

Stock Price Prediction using Reinforcement Learning and Feature Extraction



R. Sathya, Prateek Kulkarni, Momin Nawaf Khalil, Shishir Chandra Nigam

Abstract: *The goal of this project is to develop a new technique to predict stock worth's through the usage of Reinforcement Learning & Sentiment analysis from social media. During this paper we are going to analyze economical technique which may predict stock movement accurately using both Historical & Real-time Data. The Q Learning based approach will be used to predict these Stocks over a Partially Observable Markov Decision Process comprising of any number of Stocks taken as a State & providing 3 actions which are Hold, Sell or Buy. Additionally, Social media offers a robust outlet for people's thoughts and feelings it's a fast-ever-growing supply of texts starting from everyday observations to concerned discussions. Using social media comments & tweets analysis regarding a Stock, an efficient data can be obtained which can help in determining the overall public review of the Stock. Using these two distinctive approaches together, an efficient technique can be developed to predict Stocks Prices with more accuracy.*

Keyword: *Reinforcement Learning & Sentiment analysis from social media.*

I. INTRODUCTION

Stock market has a key role in the economic development of any Country. Hence India & other developing country's growth highly depends on Stock & the Stock Market Performance. If stock market rises, then countries economic growth would be high[4]. Stock market prediction is the process of trying to determine the future worth of any stock. Social media offers a robust outlet for people thoughts and feelings. Analysis of social media is strongly related to sentiment analysis as this can be used to extract emotions and opinions from texts like tweets. Data mining methodologies like NLP, Random forest, Neural network is used for analyzing social network content[8]. For many years, traditional statistical prediction methods [6] such as linear regression, time series analysis, chaos theory were popular. But for the uncertainty in stock market [7], these methods were failure or partially successfull[5]. Recent analysis reveals the existence of attention-grabbing communication patterns among completely different participants of various social network platforms.

These patterns are shown to be helpful in predicting product sales and stock costs. A successful realization of this application requires an indepth knowledge of an individual's shopping behavior [1].

Thus, a satisfying solution to make the prediction should be adaptive w.r.t a customer's nature, his buying/selling patterns, etc[2]. Compared to a social network, which may be thought of as representing connections among folks within the public, a company network connects solely staff in a very huge corporation. While participants of a social network will have a specific opinions on any problems with interest, members of a company communication network area unit expected to chiefly say company-specific business. If human communication patterns will be discovered within the social networks to predict product sales or stock performance, one might be surprised if such patterns additionally exist among members in company communication network to permit constant to be done. in contrast to social networks, in a very company communication network, e-mails have long been used as a tool for interorganizational and interorganizational data exchange. Within the same means, a social network platform is ready to capture participants' behavior and their opinions concerning varied problems and events. Thus, we tend to argue that a company communication network within the sort of Associate in nursing e-mail scheme additionally contains perceptive data, like structure stability and hardiness, a couple of company's developments. We tend to believe our argument is in line with company communications, that suggests that "employee communications will mean the success or failure of any major amendment program" ensuing from a merger, acquisition, new venture, new method improvement approach, or alternative management problems. In alternative words, worker communication will serve a crucial "business operate that drives performance and contributes to a company's financial success". Based on these broad company communication theories, we tend to anticipate that each company has its own communication approach with identifiable patterns. we tend to believe that these communication patterns will reflect however a company manages major company activities (such as mergers, acquisitions, new ventures, new method improvement approaches, Going considerations or bankruptcy) which will afterwards influence the company's performance within the exchange. The use of evolutionary methods such as Genetic Algorithms, Swarm Optimization and Evolutionary Learning [4] is also popular[9] but not very efficient. Hence the Reinforcement Learning method is used for a more accurate result.

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II. IMPACT

Stock Exchange is an institution in the investment stock market that monitors resources for economic affairs[4]. It absorbs savings and provides liquidity for investments, helps reduce investment risks, offers transparency for investments and encourages entrepreneurship. Economic development requires commitment to long-term investment. The stock exchange provides long-term capital for major sectors of the economy including businesses and the government. Stock exchange indexes are often used as an indicator of economic health.

Characteristics of a good stock prediction System:

There are seven factors which must be kept into Consideration while designing a Stock Prediction System these are Earnings Growth, Stability, Relative Strength in the Market, Debt-to-Equity Ratio, Earnings Ratio, Management, Dividends. Since there are too many factors such as public opinions, general economic conditions, or political events, that have direct or indirect impacts on the evolution of financial time series, extracting these features is tedious and costly[3]. Also the accuracy prediction of these Stock Prediction Techniques should be high which must not decrease with increasing levels.

III. OBJECTIVE

The objective is to develop a model that can predict the Stock price and worth through Reinforcement Learning & Sentiment analysis. This Prediction model will be capable of working with respect to both Historical as well as Real-time data.

IV. METHODOLOGY

A type of Model free RL Technique called Q Learning is used over a set of Stocks of various Companies to predict the best action to be taken. In order to improve the model the State Space is also included with factors like Company News Data. The precision of Company News data is increased with separate usage of Sentiment Analysis. The model designed with Q Learning algorithm will use the results of the Sentiment Analysis algorithm to present a more accurate Outcome. Also LSTM approach to give more precision is taken into consideration.

V. PROBLEM STATEMENT

The problem with present techniques used is that the accuracy of the prediction would decrease when setting more levels of stock market movement. Also the present system is not capable of dealing with real-time trends of the Stock. Therefore there is a need to develop a system such that its accuracy does not decrease with the increase in the data available & is capable of considering both historical & real-time facts & figures.

VI. PROPOSED SYSTEM

The proposed system is designed with the objective to use both Historical data and the Real-time data to process the data more efficiently. The proposed system uses Real-time data which are accessed using the Alpha Vantage API. The

Real-time environment is based on time, thus Reinforcement Learning can be used as it takes time into consideration. Reinforcement learning is a Machine Learning technique which is based on considering actions for maximizing the reward in a particular situation. It's used to find the best possible behavior or path the software must consider at a time. RL is different from the supervised learning and Un supervised learning techniques as there is no answer based decision making here and the reinforcement agent decides what to do which can complete the given task. In the absence of training dataset, it can learn from its experience. Using RL, the Stock Price Problem can be framed as a Markov Decision Process(MDP) consisting of States, Actions & Rewards. Action possible for Stocks Marketing are BUY, SELL and HOLD. The state can be represented as an array of Price of each Stock, total account balance etc . In this environment the Multiple agents are to be considered for which data access may be denied due to privacy. Thus a Partially Observed MDP is obtained. In order to evaluate this POMDP, MODEL FREE RL can be used which is independent of Reward Function or Transition Probability. Q Learning Technique, which is a Model free RL technique, is used. **Q-Learning** is a Reinforcement Learning algorithm which uses Q-values which undergo continuous iterations to improve the behavior of the learning agent.

VII. SYSTEM ARCHITECTURE

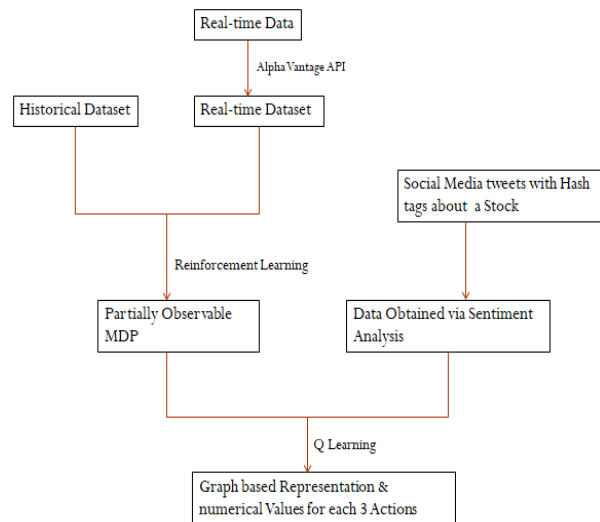


Fig 1. System Architecture

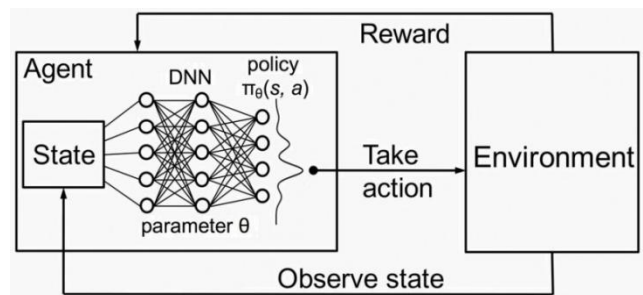


Fig 2. Working of Reinforcement Algorithm

If we can predict whether market will up/down we can buy when the market is down & sell when once its gone up. But the problem is what price are we actually predicting as there is no single price we are buying at.

A naïve approach is to predict the mid part between Best Ask and Best Bid.

If we look at finance industry reports we can find that stock on & future trading are all heavily automated & algorithms behind both trade execution have yielded good results.

Starting with the Datasets ,,,, We built an algorithm that on learn from these datasets.

Now, we have historical data & also access to the real-time data via the API that can constantly in updated prices which we can add to our csv files. Thus, this is a real-time environment where Time is a dimension. Thus, we can use Reinforcement Learning as it takes time into consideration.

Using RL, we can frame our Stock Prediction problem as a Markov Decision Process which consists of States, Actions & Rewards.

The Agent used will be able to execute an action in this environment which will specify an individual value to each. State Category of MDP will contain all data from which algorithm can learn & we can add more to it.

In this exchange environment we have defined there are actually multiple agents for whom we have no access to their data. Thus, it's a Partially Observable MDP. Since its Partially Observable or transaction looks like.

Since we don't know these two, we could use another model based reinforcement learning techniques but there is an alternative way i.e. what if we could just learn the mapping from states to actions directly so we can compute a policy without needing to construct a full model of our environment i.e. Model Free Reinforcement Learning. The best approach to perform this function is Q Learning.

In Q learning we define a function for a State and Action. This function represents the maximum discounted future reward when we perform an action in state S & continue optimally from that point. In this case all 3 possible actions i.e. Sell, Buy, Hold can be rated by this Q Function. Then we can pick the action with highest Q value.

In this we can also include more data to improve the States for which the data from Sentiment Analysis is taken. The Sentiment Analysis is done to improve the accuracy as it will help in analyzing the review of that Stock among people.

VIII. RESULT

Plots are obtained representing the Buying Signal, Selling Signals with respect to the States involving Buy state, Sell state etc with Total Gains & Total Investment Percentage

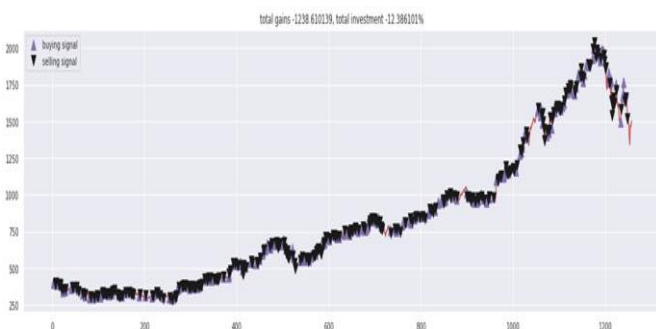


Fig 3. Result on Dataset 1

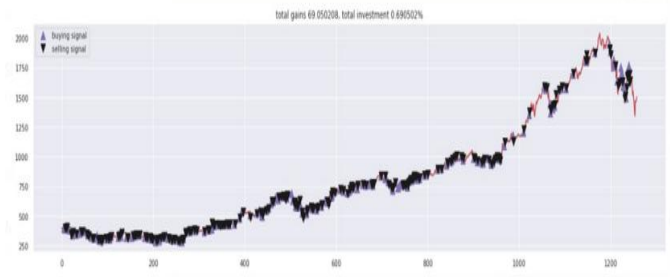


Fig 4. Result on Dataset 2

IX. FUTURE EXPANSION

The future expansion of the project can be to make the use of Machine Learning algorithms to more efficiently sort out the area where the data related to Sentiment Analysis is being obtained i.e. to more precisely understand the Tweet or Comment made by the user & use that data into the analysis & understanding of the Stock Value This factor can then be included in the States table while performing the Q Learning technique which will eventually produce better prediction results.

X. CONCLUSION

The described method using Reinforcement Learning & LSTM based approach has better possibilities of accurately predicting a Stock Price and the action to be performed over it. With the usage of Q Learning approach, the designed model is more efficient in the market as compared to other techniques especially In the field of Competitive Marketing where the Worth prediction is more difficult as the amount which will be invested by others will not be known. In such condition this technique can be efficiently utilized as it works with partially observable states too. Thus a more precise output can be obtained. When used with Sentiment Analysis, this prediction model also becomes more efficient as it now can also judge the stability & trust associated with a stock too.

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