

Stock Market Psychology: Using Gann- Chart and LSTM Model

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Abstract - To understand the psychology of the stock market is to keep an eye watch on the numbers/prices of the stock. The psychology in terms of the stock market is to understand what is the best time to buy or sell a particular stock. This becomes difficult for the novice crowd entering the stock market because of which many times they end up with a great loss. This paper presents an extensive process that can be used by both professional as well as novice users to predict the future stock market value of a stock based on historical data. Moreover, our project will also help the user by giving an end-to-end insight into the buying trend and the selling trend of a particular stock for intraday trading to gain profit. All in all, this paper will give you a walkthrough of two powerful techniques namely the Long Short-Term Memory (LSTM) and Gann Chart theory which are used to predict future stock prices. A comparison with respect to accuracy is then performed against an Arima model.

Key Words: stock market, buying trend, selling trend, Long Short-Term Memory, Gann Chart theory

1. INTRODUCTION

Stock market prediction is one of the most debated topics on the internet. Today we see researchers and mathematicians are continuously working to predict the future stock price to yield significant profit. As the craze for the stock market increases more and more people want to trade in the stock market to make significant gains. Preliminary to investing in the stock market one has to understand the psychology of the stock market which will require studying the stock market to a great extent. As we are aware not everyone has enough time and resources to study the stock market and many novice users stay skeptical to invest in the stock market. Hence this is where our paper comes in to picture, we have proposed a methodology that one can use to predict the future price of a stock and avoid losses while trading in the stock market. In this paper, we use two methods for understanding the psychology of the market. One is using the Gann-Chart theory and the other is the LSTM model. The Long Short-Term Memory, or LSTM, network is a special type of Recurrent Neural Network designed for sequence problems. Moreover, our project will also help the user by giving an end-to-end insight into the buying trend and the

selling trend of a particular stock for intraday trading to gain profit. A user basically can perform three actions at a particular given time that is buy a stock, sell a stock and hold a stock. Understanding psychology is to undertake the best action to gain profit. The selling trend is used by the bear cattle i.e., when the market is behaving in a bearish manner then one should sell the shares. The Buying Trend is used by the bull cattle i.e., when the market is behaving in a bullish manner then one should buy the shares. If the market is constant, i.e., it is behaving in a sideways manner then one should hold up with the shares.

2. LITERATURE SURVEY

The initial focus of our literature review was to explore the existing systems used for sequence prediction. Subsequently, we then analyzed all the systems with respect to accuracy. This helped us to get an overview of existing systems and their drawbacks which we then overcome in our proposed system. The paper "Sentiment Analysis for Effective Stock Market Prediction", illustrates the correlation between the stock market values and sentiments in RSS news feeds are established. This trained model is used for prediction of stock market rates [1]. The model, which assumes the constancy of the residual term's variance, is OLS. The findings based on this model indicate that day of the week effect is present in the return equation [2]. The paper "Stock Market Prediction Using Various Statistical Methods" is concentrated on using several statistical methods for stock market analysis and prediction. Specifically, the following methods would be discussed: Exponential Smoothing, Mean Square Error (MSE), and Autoregressive Integrated Moving Average (ARIMA) [3]. Time series analysis and forecasting is of vital significance; Time series data refers to an ordered sequence or a set of data points that a variable takes at equal time intervals [4]. After doing an intensive case study in forecasting and analysis to predict the future prices of stock, we can conclude that the Gann theory for intraday trade and LSTM model for future price prediction is most preferable.

3. PROPOSED SYSTEM

We propose an application built on python modules that presents both the prediction by LSTM model and Gann-Chart for intra-day trading. The prediction is done of one-day interval.

3.1 Sequence Prediction Problems

Sequence prediction is the attempt to predict data values in the sequence on the basis of the preceding data values.

Learning of sequential data continues to be a fundamental task and a challenge in pattern recognition and machine learning. Applications involving sequential data may require prediction of new events, generation of new sequences, or decision making such as classification of sequences or sub-sequences.

- On Prediction Using Variable Order Markov Models, 2004.

Some of the examples of sequence prediction problems include stock market prediction, weather forecasting, and product recommendation

3.2 LSTM - an overview

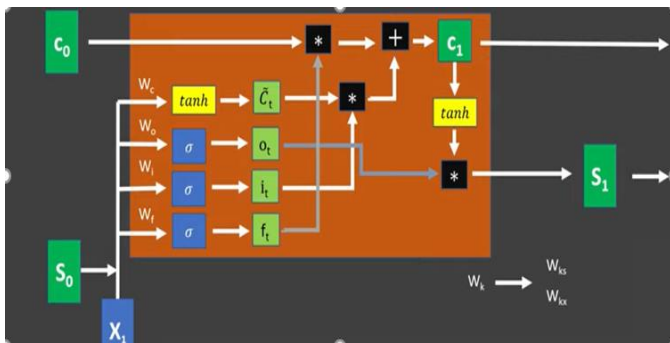


Fig. 1: An LSTM Model

$$\begin{aligned}
 f_t &= \sigma(W_f S_{t-1} + W_f X_t) \text{ - Forget Gate} \\
 i_t &= \sigma(W_i S_{t-1} + W_i X_t) \text{ - Input Gate} \\
 o_t &= \sigma(W_o S_{t-1} + W_o X_t) \text{ - Output Gate} \\
 \tilde{C}_t &= \tanh(W_c S_{t-1} + W_c X_t) \\
 c_t &= (i_t * \tilde{C}_t) + (f_t * c_{t-1}) \text{ - Cell State} \\
 h_t &= o_t * \tanh(c_t) \text{ - Output State}
 \end{aligned}$$

Fig. 2: LSTM model equation

The Long Short-Term Memory, or LSTM, network is a type of Recurrent Neural Network. Recurrent Neural Networks (RNNs) are a special type of neural network designed for sequence problems.

Like RNNs, the LSTMs have recurrent connections so that the state from previous activations of the neuron from the previous time step is used as context for formulating an output. [long-short-term-memory-networks-with-python] The key challenge faced with RNNs is how to train them effectively. Experiments show how difficult this was where the weight update procedure resulted in weight changes that quickly became so small as to have no effect (vanishing gradients).

LSTM is an RNN architecture specifically designed to address the vanishing gradient problem. Additionally, LSTMs possess memory to overcome the issues of long-term temporal dependency with input sequences.

LSTM consist of a cell, an input gate, an output gate and a forget gate. The cell remembers values over arbitrary time intervals and the three gates regulate the flow of information into and out of the cell.

The key to the memory cell is the gates. There are three gates:

1. **Forget Gate:** Decides what information to discard from the cell.
2. **Input Gate:** Decides which values from the input to update the memory state.
3. **Output Gate:** Decides what to output based on input and the memory of the cell.

The LSTM network decides for how long information about specific past trends in stock price movement needs to be retained in order to more accurately predict future trends in the variation of stock prices.

3.3 Stock Prediction Algorithm

1. Start
2. Reading and analyzing historical stock data (Pandas)
3. Convert Pandas DataFrame to NumPy Array (NumPy)
4. Normalizing the data (MinMaxScaler)
5. Build the LSTM model (Keras)
6. Training, predicting, and visualizing the result.
7. Plot the actual values vs the predicted value (Matplotlib)
8. Predict the next day stock price
9. Stop

Stock Prediction Flowchart

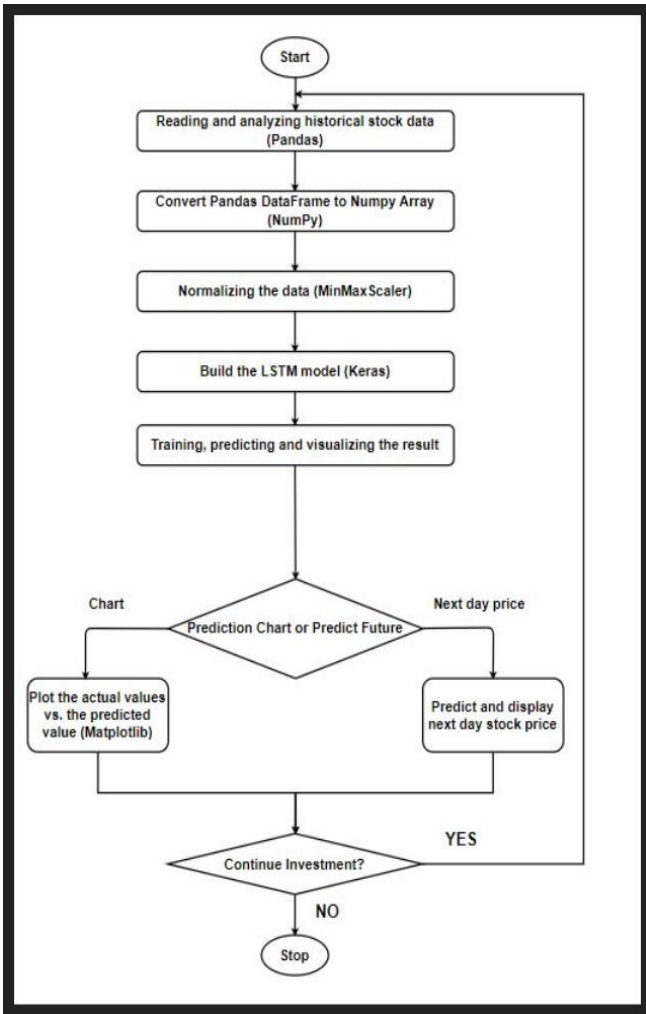


Fig. 3: Stock prediction algorithm (LSTM)

3.4 Terminologies Used

Training set: subsection of the original data that is used to train the neural network model for predicting the output values

Test set: part of the original data that is used to make predictions of the output value, which are then compared with the actual values to evaluate the performance of the model

Activation function: Here, ReLU (Rectified Linear Unit) activation function is tested to optimize the prediction model.

ReLU stands for rectified linear unit

Mathematically, it is defined as $y = \max(0, x)$.

Below is given the visual representation of ReLU:

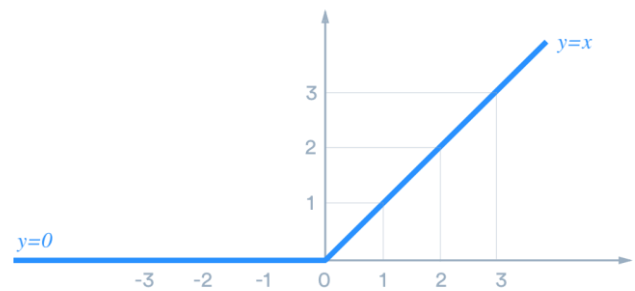


Fig. 4: ReLU (Rectified Linear Unit)

Number of Layers

In our proposed project, the LSTM model will contain four layers, two hidden layers, and two dense layers. The output of the first hidden layer is connected to another hidden layer which is further connected to a dense layer and that dense layer is lastly connected to another dense layer.

Batch size: the number of samples that must be processed by the model before updating the weights of the parameters. In our project, we use batch size of 25.

Dense layer: A dense layer is a densely connected Neural Network layer, where a dense layer connects each cell to another in the next layer. In our project, we use two dense layers.

Number of Epochs: An epoch is when the whole training data has been passed through the network, hence one epoch is one iteration of the whole training data being passed through the network. In our project we use 50 epochs.

Error Calculation:

Root Mean Square Error (RMSE): the measure of the difference between predicted values by a model and the true values observed.

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (f_i - o_i)^2}$$

Where,

n = number of samples

f = predicted values

o = true values

Note - Smaller the RMSE value, greater the accuracy of the model.

In our project we use the NumPy library (np) to find the RMSE value,

`np.sqrt(np.mean(((pred- y_test) **2)))`

Where, y is the testing data and pred is the predictions made by the model.

Mean Absolute Percentage Error (MAPE) is a statistical measure used to measure the predictive accuracy of machine learning models.

$$MAPE = \frac{1}{n} \sum_{t=1}^n \left| \frac{A_t - F_t}{A_t} \right|$$

Where,

A = Actual value

F = Forecast Value

Lower the MAPE, better fit is the model.

3.5 VISUALIZATION OF RESULTS

In the below-given graph, we have plotted the actual and the predicted closing stock price of the **State Bank of India (SBIN.NS)** from the date “2012-01-01” to “2019-12-17”. The model was trained with a batch size of 25 and 50 epochs, and the predictions made closely matched the actual stock prices, as observed in the graph.

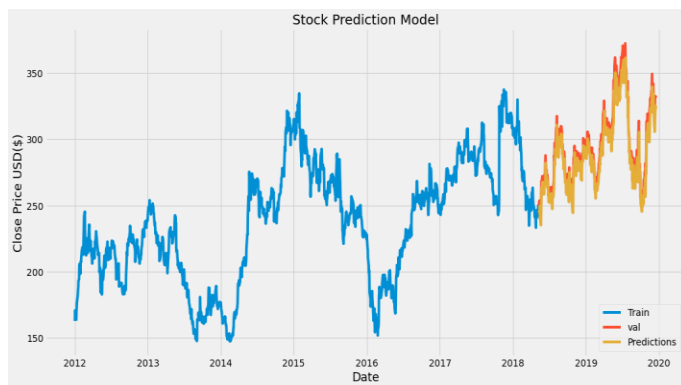


Fig. 5: LSTM Prediction Graph

Calculating Error function

Table 1: Error calculation for SBI.NS dataset (LSTM)

State Bank of India (SBIN.NS)		
Date	Data Size	LSTM
Start: '2012-01-01'	(1942 rows, 6 columns)	RMSE- 9.05
End: '2019-12-17'		MAPE: 0.0245

Calculating Future Price

Let us predict the stock price for “2019-12-18” which is not present in the testing data and then compare it to actual(true) value.

Predicted stock Price:

2019-12-18 predicted stock value is: [[325.28094]]

Actual stock price

Date	High	Low	Open	Close	Volume	Adj Close
2019-12-18	335.549988	325.799988	335	326.950012	26449075	326.950012

As we observe the actual stock price is 326.95 and the predicted stock price value is 325.28. Hence, we can conclude that the difference between the actual and predicted stock price is very minimal and our model gives the finest result.

3.6 COMPARISON OF LSTM WITH ARIMA

The performance of our proposed stock prediction system, which uses an LSTM model, was compared with ARIMA model on two different stocks.

The two data sets that we used to make the predictions were “Nifty 50(^NSEI)” and “State Bank of India (SBIN.NS)”. In both the data sets we have considered 8 years of data starting from “2012-01-01” to “2019-12-17”. We extract data from ‘yahoo’ using the pandas-data reader library.

We now check which model is more accurate by comparing the RMSE and MAPE values that we obtain after a successful prediction of both models on the same dataset.

Table 2: Nifty50 dataset (LSTM vs Arima)

^NSEI			
Date	Data Size	LSTM	ARIMA (1,0,1)
Start: '2012-01-01'	(1942 rows, 6 columns)	RMSE- 112.43	RMSE -851.89
End: '2019-12-17'		MAPE: 0.0078	MAPE: 0.0633

Table 3: SBI.NS dataset (LSTM vs Arima)

State Bank of India (SBIN.NS)			
Date	Data Size	LSTM	ARIMA (1,0,1)
Start: '2012-01-01'	(1942 rows, 6 columns)	RMSE- 9.05	RMSE - 42.98
End: '2019-12-17'		MAPE: 0.0245	MAPE: 0.1183

As mentioned in the above tables, we see observation for two following data set:

Considering the **Nifty 50(^NSEI) data set**, the LSTM gave a MAPE value of 0.0078 whereas the ARIMA model returned a MAPE value of 0.0633. For data set

Considering the **State Bank of India (SBIN.NS) data set**, the LSTM gave a MAPE value of 0.0078 whereas the ARIMA model returned a MAPE value of 0.0633.

For Data set, in both the cases we observe that LSTM gave a lesser MAPE value compared to ARIMA and as we know lower the MAPE value, the better fit is the model. Hence, we can conclude that LSTM model predicted better than ARIMA model.

3.7 Gann-Theory: Introduction

William Delbert Gann, an American trader, and market theorist developed Gann trading theory in 1935. The theory given by him are popular and reliable among the trader. In fact, most of the traders take their position by looking at the price and rely on the Gann angles.

Gann theory predicts the movement of stocks after taking into account the past, present and future of the markets. By analysing and assessing the information of the different period including the short-term market highs and long-term market highs, angles are drawn to determine the future market trend.

He invented the Gann Fan, are a form of geometric technical analysis based on the assumption that markets are cyclical in nature. The Gann fan theory describes that it has 9 angles which are upon 360 degrees. And angles are based on 45 degrees it's also known as 1:1 angle and Gann believe the 45-degree angle is important and trends above it are strongly bullish and trends below it is strongly bearish.

The 9 angles are: 0, 45, 90, 135, 180, 225, 270, 315, 360.

By Using these 9 angles as a Quadrants along with integers numbering from 0 to 450, calculate the values. (450 is our assumption you can calculate as many as you want).

3.8 Generating Gann-Chart using Gann-Theory

- All Quadrants are substituted by numbers starting from 0 to 8.

	A	B	C	D	E	F	G	H	I	J
Quadrant	0	45	90	135	180	225	270	315	360	
	0	1	2	3	4	5	6	7	8	

Figure 6

- Then each number is divided by 8 and the value is written below it. ($1/8 = 0.125$).

Quadrant	0	45	90	135	180	225	270	315	360
	0	1	2	3	4	5	6	7	8
Integers	0	0.125	0.25	0.375	0.5	0.625	0.75	0.875	1

Figure 7

- Each integer value is summed to the produced answer from above and is squared to generate the table values. ($((0+0) = 0)^2 = 0$, $((0+0.125)^2) = 0.01563$

	0	1	2	3	4	5	6	7	8
Integers	0	0.125	0.25	0.375	0.5	0.625	0.75	0.875	1
0	0	0.01563	0.0625	0.14063	0.25	0.39063	0.5625	0.76563	1

Figure 8

Flowchart of Gann-Theory

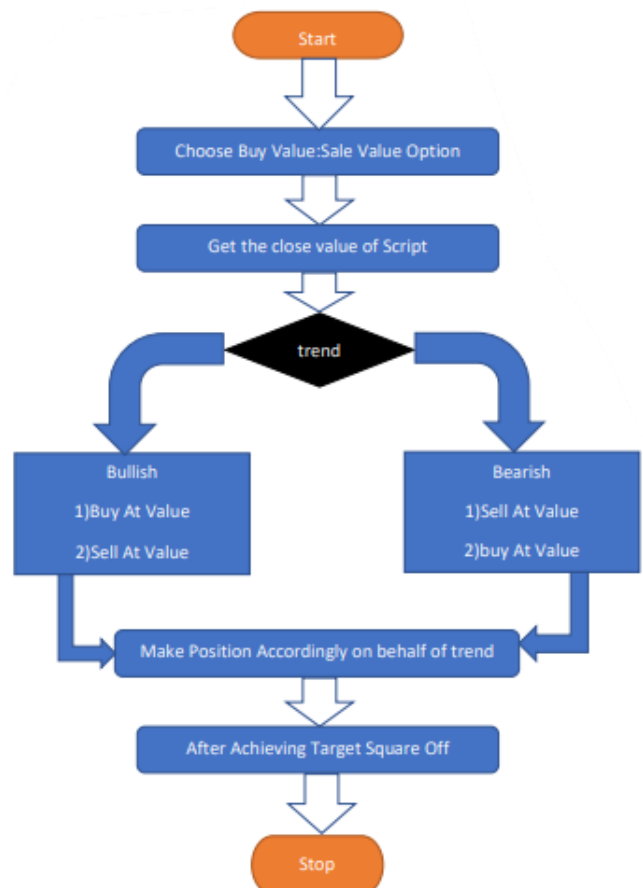


Figure9: Buy and Sell Trend Flowchart

3.9 Calculating the Buying Trend

Buying Trend refers to the bullish behavior of the stock market. When the investor wants to know buying trend of a particular stock then the system will generate two values i.e., "Buy Value" and "Sell Value". In order to gain profit, the user is expected to buy the stock at Buy Value and sell the stock at Sell Value.

Buying Trend:

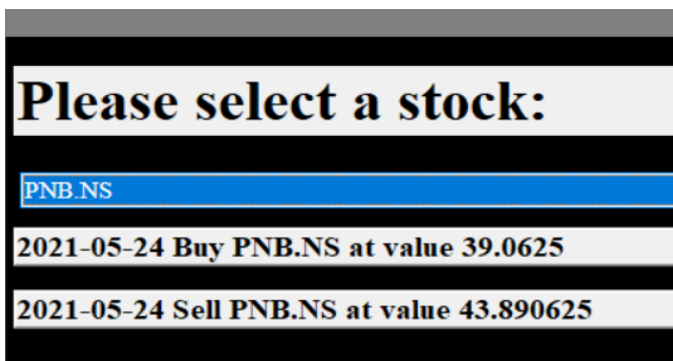


Figure 10: Buying Trend

3.10 Calculating the Selling Trend

Selling Trend refers to the bearish behavior of the stock market. When the investor wants to know the selling trend of a particular stock then the system will generate two values i.e., "Buy Value" and "Sell Value". In order to avoid loss, the user is expected to sell the stock at higher value (Sell Value) and buy the stock at lower value (Buy Value).

Selling Trend:

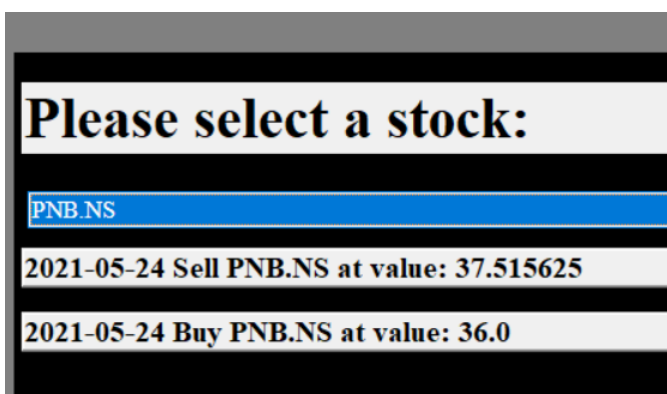


Figure 11: Selling Trend

4. CONCLUSIONS

We implement the application "Stock Market Psychology" that can be used by both novice investors as well as intermediate traders to predict the future price of a stock on the basis of historical data. The main aim of this application is to figure out what is the best time to buy or sell a

particular stock. All in all, using this system will benefit the investors to invest in the stock market without any hesitation about financial loss and also get a statistic about stock movement.

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