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Stock Market Prediction: A Survey and Evaluation

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Abstract—**Bond forecasts are a major financial concern as a successful stock pricing projection may promise fascinating advantages. The stock market is a share of a company's ownership. Every company and everybody wants to enhance their assets. Many approaches and strategies have been employed to determine the stock value in the future. The stock market is the location where stock value rises and falls at every instant. In recent years, several analysts have proposed various approaches to try and identify the exact worth of the stock to increase the accuracy of inventory predictions. In this article, we are trying to show and examine several models and approaches used in stock market prediction and to concentrate on their pros and shortcomings. This article examined over 10 approaches or techniques utilized in the last few years which were introduced into the forecast of stock market values. This technique can benefit both individual traders and business investors. They can forecast future market pricing behavior and take suitable actions to benefit.**

Index Terms—**Stock, Prediction, Stock price, Model, Business intelligence, Artificial Intelligence.**

I. INTRODUCTION

All desire to facilitate life by earning cash that offers comfort and pleasure. The simpler approach to increase assets by investing in stocks. This wish sometimes causes a person to lose its assets via incorrect stock investing forecast. The forecast of stock values might lead to errors and losses manually. Everyone must know the current stock value when buying and selling stock so that they are not easily misled by a phony stock value. Stock analysts and academics have developed strategies and algorithms to forecast stock value in recent years. Because of the intricate structure of the stock market in financial forecasting, stock market price prediction is considered one of the most challenging professions. Investors should decide on any strategy that may easily assure wellness while reducing investment risk in the stock market. The remaining components convince experts to build new prediction models and develop them [1]. In recent years, then, many academics have been trying to overcome the problem by proposing new methodologies and approaches to determine the predicted stock value more accurately. They

3 errors3 warnings offered many approaches and strategies that assess and anticipate the market value of the stock.

The rest of the paper is laid out as follows: The investigation's background is explained in Section II. Section III examines a variety of prediction algorithms that have

already shown to be useful. Finally, Section IV summarizes the findings of this research.

II. BACKGROUND

The share market provides an overview of the company and economy's future prospects for growth. Many factors contribute to stock price volatility, including but not limited to macroeconomic conditions, market expectation, and investor confidence in the company's management and operations. People can now get more knowledge more rapidly because to technological advancement. As a result, inventory analysis becomes more difficult since a significant amount of data must be processed in a short period of time. Big data progress, particularly in the field of deep learning, may potentially be studied. Continuous advancements in the field of AI have led to the widespread use of deep learning techniques in a variety of academic and commercial settings.

The market value for artificial intelligence in different aspects of our life is increasing day by day. We presented such an graphical scenario studied [2] on ASIA Pacific region shown in Fig.1. Natural language processing, image acknowledgement, medical forecasts and more are included. As a result of the increased use of deep learning, the neural networks used in these applications have evolved and improved. For example, strengthening learning became well-known after AlphaGo used it to defeat the world's best chess player at the time, and strengthening learning has since been used to financial forecasting. In these trend years, many researchers have been using

ASIA Pacific artificial intelligence market size, 2017-2025 (USD Million)
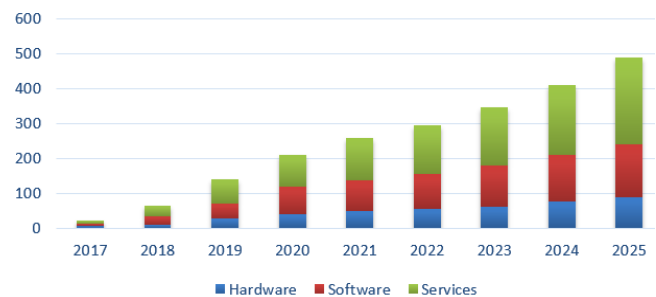

Fig. 1. The growth rate of artificial intelligence market.

several kinds of architectures of machine learning and deep

learning, that is Multilayer Perception (MLP), Convolutional Neural Network (CNN), Recurrent Neural Networks (RNN), and Long Short-Term Memory (LSTM) and so on to forecast the stock value of a company depending on the historical prices available in the company. A set of data calculated overtime to acquire the level of some activity is a time series. The stock market is having exceptionally non-linear and fluctuating time-series information. The stock value in certain future predictions based on analyzes of the previous value of the stock. This article thus explores the varied effects on stock and forecasts of several machine learning and deep learning approaches based on published publications. The following areas will be discussed by this survey in each paper:

- What machine learning and deep learning methods are used in the recent years?
- What type of profound learning approach was adopted?
- What is the prediction model result?

Nowadays technology has enriched each and every sector in many ways. In this recent world everything is automated like E-voting [3], supply chain management, robotics [4], vehicle registration [5], national identity card management [6],sentiment analysis [7],blockchain based payment system, stock market prediction [8], network systems and so more. The following will be the structure of this paper: first, an introduction to forex and stocks in conjunction with machine learning and in-depth learning; second, the impact and analysis of different deep learning methods on stocks and forex forecasting; fourth, a discussion and analysis of the above methods; and finally, the entire paper.

III. PREDICTION WITH MACHINE LEARNING

Most approaches and procedures were tried to attempt to identify the inventory's future value. As the forecast of stock prices in finance and economics is an essential subject, the interests of researchers are becoming increasingly significant in developing a better predictive model which can predict a precise stock value. In recent decades, due of their high demands, so many prediction models have been introduced. The fundamental process diagram shows in Fig 2 how the forecast of the stock market works for machine training (ML) and deep learning (DL).

A. FUNDAMENTAL ANALYSIS

Several academics utilize basic analysis and technological analysis approaches to achieve the aim of projecting stock revenues. These guidelines for stock exchange are based on macroeconomic data, ancient stock trading data. Fundamental approaches of analyzes acknowledge that inventory costs are based on their innate features and projected investment profit. Repeated analysts refer to financial statements, text analyzes and reports for their data or key accounting signals. In this paper, the author presents the future income changes on the current year's profit change with fundamental signals. Here, one-year-ahead earning is represented as $CSPS$ and designating year is represented as a funtion of t. Here t is the

year for which the fundamental signal has been calculated in (1).

$$CSPS = EPS(t+1) - EPS(t) \qquad (1)$$

Most scientists think that basic analytical procedures are useful for the long-term source. The best approach to understand the existing circumstances is to anticipate the future. It's thought that historical data can forecast future inventory returns [9].

B. TECHNICAL ANALYSIS

Basically the stock market is statistically dependent. Technical analysis refers to the study of the market's own actions concerning commodities. The market research action produced the technical data. This analysis is the science of price change records, transaction volumes, etc., known as the real trading history. To predict changes in value, technical analysts frequently depend on technically discovered trends, patterns, and strengths within market data. Stock price technical indicators [10] is a function that returns a value for a given stock price in some given length of time in history. These specialist signals, such as $BIAS$, can tell traders if a stock is overbought or if a trend is likely to continue. $MACD$ is a technical indicator that attempts to anticipate changes in market tendency. The difference between the two periods' time is the value of $MACD$. The difference between 12 and 26 periods of $EMAs$ is represented in (2).

$$MACD(t) = EMA12(t) - EMA26(t) \qquad (2)$$

$BIAS$ is another technical indicator that is used to observe the differences between the closing price and its moving average line. If P_t is the stock price at time t and $SMAn$ is the sample moving of average at time t, the $BIAS$ for n-period of time t is defined in (3).

$$BIASn(t) = (P_t - SMAn(t))/SMAn(t) * 100 \qquad (3)$$

For the use of measurable data [11], technical analysis is highly significant. This technical analysis includes the peak-and-trough analysis. The author Li Zhe [12] employed the approach of the technical analysis where rules of exchange were established based on old stock data. The technical analysis employs several techniques which anticipate the future stock price on the presumption that history is going back again. By analizing past stock prices, future market directions may be controlled.

C. ARIMA MODEL

Since the prediction of the stock prices in finance and in economy is an important issue, the attention of researchers rises to build a better forecast model capable of predicting correct stock prices. In 1970, Box and Jenkins proposed the integrated moving average autoregressive model (ARIMA). For time-series predictions, ARIMA models were studied. A linear combination of previous values and past mistakes in the ARIMA model [13] represents the future value of a variable. ARIMA models have demonstrated their efficient
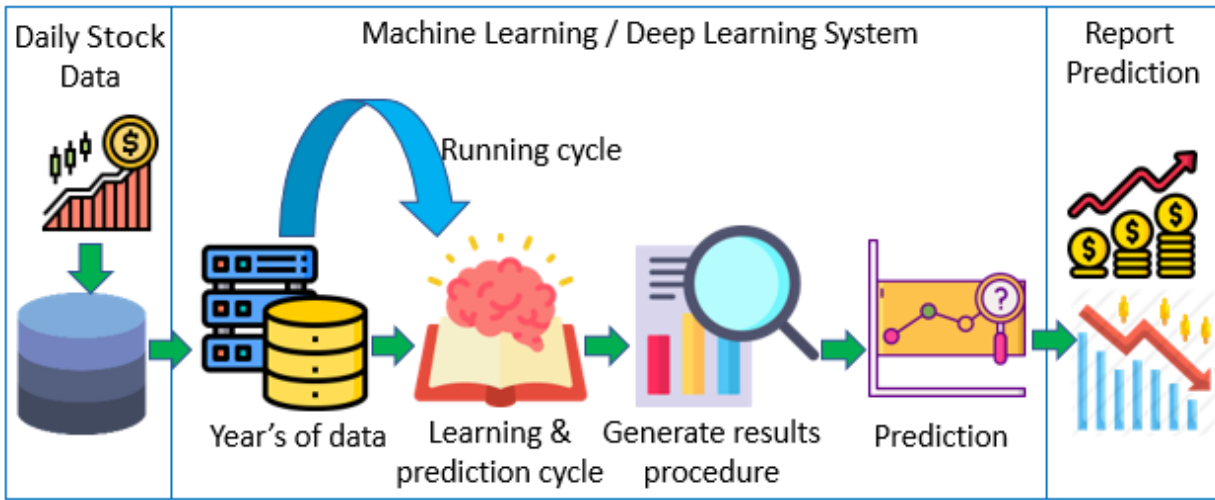
Fig. 2. Basic work flow of stock market prediction using machine learning and deep learning.

capacity to produce a short-term forecast and have continuously outperformed sophisticated structural models in the short-term [13] prediction. This model in financial time series is especially efficient and solid as the most common ANN techniques [15]–[17]. This model was recognized for its long-range prediction. Predictive ARIMA model building phases involve model identification, diagnostic control and the [18] parameter evaluation. ARIMA models were utilized in [13] to construct a comprehensive short-term stock price prediction method. For the prediction of few studies linked to the ARIMA model [19]–[24]. The authors utilized the ARIMA model to set up a predictive stock price model with NYSE and NSE data.

D. ARTIFICIAL INTELLIGENCE AND DATA MINING

The Artificial Neural Network (ANN) model is recognized for its capacity to infer solutions from unknown input while learning patterns from it. To extract information from the data supplied, data mining techniques may be employed to separate knowledge from the data. As a result, a large number of researchers focused on advanced mathematics and science. The subject of artificial intelligence and data mining techniques has received excessive attention [25]. Multi-capacity neural networks have been frequently utilized for financial forecasts owing to its capacity to identify and predict variable reliability properly (1999, Vaughan and Vellido, Lisboa). The input value is concurrently inserted into a layer for each training sample to create the input layer. The IG (information gain) data mining analysis [9] was utilized to discover the entire set of excellent subjects that had a first period input value or variables.

E. BPNN

Some models were suggested and developed utilizing neural network techniques stated above, while writers of [26] performed an observatory survey on creating an alert system using neural back propagation networks to buy stocks or to sell alerters (BPNN). In the January 2004 to December 2005

timeframe, the system has been evaluated utilizing previous pricing figures of Hong Kong and Shanghai Banking Corporation Holdings. The testing results revealed that the method developed was able to accurately anticipate short-term pricing by around 74%.

F. NEURO-FUZZY MODEL

The 5-layer neuro-fuzzy model of Ching Long Su et al [27] is designed to display stock market components by utilizing specialist technical indicators. A number of data comprising four indicators were used to complete this model in prediction and forecasting: the stochastic oscilator (percentage K and percentage D), the adjusted volume moving average (VAMA), and easy moving (EMV) of TAIEX. M.H. The type-2 fuzzy rules based master framework for stock value prevision has been created by FazelZarandiet et al. [28]. The fluid logic system Type-2 allowed uncertainties to be modelled. The type2 fluid model suggested applied to the input variables the specialized and fundamental parameters. The model may be tested on prediction and forecasting of stock prices. The algorithm has succeeded in forecasting stock values from different industries via the tests. In real time trading the results were applied.

G. NEURAL-FUZZY INFERENCE SYSTEM

Weng Luen Ho et al [29] has suggested a predictor model financial trading system enabling the neural fuzzy inference system of Mamdani Takagi and Sugeno (eMTSFIS). The eMTSFIS model has human hippocampal mechanisms and processing capability. The system presented was based on the idea of average moveable divergence (MACD).

H. CHMM

Yin Song [30] has suggested a technique for analyzing the market behaviour. CHMM(Coupled hidden Markov model has proposed a new system development graph which would provide anomalies that could occur in connected behaviours.

The results are applied to the actual inventory data and have proven the method to overcome both technical and business measures in terms of CHMM Markov basic model. A technique based on the Hidden Markov model was proposed by the authors Tao Xing and Yuan Sun [31] for predicting stock price movements. This document shows the hidden connection between the Markov Hidden. The approach for multiple variable fuzzy forecasting given by Shyi-Ming Chen and Yu-Chuan Chang [13] is implemented with fuzzy clusters and fluid rule interpolation techniques.

I. GENETIC FUZZY SYSTEM AND ANN

In order to create an expert stock price forecasting system, some researchers have introduced genetic fuszy (GFS) and artificial neural networks (ANN). Specification of elements which impact stock prices is utilized step by step with regression analysis (SRA). They spread raw data to k clusters on the next level through the use of neural self-organization map (SOM) networks. Lastly, all the clusters have the capacity to adjust database to GFS models.

J. DECISION TREE

The financial time series prediction model has been established by developing and grouping fugitive inventory decision trees. For building a decision-making system, the forecasting model is coupled to the data collection process, a fuzzy decision tree (FDT), and genetic algorithms (GA). They used the decision tree classification method. As numerous factors affected the stock market, the results were ineffective for the suggested model. Within this study, a decision tree is utilized in prediction of stocks as a means of improving long-term and short-term analysis by using some data processing techniques.

K. AUTO REGRESSIVE APPROACH

To anticipate stock prices, the authors [30] used a self-regressive approach. Because of its simplicity and widespread acceptance, the autoregression design is used. The Moore and Penrose technique is used to predict regression coefficients, and the prediction precision has also been investigated by comparing the values predicted with the actual values.

IV. PREDICTION WITH DEEP LEARNING

A. Convolutional Neural Network (CNN)

P. Patil et al. used graph theory and CNN to create a novel network that used temporal data from numerous equities, portraying the stock market as a complex web. In the meanwhile, stock and financial news indicators were used as inputs in the model. A model featured multiple CNN and bidirectional LSTM pipelines, given by J. Eapen and others. With the S&P500 large challenge data base, a single pipeline deep learning model and almost a factor of six may enhance the preview performance by 9% with a regressive vector maker support model.

B. Recurrent Neural Network (RNN)

W. Chen created an RNN boost model that predicts stock prices using technical data, sentiment and LDA. According to findings, the recommended model outperformed the single RNN model. Zeng. Z introduced a novel RNN (ARNN), which got denoted input from the wavelet. The prediction was made using the integrated moving mean Autoregressive (ARIMA) and the output ARNN model.

C. Long Short-Term Memory (LSTM)

One modification of the RNN is the LSTM model. The self-loop design is used as a crucial input to construct a steep path that can be freely followed for a long time. A technique using nonlinear parameters is used to model a time series. The LSTM model is effective at displaying the link between nonlinear time series and the stock prediction aim in delayed state space.

D. Deep Neural Network (DNN)

At least one hidden layer of neural network is present in a deep neural network (DNN). It may be able to offer complex non-linear functions as well as a huge abstraction capacity, implying that the model's fitting power is considerably increased. To predict stock market crises, S.P. Chatzis developed a DNN model that employed boosted methods. Although his research is not limited to certain prediction approaches, he discovered that learning about stock market crises was helpful in predicting the price.

E. Reinforcement Learning

Reinforcing learning is a form of profound learning that focuses on how you respond to profits in a specific circumstance. The two essential components of strengthening learning are state and action. Increasing learning, which supplied buying, selling and holding probabilities as final output, defined the neural net structure, the reward and the behavior of the agents. Q. Kang proposed tackling portfolio management using an advanced Actor-Critical Asynchronous Advantage (A3C method) algorithm and created an independent deep enhancement learning model. This enhancement learning is based on a market reaction to the optimal timing of trading actions (choice of the best price, trading length, and order size).

V. COMPARATIVE STUDY

Table I summarized different types of available methods that have already been used for the stock market prediction task.

The stock market prediction is a hard endeavor in the future foreseeing stock values. Because the stock is changing, it's too tough to forecast the stock market. This article reviews and compares several stock market prediction systems. This study gives an analysis. These approaches are used to assess the performance and trends of the stock market. Increasing accuracy is the stock market prediction technique. In this section, we presented the comparative study of the state of art in the presented literature. In Table II a comparison between

Reference	Focused Method
[1], [14], [20]	Arima model
[9]	Data Mining and ANN
[10]	Sentiment analysis
[11]	Textual web data
[12]	Multilevel capital market
[13], [28]	Fuzzy technique
[15]–[17]	ANN and ARIMA
[21]	Fuzzy system and ANN
[25]	Bias decision tree
[26]	NN5
[27], [29]	Neuro-Fuzzy system
[30]	RBM and SVM
[31]	Markov model

different techniques used by authors is shown with their accuracy and in Table III a result analysis comparison is shown based on used datasets by authors.

TABLE II
PERFORMANCE COMPARISON TABLE FOR STOCK MARKET PREDICTION

Authors	Technique	Over all hit Rate
Enke et al. [9]	Neural Networks	95.00
Wuthrich et al. [10]	Data Mining	46.70
Lee et al. [22]	ARIMA	92
Wang et al. [25]	Two Layer Bias Decision Tree	89.66
Tsanga et al. [26]	NN5	70
Su et al. [27]	Neuro Fuzzy	92.5-98.5
Cai et al. [30]	SVM+DBN	90.31

TABLE III
AVAILABLE DATASET AND RESULT ANALYSIS TECHNIQUES IN TERMS OF STOCK MARKET PREDICTION

Reference	Dataset	Result Analysis
[1]	NYSE and NSE	SER of 0.7872
[10]	Three US company	RMSE of 0.3025
[11]	ASIA, US and Europe	AC of 43.6%
[13]	TAIEX	RMSE of 90.41
[15]	KOSPI	MVE of 0.246
[16]	BSEIT	RMSE of 46.75
[21]	US dollar vs IRAN Rials	MSE of 1.24
[26]	HSBC	Hit rate of 71.8%
[28]	ASIA Stock market	RMSE of 14.21
[29]	SP500	SPC of 0.9763
[30]	SP500	NMSE of 0.0019571
[31]	Hourly 280 data	AE of 0.021364

VI. CONCLUSIONS

The stock market forecast is a challenge for future stock price forecasting. The stock exchange is too difficult to anticipate, given the changing nature of the stock. Every day stock prices change constantly. The stock market estimation has a strong stock client demand. Implementing at all times all rules derived is an important difficulty in order to estimate with high precision the future stock price. In this study we aim to explain the value of the stock market using around elf prediction models. The major objective of these models was to better explain or forecast the stock market value. These model predictions can aid investors make investing decisions to avoid financial hazards. If investors are able to anticipate the place to put their money, it will be safer and the stock market more stable. However, government officials must handle some concerns in order to prevent stock values from rising and falling inexorably owing to major increases. This article combines stock market news analyses with pricing in order to increase the precise behavior of the stock market. In order to better comprehend market interactions with the investors, we intend to shortly broaden our study on the dependability and compliance aspects of the stock market.

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