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A RNN-LSTM-Based Predictive Modelling Framework for Stock Market Prediction Using Technical Indicators

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ABSTRACT

The successful prediction of a stock's future price would produce substantial profit to the investor. In this paper, the authors propose a framework with the help of various technical indicators of the stock market to predict the future prices of the stock using recurrent neural network-based long short-term memory (LSTM) algorithm. The historical transactional data set is amalgamated with the technical indicators to create a more effective input dataset. The historical data is taken from 2010-2019, ten years in total. The dataset is divided into 80% training set and 20% test set. The experiment is carried out in two phases, first without the technical indicators and after adding technical indicators. In the experimental setup, it has been observed the LSTM with technical indicators have significantly reduced the error value by 2.42% and improved the overall performance of the system as compared to other machine learning frameworks that are not accounting the effect of technical indicators.

KEYWORDS

Artificial Neural Network, Deep Learning, LSTM, Machine Learning, Recurrent Neural Network, Stock Market Prediction

1.INTRODUCTION

To have a competitive edge, it is critical to have an insight into future and outcomes that challenge conventional assumptions. Thus, in almost all domains of life we are looking for the mechanisms which can help us in understanding what is likely to happen in near and far future and how we can take appropriate measures for gains and survival. Predicting about the future has neither been easy nor accurate particularly when it is based more on assumptions and intuitions. Science and mathematics have always been looking for the methods and techniques which can help us in taking conscious decisions based upon the facts and past history. For a credible prediction, the required ingredients can be accurate facts, precise history and a reliable evaluation mechanism. Thanks to the digitization of the data, precise historical data and accurate facts from the processed data are available on the desktops of the organizations and the only requirement that remains to be fulfilled is to design an appropriate predictive mechanism. The field of predictive analytics has grown richer with the time due to availability of accurate data sets and open source tools to carry out the computations making it feasible to predict in the areas which were otherwise considered unpredictable in general. One such area is stock market. Burton Malkiel, in his book "A Random Walk Down Wall Street", claimed that stock prices could not be accurately predicted (2007).

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Online availability of accurate detailed data about the stock market transactions and performance of various indices has attracted the attentions of many data scientists to search for a reliable mechanism to predict the future trends in stock(s) in quite reasonable manner, if not accurate. Work proposed in this paper is an effort in this direction.

The paper has been divided into 6 sections. Section 2 takes up the literature survey wherein various efforts used in predicting the stock prices have been discussed. This section also takes up the shortcomings of these methods. Section 3 takes up the framework of the proposed methodology. Section 4 discusses the basic details of the proposed framework. Section 5 discusses the experimental setup and the results obtained. Section 6 concludes with the outcomes of the proposal.

2.LITERATURE SURVEY

Atsalakis et al. (Atsalakis & Valavanis, 2009; Zopounidis et al., 2013), have defined three major components for the accurate prediction of stock prices. These components include: Fundamental analysis, Technical analysis and the choice of appropriate technological methods. Fundamental Analysis includes the study of various parameters indicating the performance and credibility of the company over a period of time. Technical analysis is based on Dow Theory and uses price history for prediction. It is a form of a time series analysis, which determines the future price of a stock on the basis of the past price, exponential moving average (EMA), oscillators, support and resistance levels or momentum and volume indicators (Agrawal et al., 2019; Teixeira & De Oliveira, 2010).

The choice of appropriate technological methods for stock price forecasting has always been a challenging task. The Artificial Neural Networks (ANN), with their ability to learn, have always attracted the data scientists to use them in prediction problems with Stock Market being no exception (Shah, 2019; Wang, 2011). With the time, the machine learning techniques have improved and it has been possible to use multiple hidden layers or to cascade various layers, as in case of Convolutional Neural Network (CNN) making it feasible to extract the factual relationships which are otherwise hidden from the normal human analysis.

Singh et al. (Singh & Srivastava, 2016), have used Deep Neural Network algorithm to gain future price information. The performance was evaluated on Google stock price multimedia data (chart) from NASDAQ (National Association of Securities Dealers Automated Quotations exchange) and demonstrated that deep learning can improve stock market forecasting accuracy.

Guresen et al.(2011), analyzed the performance of the MLP (Multilayer perceptron), DAN2 (Dynamic Architecture for Artificial Neural Network, Hybrid Neural Network models for obtaining accurate prediction results. Studies have been mostly preoccupied with forecasting volatilities.

Pang et al. (2018), proposed a deep long short term memory neural network (LSTM) with embedded layer to predict the stock market.

Hegazy et al. (2013), proposed algorithm integrates Particle swarm optimization (PSO) and least square support vector machine (LS-SVM). The PSO algorithm is employed to optimize LS-SVM to predict the daily stock prices.

Nayak et al. (2016), proposed a model that predicts the future trend for the next day. Outcome of sentiment analysis is considered along with open price, close price of stock with extracted statistical parameters to build model.

The neural network models and frameworks that have been discussed above have taken into account different types of neural network techniques with dimensionality reduction. However, the domain of technical indicators is yet to be explored. In this paper, we analyze the accuracy of prediction using LSTM with technical indicators of the stock market. As many as 33 parameters are taken into account for making predictions. The next section discusses in detail recurrent neural network which is used to carry out predictions in the proposed framework.