes.

Nguyen and Shirai (2015) presented a technique to predict stock market fluctuations using sentiment expressed on social networks. This model contains a novel function that concurrently captures participants and their emotions. This feature is implemented utilizing a new topic model called Temporal Sentiment Latent Dirichlet Allocation (TSLDA). The outcomes propose that car this strategy beats models utilizing simply historical prices and other sentiment analysis methods, demonstrating that adding sentiment information from social networks helps better predict stock.

Jin et al. (2019) explored the prediction of stock closing prices using the Long Short Term Memory model. The results have shown the effectiveness of sentiment analysis in stock price projections, therefore giving a theoretical basis for applying machine learning techniques to stock market prediction. On the other hand, Valencia et al. (2019) underscored the relevance of cryptocurrencies in financial markets and their potential as a new industry for sentiment research and machine learning technologies. The study focuses on employing sentiment analysis and machine learning to forecast bitcoin price fluctuations, the importance of the wide availability of data, and low barriers to entry in the cryptocurrency business as essential aspects in doing predictive analysis.

Also, Jing et al. (2021) suggested a combination of methods that mix deep learning with sentiment among investors research to predict the stock market. This research delivers new insights into the possibility of combining machine learning techniques with sentiment analysis to improve stock market forecasting models. Mohan et al, (2019), examine the topic of anticipating unpredictability in financial markets using sentiment analysis. Their research focuses on sentiment analysis of corporations' annual stock market filings to anticipate volatility, highlighting the potential of sentiment analysis in capturing market dynamics. In summary, the results demonstrate that emotional information from social media, news, and the public domain may considerably affect stock price changes.

3.2 Summary of Related Work

Review of findings and methods presented by different authors (2018-2024) is presented in Table 3.

Table 3. Review of findings and methods presented by different authors (2018-2024)

Author(s)	Year	Method /Technique	Data source / Dataset	Findings / Results
Shen et al.	2018	Support Vector Machine	Yahoo Finance and S&P 500 indexes	the Support Victor Machine outperformed the SoftMax output layer, indicating the success of this approach in financial sequence predictions
Pahul Preet Singh Kohli et al.	2019	Machine learning models AdaBoost algorithm	Foreign Exchange, Market History, and Rate. Commodity Prices.	Gold price characteristics showed the best positive association with market performance. AdaBoost algorithm ranked better among other approaches.
Muhammad Umer et al.	2019	Time Series Forecasting, Three-month Linear Regression Moving Average, Exponential Smoothing,	Google stock, Amazon stock and. AAPL stock,	Successful prediction of stock market trend Measurement of accuracy according to measurements
Saurav Agrawal et al.	2019	Artificial Neural Network, Logistic Regression	stock market dataset	The performance of stocks may be predicted using the logistic regression. Stock data is categorized by adopting the ANN model.
Ashwini Patha and Sakshi Pathak	2020	Logistic Regression, K Nearest Neighbor, Random Forest, Autoregressive Integrated Moving Average. Support Vector Machine.	Stock Exchange of India	Identifying the optimal method for forecasting future stock market performance.

Yu Zhang	2020	Classification and Regression Tree Algorithm and Support Victor Machine	the Chinese Market Index, and indicators of the Baidu Index.	The accuracy of all models surpasses 50%, the Logistic model and Classification and Regression Tree Algorithm overperforms other models,
Yang et al.	2020	natural language processing, Word2Vec, Count Vectorizer, Doc2Vec Adaboost, XGboost, Gradient Boosted Decision Trees, decision tree, and logistic regression	news articles	Gradient Boosted Decision Trees were identified as the most accurate model in stock market prediction.
Omar et al.	2021	Preprocessing for stock market dataset Employing K-Nearest Neighbor and Random Forest.	stock market dataset	The Random Forest model achieved 93.23% prediction accuracy and for K Nearest Neighbor model achieved 93.12% prediction accuracy
Ernest Kwame et al.	2021	Gaussian Naive Bayes algorithm, Feature scaling, and feature extraction techniques	stock market dataset	Gaussian Naive Bayes with Linear Discriminant Analysis model had the highest accuracy results. And had the best F1 scores.
Yash Kadam et al.	2022	Moving Average, Prophet, K-Nearest Neighbors, and Long Short-Term Memory feature engineering Autoregressive Integrated Moving Average and Linear Regression,	stock market	Models are efficient in predicting stock closing prices. And proposed solution outperforms due to comprehensive feature engineering
K. Velmurugan et al.	2022	Artificial Neural Network, Convolutional Neural Network, and Recurrent Neural Network.	historical or past prices.	The study found limitations in using regression with the dataset.
Latha et al.	2022	K Nearest Neighbor	stock market	The proposed model achieves 70% accuracy in stock market prediction.
Malti et al	2022	K-nearest neighbor, Linear Regression, Decision Tree Regression, Support Vector Regression, and Long Short-Term Memory	the National Stock Exchange in India	For predicting time series or market prices, the Linear Regression algorithm performs better than any other method.
Hum et al.	2022	Long Short-Term Memory	the S&P 500 index	the model working with a single hidden layer with 150 neurons is much better than several hidden layers with 150 and 100 neurons.
Jinhui Wei et al.	2022	Long Short-Term Memory	the Hang Seng Index	According to the study, the Long Short-Term Memory model's accuracy has increased.
Asha Kumari	2023	Autoregressive Integrated Moving Average model for stock market prediction Web scraping for real-time data retrieval	the National Stock Exchange real-time series data	The paper aims to develop a user-friendly web application for stock market prediction. The application will utilize web scraping and the Autoregressive Integrated Moving Average model for forecasting.
Pinki Saga et al.	2023	Support Victor Machine and Long Short-Term Memory	stock market	Support Victor Machine has a precision of 91% but Long Short-Term Memory is not in the same way.
Timothy Juliana et al.	2023	a multilayer perceptron model	the Indonesian stock market	The model used to achieve an R2 of 0.9955
Ronaghi et al.	2023	CNN and Bi-directional LSTM deep fusion framework for market sentiment detection.	Twitter (COVID-19-related), stock data	Effective in modeling social media sentiment's influence on market volatility.
Kumar et al.	2023	BERT with emotion-tagged news dataset to predict stock trends.	Financial news and proprietary datasets	Demonstrated improved accuracy when integrating emotional tags with market trend forecasting.
Wang et al.	2023	Hybrid neural network combining textual sentiment from news and numerical trends.	News and historical data	Successfully modeled the interplay between textual and numerical data for stock volatility prediction.

Olamilekan Shobayo et al.	2024	FinBERT, GPT-4, Logistic Regression; Hyperparameter optimization using Optuna.	the Nigerian Exchange (NGX) All-Share Index, financial news	Logistic Regression achieved the best results with accuracy: 81.83% and ROC AUC: 89.76%. GPT-4 was effective for analysis.
Najem et al.	2024	Stacked Autoencoders	Yahoo Finance and Wavelet Transform	Artificial Neural Network showing better accuracy compared to Random Forest

There appears to be increasing importance in the topic of sentiment analysis-based stock price prediction, according to a review of the literature. Ma (2021) gives a detailed assessment of the application of sentiment analysis in stock price and investor sentiment projections, emphasizing the demand for deeper investigation into the approaches applied. Pinto (2021) gives his methodical review of 57 research and points forth the potential of internet data and social media to boost forecast accuracy.

Hotasi (2023) further recommends merging news sentiment research with prior stock market information to forecast stock price swings and achieve high prediction accuracy. Overall, these studies accentuate the ability of sentiment research to predict stock prices but also illustrate the requirement for further research and the necessity to identify and measure market sentiment appropriately.

Recent studies underline the usefulness of hybrid models that leverage traditional financial data and sentiment indicators to boost forecasting accuracy. As the discipline continues to expand, addressing current knowledge gaps and exploring creative techniques will be vital in increasing the capabilities of predictive models in financial markets.

4. Limitations and Challenges in Stock Prediction with Sentiment Analysis and Machine Learning

Despite improvements in machine learning and sentiment analysis techniques, there are major restrictions and difficulties that researchers encounter in accurately predicting stock prices. One of the difficulties is the availability as well as the quality of text data for sentiment analysis. Relying on external sources such as social media and news items introduces confusing components and biases that could hamper the quality of sentiment analysis. Another concern is the dynamism and diversity of the stock market which is affected by a range of elements, like financial indicators, news events, and geopolitical events. Accurately acquiring relevant information in real-time is a challenging study. Additionally, the performance of predictive models is particularly subject to market swings, making it hard to create steady and trustworthy models.

Even with its potential, sentiment analysis faces several limitations in real-world applications. One significant challenge is ambiguity in natural language, such as sarcasm, irony, or context-dependent expressions, which can lead to inaccurate sentiment detection. For instance, a sarcastic comment like "Great, another stock crash!" might be misinterpreted as a positive sentiment. Furthermore, domain-specific language in financial discussions, including jargon or abbreviations, can complicate model training. The lack of high-quality labeled data and the presence of noisy or imbalanced datasets also hinder performance. Additionally, sentiment models often fail to account for cultural nuances and regional variations in language, making them less reliable across diverse user bases. Addressing these issues requires advanced techniques like sarcasm detection and domain adaptation to improve sentiment analysis accuracy in practical settings.

Recent achievements in machine learning approaches have also led to more accurate stock price predictions; however, challenges remain in accounting for integrating multiple data sources, market volatility, and developing models resilient to sudden economic shifts. By capturing these complex liaisons, the proposed framework enhances the capabilities of machine learning models, suggesting a shift towards more dynamic and relational models in stock price forecasting.

Moreover, Particle swarm optimization and genetic algorithms combined with multilayer perceptron methods have shown a potential to boost the prediction performance of stock indices, representing the creative approaches being studied in this area. These hybrid approaches not only improve forecasting outcomes but also address the multifaceted nature of stock market prediction.

5. Research Gaps and Future Research Directions

Future research may focus on constructing interpretable machine-learning algorithms that deliver actionable information to investors. Furthermore, not much research has been done on how financial news components influence stock market prediction models. Exploring the incorporation of other indicators, such as macroeconomic variables and technical analysis components (e.g., moving averages, and volatility indices), might increase the robustness of stock market forecasts.

Additionally, the consequences of sarcasm and irony in social media statements as they apply to stock market predictions remain underexplored. Addressing this might lead to a deeper comprehension of sentiment and boost model accuracy. Another potential field is the deployment of multi-modal techniques that incorporate text, photos, and video data from social networks, further enhancing the input for sentiment analysis.

Lastly, future research should also examine the advancement of combinations that mix traditional financial models with AI-driven methodologies to better capture market dynamics. This might bridge the gap between traditional financial theory and current data-driven techniques, and they were leading to more accurate and actionable projections. Addressing the scalability and computational efficiency of these models, especially in high-frequency trading situations, remains a major technical problem.

6. Conclusion

In synthesis, the convergence of machine learning, sentiment analysis, and social media data provides tremendous potential for boosting the forecast of stock market movements. The literature reveals the increased success of these strategies, particularly in harnessing real-time, unstructured data from platforms such as Twitter and financial news. However, while the present study showed effectiveness in several areas, there are crucial gaps, notably in tackling nuances like sarcasm recognition, context-specific mood, and the influence of altering market conditions.

Hybrid models for stock market prediction, which integrate sentiment analysis with machine learning, offer practical benefits by enabling more accurate and dynamic financial forecasting. These models can be deployed in trading systems for real-time decision-making, where sentiment analysis of financial news or social media posts (e.g., using FinBERT or GPT-4) complements numerical market data to predict trends and volatility. For instance, they allow portfolio managers to adapt to market changes influenced by investor sentiment quickly, enhancing risk management strategies.

However, limitations must be acknowledged. High computational demands, particularly for deep learning frameworks, can limit scalability and affordability, especially for smaller organizations. Additionally, these models depend on high-quality datasets, which may not always be available or adequately curated, leading to potential biases or inaccuracies. Finally, the lack of interpretability in complex neural networks poses challenges for stakeholders seeking to understand the rationale behind predictions. Addressing these issues through developing resource-efficient, transparent models and improved data collection methods will be critical for maximizing their practical applicability. Future research should seek to solve these deficiencies by concentrating on more advanced sentiment analysis approaches, such as sarcasm detection and context-aware models, which might better capture the intricacies of investor sentiment. Additionally, initiatives to increase the interpretability of Machine Learning varieties, such as the purpose of explainable Machine Learning approaches, would give better transparency and trust in predictions. By improving these methodologies, more studies may contribute to more robustness, reliability, and accessibility. prediction models, eventually permitting better investment choices in increasingly turbulent markets.

References

Abdi, A., Shamsuddin, S. M., Hasan, S., & Piran, J. Deep learning-based sentiment classification of evaluative text based on multi-feature fusion. *Information Processing & Management,* 56(4), 1245-1259. 2019.

Agrawal, S., Thakkar, D., Soni, D., Bhimani, K., & Patel, C. Stock market prediction using machine learning techniques. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology,* 5(2), 1099-1103. 2019.

Ajinkya Yelne; Dipti Theng; "Stock Prediction and Analysis Using Supervised Machine Learning Algorithms", 2021 *INTERNATIONAL CONFERENCE ON COMPUTATIONAL INTELLIGENCE* 2021.

Al-Alawi, A. I., & Alaali, Y. A.Stock Market Prediction using Machine Learning Techniques: Literature Review Analysis. *In 2023 International Conference On Cyber Management And Engineering (CyMaEn)* (pp. 153-157). IEEE. January, 2023.

Ampomah, E. K., Nyame, G., Qin, Z., Addo, P. C., Gyamfi, E. O., & Gyan, M. Stock market prediction with gaussian naïve bayes machine learning algorithm. *Informatica*, 45(2). 2021.

Anup Munde; Ashwin Jadhav; Harshal Kaute; Ajay Gosavi; "Automated Stock Trading Using Machine Learning", *COMPUTER SCIENCE EDUCATOR: COURSES*, 2021.

Bansal, M., Goyal, A., & Choudhary, A. Stock market prediction with high accuracy using machine learning techniques. *Procedia Computer Science*, 215, 247-265. 2022.

Bhandari, H. N., Rimal, B., Pokhrel, N. R., Rimal, R., Dahal, K. R., & Khatri, R. K.Predicting stock market index using LSTM. *Machine Learning with Applications*, 9, 100320. 2022.

Bourezk, H., Raji, A., Acha, N., & Barka, H. An Overview on Sentiment Mining for Stock Market prediction. *In 2019 1st International Conference on Smart Systems and Data Science (ICSSD)* (pp. 1-8). IEEE. October, 2019.

Chen, Hao, et al. "Graph Neural Networks for Sectoral Trend Prediction in Financial Markets." *Journal of Computational Finance,* 2024.

Cheng Zhang; N. N. Sjarif; Roslina Ibrahim; "Decision Fusion for Stock Market Prediction: A Systematic Review", *IEEE ACCESS*, 2022.

Daradkeh, M. K. A hybrid data analytics framework with sentiment convergence and multifeature fusion for stock trend prediction. *Electronics*, 11(2), 250. 2022.

Dong, S., & Liu, C. Sentiment classification for financial texts based on deep learning. *Computational Intelligence and Neuroscience*, 2021.

Hassan Ezzeddine; Roger R. Achkar; "Ensemble Learning in Stock Market Prediction",2021 13TH *INTERNATIONAL CONFERENCE ON MACHINE LEARNING AND ...*, 2021.

Hotasi, Abraham, and Dicky Prima Satya. Predicting Stock Market Trends with News Sentiment Analysis and Historical Stock Market Data Analysis Using Data Mining Techniques.*2023 10th International Conference on Advanced Informatics: Concept, Theory, and Application (ICAICTA)*. IEEE, 2023.

Jin, Z., Yang, Y., & Liu, Y. Stock closing price prediction based on sentiment analysis and LSTM. *Neural Computing and Applications*, 32, 9713-9729. 2020.

Jing, N., Wu, Z., & Wang, H. A hybrid model integrating deep learning with investor sentiment analysis for stock price prediction. *Expert Systems with Applications*, 178, 115019. 2021.

JinShan, Y., ChenYue, Z., HaoTong, Y., & HeYang, C. Use GBDT to Predict the Stock Market [J]. *Procedia Computer Science*, 174, 161-171. 2020.

Juliana, T., Devrison, T., Anora, V., & Suryaningrum, K. M. Stock Price Prediction Model Using Deep Learning Optimization Based on Technical Analysis Indicators. *Procedia Computer Science*, 227, 939-947. 2023.

Kohli, P. P. S., Zargar, S., Arora, S., & Gupta, P. Stock prediction using machine learning algorithms. *In Applications of Artificial Intelligence Techniques in Engineering*: SIGMA 2018, Volume 1 (pp. 405-414).2019.

Koushik Sutradhar; Sourav Sutradhar; Iqbal Ahmed Jhimel; S. Gupta; Mohammad Monirujjaman Khan; "Stock Market Prediction Using Recurrent Neural Network's LSTM Architecture",2021 IEEE 12TH *ANNUAL UBIQUITOUS COMPUTING, ELECTRONICS & ...*, 2021.

Kumar, Ankit, et al. "Emotion-Enhanced Sentiment Analysis for Stock Market Forecasting." *Machine Learning in Finance Review*, 2023.

Latha, R. S., Sreekanth, G. R., Suganthe, R. C., Geetha, M., Selvaraj, R. E., Balaji, S., ... & Ponnusamy, P. P. Stock Movement Prediction using KNN Machine Learning Algorithm. In 2022 *International Conference on Computer Communication and Informatics (ICCCI)* (pp. 1-5). IEEE. January, 2022.

Lin, Yue, et al. "Spatial-Temporal Attention Networks for Stock Market Forecasting." *Neural Computing and Applications*, 2023.

Ma, Y. The Research on Influencing Factors of Stock Price Fluctuation of Listed Companies in China Based on PCA-Multiple Regression. *Open Journal of Social Sciences*, 9(3), 305-315. 2021.

Madeeh, O. D., & Abdullah, H. S. An efficient prediction model based on machine learning techniques for prediction of the stock market. *In Journal of Physics: Conference Series* (Vol. 1804, No. 1, p. 012008). IOP Publishing. February, 2021.

Mehta, P., Pandya, S., & Kotecha, K. Harvesting social media sentiment analysis to enhance stock market prediction using deep learning. *PeerJ Computer Science,* 7, e476. 2021.

Mishev, K., Gjorgjevikj, A., Vodenska, I., Chitkushev, L. T., & Trajanov, D. Evaluation of sentiment analysis in finance: from lexicons to transformers. *IEEE access*, 8, 131662-131682. 2020.

Mndawe, S. T., Paul, B. S., & Doorsamy, W. Development of a stock price prediction framework for intelligent media and technical analysis. *Applied Sciences*, *12*(2), 719. 2022.

Mohan, S., Mullapudi, S., Sammeta, S., Vijayvergia, P., & Anastasiu, D. C. Stock price prediction using news sentiment analysis. *In 2019 IEEE fifth international conference on big data computing service and applications (BigDataService)* (pp. 205-208). IEEE. April, 2019.

Najem, R., Amr, M. F., Bahnasse, A., & Talea, M. Advancements in Artificial Intelligence and Machine Learning for Stock Market Prediction: A Comprehensive Analysis of Techniques and Case Studies. *Procedia Computer Science*, 231, 198-204. 2024.

Nguyen, T. H., & Shirai, K. Topic modeling-based sentiment analysis on social media for stock market prediction. *In Proceedings of the 53rd Annual Meeting of the Association for Computational Linguistics and the 7th International Joint Conference on Natural Language Processing* (Volume 1: Long Papers) (pp. 1354-1364). July, 2015.

Nishant Verma; S G David Raj; Ackley J Lyimo; Kakelli Anil Kumar; Stock Market Prediction and Risk Analysis Using NLP and Machine Learning, *INTERNATIONAL JOURNAL OF ENGINEERING AND ADVANCED TECHNOLOGY,* 2020.

Parray, I. R., Khurana, S. S., Kumar, M., & Altalbe, A. A.Time series data analysis of stock price movement using machine learning techniques. *Soft Computing*, *24*, 16509-16517. 2020.

Patel, J., Shah, S., Thakkar, P., & Kotecha, K.. Predicting stock market index using fusion of machine learning techniques. *Expert Systems with Applications*, 42(4), 2162-2172. 2015

Pathak, A., & Pathak, S. Study of machine learning algorithms for stock market prediction. *INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH TECHNOLOGY* (IJERT), 9(06). 2020.

Pinto, N., da Silva Figueiredo, L., & Garcia, A. C. Automatic prediction of stock market behavior based on time series, text mining, and sentiment analysis: a systematic review. In 2021 IEEE *24th International Conference on Computer Supported Cooperative Work in Design (CSCWD)* (pp. 1203-1208). IEEE. May, 2021.

Rao, P. S., Srinivas, K., & Mohan, A. K. A survey on stock market prediction using machine learning techniques. In *ICDSMLA 2019: Proceedings of the 1st International Conference on Data Science, Machine Learning and Applications* (pp. 923-931). Springer Singapore. 2020.

Rico Bayu Wiranata, R. B. W., & Arif Djunaidy, A. D. The stock exchange prediction using machine learning techniques: a comprehensive and systematic literature review. *Journal Ilmu Komputer dan Informasi*, 14(2), 91-112. 2021.

Ronaghi, Farhad, et al. "Deep Fusion Models for Market Sentiment Detection: A COVID-19 Case Study." *Journal of Applied AI Research,* 2023.

Sagar, P. L., Maheshbabu, C., Teja, G. V. S., Vishnu, C., Sai, D. V., & Mahesh, C. An Evaluation of Stock Market Prediction using Supervised Machine Learning Techniques. *In 2023 International Conference on Inventive Computation Technologies (ICICT*) (pp. 1-6). IEEE. April, 2023.

Salur, M. U., & Aydin, I. A novel hybrid deep learning model for sentiment classification*. IEEE Access*, 8, 58080-58093. 2020.

Sarode, S., Tolani, H. G., Kak, P., & Lifna, C. S. Stock price prediction using machine learning techniques. In *2019 international conference on intelligent sustainable systems (ICISS)* (pp. 177-181). IEEE. 2019.

Selvamuthu, D., Kumar, V., & Mishra, A. Indian stock market prediction using artificial neural networks on tick data. *Financial Innovation*, *5*(1), 1-12. 2019.

Shen, G., Tan, Q., Zhang, H., Zeng, P., & Xu, J. Deep learning with gated recurrent unit networks for financial sequence predictions. *Procedia computer science*, 131, 895-903. 2018.

Shobayo, Olamilekan, et al. "Sentiment Analysis in Financial News Using FinBERT and GPT-4." *International Journal of Financial Data Analytics*, 2024.

Strader, T. J., Rozycki, J. J., Root, T. H., & Huang, Y. H. J. Machine learning stock market prediction studies: review and research directions. *Journal of International Technology and Information Management*, 28(4), 63-83.2020.

U. P. Gurav; S. Kotrappa . Sentiment Aware Stock Price Forecasting Using An SA-RNN-LBL Learning Model, *ENGINEERING, TECHNOLOGY & APPLIED SCIENCE RESEARCH*, 2020.

Umer, M., Awais, M., & Muzammul, M. Stock market prediction using machine learning (ML) algorithms. ADCAIJ: *Advances in Distributed Computing and Artificial Intelligence Journal*, 8(4), 97-116. 2019.

Valencia, F., Gómez-Espinosa, A., & Valdés-Aguirre, B. Price movement prediction of cryptocurrencies using sentiment analysis and machine learning. *Entropy*, 21(6), 589. 2019.

Vijh, M., Chandola, D., Tikkiwal, V. A., & Kumar, A. Stock closing price prediction using machine learning techniques. Procedia computer science, *167*, 599-606. 2020.

Wang, Jian, et al. "Hybrid Neural Networks for Predicting Stock Volatility: Incorporating Sentiment from Financial News." *Advances in Neural Computing*, 2023.

Wang, Z., Hu, Z., Li, F., Ho, S. B., & Cambria, E. Learning-based stock trending prediction by incorporating technical indicators and social media sentiment. *Cognitive Computation*, 15(3), 10921102. 2023.

Wei, J., Xu, Q., & He, C. Deep learning of predicting closing price through historical adjustment closing price. *Procedia Computer Science*, 202, 379-384. 2022.

Willem Sebastian; Sani M. Isa; Stock Price Prediction Using BERT and Word2Vec Sentiment Analysis, *INTERNATIONAL JOURNAL OF EMERGING TRENDS IN ENGINEERING* ...2020.

Xiao, Minghao, et al. "Multi-View Learning in Stock Prediction: Structured and Unstructured Data Fusion." *IEEE Transactions on Machine Learning and Data Mining*, 2024.

Zhang, Y. Employing Machine Learning Algorithms for Stock Index Prediction. *In Innovative Computing: IC 2020* (pp. 1095-1102). Springer Singapore. 2020.

Zhao, Liwei, et al. "Ensemble Learning for Stock Trend Classification: Random Forest and Gradient Boosting Applications." *Quantitative Finance Insights*, 2023.

Zhaoxia Wang; Zhenda HU; Fang LI; Seng-Beng HO; Learning-Based Stock Market Trending Analysis By Incorporating Social Media Sentiment Analysis, 2021.

Biographies

Abdelkhaleq El Haddad is a Ph.D., student at the High National School of Computer Science and Systems Analysis (ENSIAS), Mohamed V University, he received his master's degree from Mohamed V University in 2023 intitule Data Engineering and Development Software.

Said Achchab is a professor of digital finance, artificial intelligence, and risk management at the High National School of Computer Science and Systems Analysis (ENSIAS), Mohamed V University, Morocco, and the coordinator of the "Digital Engineering for Finance" engineering program. He is the founding chairman of the African Fintech Institute.

Younes Lahrichi is a professor of higher education. He teaches finance at ISCAE Casablanca, Morocco, and is the author of several academic publications. He is the educational manager of the Master's degree specializing in Participatory Finance and coordinator of the corporate finance sector. He also took on several educational responsibilities, particularly at the level of the doctoral cycle, the financial markets cycle, and the accounting expertise cycle.