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Machine Learning Algorithms for Prediction of Blue-Chip Stocks

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Abstract*— Because of its unpredictable and non-linear character, accurate stock market prediction is a difficult and time-consuming undertaking for researchers. Several studies are based on previous data to determine the future worth of the stock market. However, external variables such as social media and news headlines now have a significant impact on the stock market. This study is based on predicting future stock prices using Twitter social media and news data, as well as historical data, to achieve high prediction outcomes. Machine learning techniques are employed in this article to forecast future stock values of five blue-chip corporations from various sectors. To construct the final dataset, the data was collected from many sources, including Twitter, news, and historical data, and then examined. Then, using the final dataset, we deployed three machine learning algorithms – SVM, Logistic regression, and Random forest – to forecast the model's accuracy and compared the algorithms to determine the best algorithm for stock market prediction. The results demonstrate that logistic regression earned the highest prediction accuracy for five blue-chip businesses, ranging from 85 percent to 89 percent, and a comparative analysis shows that logistic regression performed better than SVM and Random forest algorithms.

***Index Terms*— Blue-chip Companies, Machine Learning, News headlines, Social Media, Stock Market Prediction, Twitter**

I. INTRODUCTION

A country's stock market is an important part of its economy. It is one of the most popular ways for investors to buy and sell shares of a company's stock (ownership) [1]. The stock market's success determines the country's economic growth. When it comes to the Indian economy, it ranks third in the world, behind the United States and China [2]. The stock market has a beneficial impact on the economy when it rises, and it has a negative impact when it falls [3]. As a result, predicting the future value of a stock market is critical. Stock price prediction is a difficult undertaking for investors and academics due to its volatile, complex, and regular changing nature, making precise predictions difficult [4]. Stock price predictions assist investors and traders in determining which stocks to buy or sell in order to maximize profits. To predict stock market prices, two common methods have traditionally been used. The first is technical analysis, which focuses on historical stock prices in order to forecast the stock market. The second type of analysis is fundamental analysis, which is based on a company's fundamental data, such as market position, revenues, annual growth rates, and expenses [5]. For stock market prediction, traditional regression approaches such as polynomial regression, linear regression, and others were previously used. Moving average, exponential smoothing, and Autoregressive Integrated Moving Average (ARIMA) are examples of conventional statistical models that predict linearly [6]. With the advancement of technology, researchers are increasingly turning to highly intelligence techniques for predicting stock values, which allows them to make quick investing selections. Machine learning is a prominent and relatively new technology for predicting stock price changes nowadays. Stock market prediction utilizing machine learning techniques aids stock traders in making more informed judgments [7].

Many academics find it difficult to precisely estimate stock prices due to the unpredictable and complicated structure of the stock market, and external influences such as social media and daily financial news can have a negative impact on stock prices. Previous stock market forecasting research relied solely on historical data [8], social media data [9], or news data [10] to forecast future stock prices using machine learning algorithms. Researchers presented various prediction methods that employ one or more types of data, with the information acquired from these systems assisting investors in making better stock purchase or sale decisions. A stock market prediction model that uses only one type of data may not provide great prediction accuracy. It is critical to integrate external components such as social media and news headlines in order to obtain excellent prediction results because unexpected occurrences represented on these factors can also effect stock prices. This study is focused on forecasting future stock prices using social media data, news data, and historical data. Using both types of data to predict the stock market improves the accuracy of the suggested prediction model. Social media is an excellent venue for expressing public feelings and ideas on any topic. Twitter, in particular, is a popular tool that allows people to voice their ideas in real time [9]. No one has worked on Blue Chip firms, which have a significant impact on stock market fluctuations, in the existing studies. Blue chip enterprises are well-established, financially sound, have a large market capitalization, and stock prices that are high [11]. These

firms' stocks are the most reliable and stable long-term investments. In India, there are a number of blue chip firms that operate in various industries or sectors [12]. We chose five blue-chip businesses from various industries for stock price forecasting with the help of professional counsel. Bharti Airtel Ltd. (Telecom industry), Reliance Industries Ltd. (Crude oil industry), Tata Consultancy Services Ltd. (Information technology industry), Maruti Suzuki India Ltd. (Automobiles & Ancillaries industry), AXIS Bank Ltd. (Banking industry), and so on are among the companies that have been chosen.

The goal of this research is to use machine learning algorithms to anticipate stock prices of blue chip firms and to estimate the accuracy of the machine learning model generated. The use of external inputs such as twitter data and news data to predict stock prices is a significant contribution of this work. Tweets are received from Twitter using Python, while news data is gathered from websites like investing.com, reuters, financial times, and business insider, among others. The website https://www.investing.com/ provided historical data from the preceding five years. The primary objective of this study is to implement various machine learning algorithms, such as SVM, Random Forest, and Logistic Regression, and to forecast the accuracy of established machine learning algorithms and generate stock price predictions for blue-chip companies, using historical, social media, and news data from diverse sources.

The following is how the rest of the paper is organised: The second section examines the available studies on stock market forecasting. The research technique is described in Section 3. The results are presented in Section 4. The conclusion is described in Section 5. The future work plan is discussed in Section 6.

II. LITERATURE SURVEY

This section summarises previous research on stock market prediction using machine learning or other techniques.

Aparna Nayak et al. [13] used supervised machine learning algorithms to create two models to predict the stock market movement. The first model forecasts the next day's trend based on daily predictions based on both historical and social media data. The second model predicts the trend for the upcoming month using only past data and is based on monthly projection.

In 2018, [14] investigated a Support Vector Machine (SVM) algorithm for predicting stock market values using data from various global financial marketplaces. The results revealed that the SVM algorithm performs well on huge datasets and that the model creates more profit.

Choudhry and Garg [15] suggested a hybrid machine learning approach based on Genetic Algorithms (GA) and Support Vector Machines for stock market prediction (SVM). TCS, Infosys, and RIL are the three equities used to test the algorithm. The GA-SVM hybrid model outperformed the stand-alone SVM system by a large margin.

K. Hiba Sadia et al. [16] concentrated on developing the best model for predicting stock market value based on historical data from prior years. Using the Random Forest Classifier, this model employs machine learning methods and achieves a high accuracy score of up to 0.808.

In 2016, Venkata Sasank Pagolu et al. [9] used solely Twitter data to investigate the link between stock market fluctuations and public attitudes in tweets. When the model was trained with LibSVM, it produced a result of 71.82 percent accuracy, indicating that there is a favourable link between a company's stock market movements and public opinion stated on Twitter.

Sikkisetti Jyothirmayee et al. [8] proposed a system to predict a company's market performance (DJIA STOCK NEWS) by comparing the accuracy of various supervised learning algorithms and determining that the SVM algorithm is the most suitable algorithm for predicting stock market prices with 99.87 percent accuracy.

In 2016, Mehak Usmani et al. [17] compared several machine learning algorithms to predict the market performance of the Karachi Stock Exchange (KSE), including Single Layer Perceptron (SLP), Multi-Layer Perceptron (MLP), Radial Basis Function (RBF), and Support Vector Machine (SVM). In comparison to other methodologies, the MLP is the best performing algorithm, predicting 77 percent right market performance.

By leveraging data about Twitter users' psychological moods, Alexander Porshnev et al. [18] developed a technique to increase the accuracy of stock market prediction. DJIA and S&P500 indicators are predicted using support vector machine and neural network methods. However, the results show that adding Twitter data to the equation does not improve accuracy.

Kompella and Chilukuri [4] focused on projecting the stock market in 2019 using the stock price and news headline as inputs. The polarity score of the new article was calculated using sentiment analysis, which assisted in accurately forecasting the outcome. Finally, the Random forest algorithm is constructed and its efficiency is compared to that of logistic regression. It was determined that the random forest technique is more efficient than logistic regression by evaluating the value of Variance score, Mean absolute score, and Mean squared score for both Random forest and logistic regression.

Mehar Vijh et al. [19] used artificial neural networks and random forests to estimate the close prices of five businesses the next day. Three indicators are used in the comparison: RMSE, MAPE, and MBE. The results indicated that the ANN model outperforms the random forest technique in terms of RMSE (0.42), MAPE (0.77), and MBE (0.013) for stock market price prediction.

Sneh Kalra et al. [10] suggested a daily prediction model that uses historical data and news items to forecast future market prices. The K-Nearest Neighbors, Support Vector Machine,

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Nave Bayes, and neural network techniques were used in this study. When compared to other algorithms, the results showed that KNN had a greater prediction accuracy of 91.2 percent.

Anjana Rajeev et al. [20] established a technique that uses twitter data to predict stock market changes. Using two machine learning techniques, Nave Bayes and XGBoost classifier, this work performed sentiment analysis on the collected tweets. The findings revealed that public opinion on Twitter had an impact on the stock market.

Ishita Parmar et al. [21] used only one company's historical data to forecast future stock prices with higher accuracy using two machine learning models: Long Short Term Memory (LSTM) Network Based Model and Regression Based Model. The LSTM model was shown to be more accurate than the regression-based approach.

For stock market prediction utilising historical data and technical indicators, Osman Hegazy et al. [22] introduced a machine learning model that combines particle swarm optimization (PSO) with least square support vector machine (LS-SVM). The findings demonstrated that the suggested model outperforms the LS-SVM and compared algorithms in terms of accuracy.

Machine learning techniques were employed by Tae Kyun Lee et al. [23] to create global stock market trading strategies based on financial network indicators. This study demonstrates how financial network indicators can be applied in real-world situations. The findings revealed that global stock market network indicators may accurately predict stock market direction.

III. RESEARCH METHODOLOGY

This section describes each step performed in our proposed prediction system as shown in Figure 1.

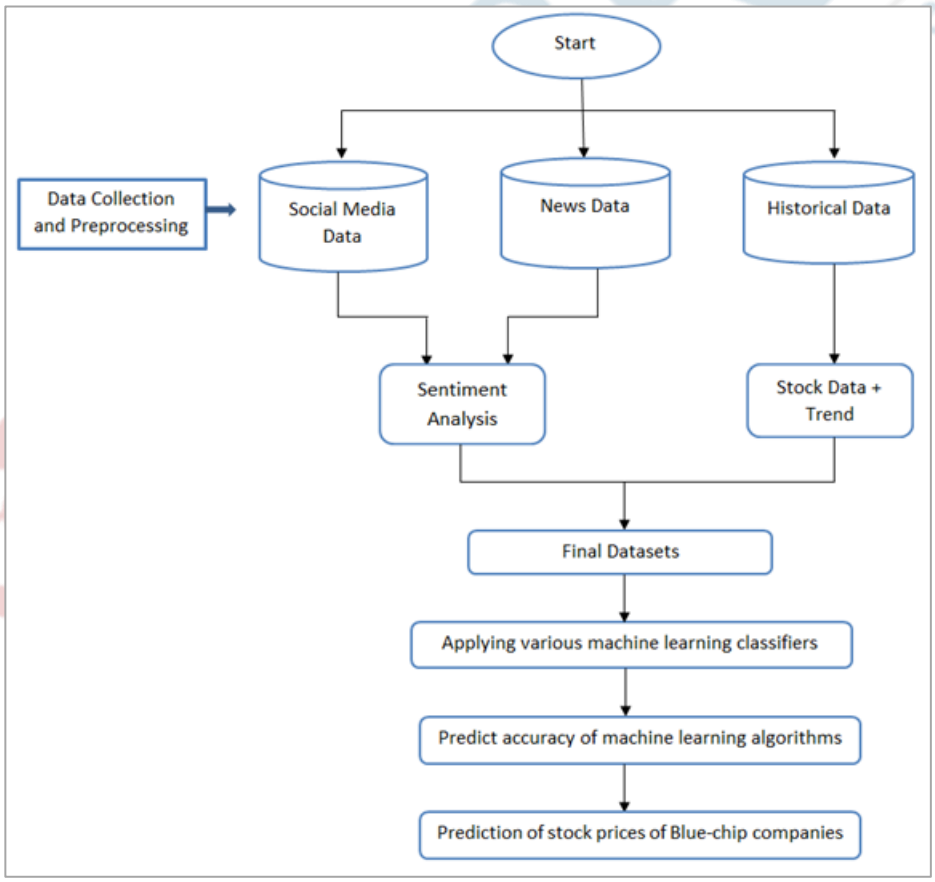

Fig. 1 Flow chart of the steps performed in our proposed system

The first stage is to gather historical data, Twitter data, and news data. Blue chip companies utilised in our study for stock price prediction include Reliance Industries Ltd (RELI), Bharti Airtel Ltd. (BRTI), Tata Consultancy Services Ltd. (TCS), Maruti Suzuki India Ltd. (MRTI), and Axis Bank Ltd (AXBK), among others.

Historical data from the last five years is collected in.csv (Comma Separated Values) file format from the https://www.investing.com/ website for the selected time period of June 18th,2016 to June 21st,2021. Figure 2 depicts the seven features of the downloaded data file: date, open, close, high, low, volume, and change percent.

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Date	Price	Open	High	Low	Vol.	Change %
21-Jun-21	539.6	535	541.9	533	5.64M	0.16%
18-Jun-21	538.75	531.4	541.9	519	14.72M	1.91%
17-Jun-21	528.65	539.5	541.25	527.05	10.03M	-1.51%
16-Jun-21	536.75	543.8	543.8	534.9	9.86M	-1.06%
15-Jun-21	542.5	541	543.65	538.4	7.13M	0.58%
14-Jun-21	539.35	540.85	540.85	529.3	5.61M	-0.28%
11-Jun-21	540.85	545.5	549.75	540.05	7.63M	-0.79%

Fig. 2 Historical Data

Twitter is chosen as the data source for social media data in this paper. Python is used to build the Twitter Application Program Interface (API) in order to get tweets from Twitter. Keywords such as #reliance, #bhartiairtel, #marutisuzuki, #axisbank, and #tcs are used to filter tweets. News data is gathered from several sources such as investing.com, reuters, financial times, and business insider, among others.

RT @DirectusMohit: Saudi Aramco Chairman to Join Reliance Industries Limited (RIL) Board
RT @CompassnInCare: "Noone wants to admit we have spent billions on regulators in order to mislead the public into be
RT @Bhai1Its: Long signal in #Reliance rewarded me well today . Entered as there is a long signal and +ve crossover in
Has anybody notice as #Reliance #AgM is near by all Future group stocks and other stocks related to Reliance has moved
@dmuthuk Opportunity cost ? , can always use of alerts in technical chart to enter again... #Reliance #ITC great exampl
RT @VRtrendfollower: #Reliance Big Announcement Likely in Co AGM for Saudi Aramco Chairman Induction in Board.
RT @CompassnInCare: "Noone wants to admit we have spent billions on regulators in order to mislead the public into be
RT @livemint: Mukesh Ambani-led Reliance Industries Ltd (RIL) is building a suite of diverse learning solutions for India?s

Fig. 3 Twitter data

RIL AGM 2021: Jio, Google to roll out 4G smartphone on September 10
Reliance charts mega plan for its renewable energy business
RIL offers board seat to Saudi Aramco's Yasir Al-Rumayyan in global push
Reliance Industries to invest Rs 75,000 crore on new clean energy business over
Reliance Retail is on a "Hyper Growth Trajectory", says Mukesh Ambani
Jio's 'Made in India' 5G solution globally competitive: Mukesh Ambani
Future Retail seeks extension of time for filing results
JioPhone Next final pricing, performance crucial for success: industry watchers

Fig. 4 News Data

Data preprocessing is used to reduce noise and other irregularities from data. Special characters in downloaded tweets and news headlines, such as user mentions, hashtags (#), Uniform Resource Locators (URLs), and so on, must be preprocessed before machine learning techniques can be applied. To convert tweets and news headlines into the right format, a number of preprocessing procedures are done.

Sentiment analysis is the computational method of classifying written content as positive, negative, or neutral [24]. Positive sentiment is expressed by one, negative feeling by one, and neutral sentiment by zero. Python is used to perform sentiment analysis on tweets and news by evaluating polarity, subjectivity, and compound value. The polarity score is between [-1,1] while the subjectivity score is between [0,1]. The compound score, which ranges from -1 to 1, is the sum of positive, negative, and neutral scores [25]. Figure 5 depicts the sentiment analysis of preprocessed tweets and news.

Preprocessed tweets	Subjectivit	Polarity	Compound	Negative	Neutral	Positive	label
Anil Ambani bankrupt c	0.5	0.5	-0.1779	0.185	0.667	0.149	0
Google Reliance Smart	0.4	-0.1	-0.2263	0.16	0.84	0	-1
Today Sold Reliance Ju	0	0	0.4404	0	0.775	0.225	1
Capital Growers RELIAI	0.6	0.7	0.4404	0	0.633	0.367	1
Reports that Saudi Arar	0	0	0.5574	0	0.723	0.277	1
Reliance https cqRDvt	0	0	0	0	1	0	0
JioCare more than hou	0.75	-0.25	-0.2815	0.259	0.561	0.18	-1

Fig. 5 Sentiment analysis

We projected the stock movement using the "close" characteristic existing in previous data after doing sentiment analysis on Twitter and news data. If today's close price is higher than the previous day's close price, the label is set to 1, otherwise it is put to 0. Label 1 indicates that the trend has increased or remained constant, whereas label 0 indicates that the trend has dropped. Twitter and news attitudes are now combined with historical data to form the **final dataset**. Figure 6 depicts a sample of the completed dataset.

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Date	Price	Open	High	Low	Subjectivit	Polarity	Compound	Positive	Negative	Neutral	label
18-06-21	2,225.65	2,225.50	2,235.00	2,184.35	0.4	-0.05	0.2023	0.083	0	0.917	1
17-06-21	2,215.65	2,200.00	2,235.00	2,179.90	0	0	0	0	0	1	1
16-06-21	2,211.60	2,244.90	2,247.05	2,205.85	0	0	0	0	0	1	0
15-06-21	2,250.00	2,261.00	2,274.90	2,240.30	0.65	-0.1	0.296	0.091	0	0.909	1
14-06-21	2,244.90	2,215.00	2,258.25	2,195.05	0.5	0.5	0	0	0	1	1
11-06-21	2,213.15	2,182.90	2,228.00	2,180.10	0.7	0.366667	0.5859	0.231	0	0.769	1
10-06-21	2,183.00	2,193.40	2,230.00	2,177.55	0.61	0.29	0.91	0.38	0	0.62	1
09-06-21	2,175.00	2,219.00	2,221.00	2,157.95	0	0	0	0	0	1	0
08-06-21	2,214.60	2,226.60	2,227.15	2,198.15	0.565	0.3075	0.6478	0.194	0	0.806	0

Fig. 6 Final dataset

Three machine learning algorithms (SVM, Random forest, and Logistic regression) are chosen and compared in this study based on their prediction performance. These algorithms are first trained and then evaluated on final datasets to forecast future stock prices of blue chip companies. The final datasets are separated into 80 percent training data and 20 percent testing data before applying machine learning algorithms. We created prediction models in Python using the scikit-learn machine learning framework to train and evaluate the machine learning algorithms.

IV. PERFORMANCE EVALUATION AND RESULTS

Different parameters such as accuracy, precision, recall, and F1 score are used to evaluate the performance of the chosen machine learning algorithms. We compared the performance of three machine learning algorithms after calculating all of these parameters to find the best algorithm for stock price prediction.

Accuracy: The rate of correct classifications is known as classification accuracy. The number of correct predictions divided by the total number of predictions is the ratio.

$$Accuracy = \frac{No.\_of\_correct\_pred}{Total\_no.\_of\_pred}$$

The algorithm's true positive rate is TP, the true negative rate is TN, the false positive rate is FP, and the false negative rate is FN.

Precision: It is defined as the proportion of true positives among positive instances. It's derived by dividing the total number of true positives and false positives by the number of true positives.

$$\Pr ecision = \frac{TP}{TP + FP}$$

Recall: The proportion of true positives among all positive instances in the data is known as recall. It's calculated by dividing the total number of true positives and false negatives by the number of true positives.

$$\mathrm{Re}\,call = \frac{TP}{TP + FN}$$

F1 Score: The F1-score is a single metric that combines precision and recall. When compared to accuracy, F1 is frequently more useful [26].

$$F1 = 2 * \frac{\Pr ecision * \mathrm{Re}\,call}{\Pr ecision + \mathrm{Re}\,call}$$

The results of the proposed machine learning algorithms are represented in the below tables. The 80:20 ratios are used to divide the final dataset. Data is used for training in 80% of the cases, and testing in 20% of the cases. The five blue-chip companies' data is used to train and test the major three machine learning algorithms: SVM, Random forest, and logistic regression. Table I, table II, table III, table IV, and table V illustrate the projection results for chosen blue chip companies: Reliance Industries Ltd (RELI), Bharti Airtel Ltd. (BRTI), Tata Consultancy Services Ltd. (TCS), Maruti Suzuki India Ltd. (MRTI), and Axis Bank Ltd (AXBK).

Table 1: Prediction Results for Reliance

Reliance	**Accuracy**	**Precision**	**Recall**	**F1**
Logistic Regression	85%	85%	85%	85%
SVM	54%	54%	59%	48%
Random Forest	60%	60%	61%	60%

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Table 2. Prediction Results for TCS

TCS	Accuracy	Precision	Recall	F1
Logistic Regression	86%	86%	86%	86%
SVM	56%	56%	55%	46%
Random Forest	75%	75%	74%	75%

Table 3 Prediction Results for Maruti Suzuki

Maruti Suzuki	Accuracy	Precision	Recall	F1
Logistic Regression	89%	89%	90%	89%
SVM	45%	45%	50%	28%
Random Forest	73%	73%	73%	73%

Table 4. Prediction Results for Bharti Airtel

Bharti Airtel	Accuracy	Precision	Recall	F1
Logistic Regression	88%	88%	88%	88%
SVM	78%	78%	77%	78%
Random Forest	79%	79%	79%	79%

Table 5. Prediction Results for Axis Bank

Axis Bank	Accuracy	Precision	Recall	F1
Logistic Regression	87%	87%	87%	87%
SVM	68%	68%	70%	67%
Random Forest	80%	80%	80%	80%

The tables above indicate that among the classification models for five blue-chip companies, Logistic regression clearly surpasses the other classifiers in terms of all performance criteria, whereas SVM performs the worst for the input dataset. The results demonstrate that the logistic regression algorithm had the best prediction accuracies for five blue-chip companies, ranging from 85 percent to 89 percent.

V. CONCLUSION AND FUTURE SCOPE

We proposed a framework in this study for predicting the future value of chosen blue-chip companies using external inputs like twitter data and news headlines, as well as historical data. Three machine learning algorithms – SVM, Logistic regression, and Random forest – were utilized to construct the prediction system, and these algorithms were compared to discover the optimum method for stock market prediction. The accuracy, precision, recall, and F1 score of the chosen machine learning algorithms are all used to evaluate their performance. The highest prediction accuracies were attained using the logistic regression method for five blue-chip businesses, ranging from 85 percent to 89 percent, and the comparative analysis revealed that logistic regression performed better than SVM and Random forest algorithms. More machine learning algorithms for stock market prediction could improve the model's accuracy in the future. Future studies may also incorporate data from other social media platforms, such as Facebook, reviews, and blogs, which have an impact on the stock market.

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