

# **Stock market Forecasting Using Machine Learning and Deep Learning using stacked LSTM**

## **M.Sc. in Information Technology (A.I)**

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# Motivation:

Motivated by the desire to enhance stock market prediction, this project aims to revolutionize the field by integrating the powerful capabilities of machine learning and deep learning. Specifically, I aspire to combine Stacked LSTMs with innovative components such as Recurrent Neural Networks (RNN), Exponential Moving Averages (EMA), and Reinforcement Learning. By seamlessly integrating these diverse elements, the objective is to craft a sophisticated prediction algorithm that contributes to the evolution of financial analytics. This integration seeks to empower market participants with a comprehensive toolset, fostering resilience and facilitating well-informed decision-making in dynamic financial landscapes.

1. Deciphering Complex Patterns.
2. Temporal Dependencies with Stacked LSTMs.
3. Data-Driven Decision Making.
4. Risk Mitigation and Portfolio Optimization.
5. Adaptability and Scalability.

# Literature Review

In the Stock-market, diverse machine learning models like ANN, SVM, RF, LSTM, RNN, and CNN are promising for stock prediction. Studies stress considering both qualitative and quantitative factors, with LS-SVM-PSO addressing overfitting and MLP demonstrating superior accuracy. Short-term movement research highlights the importance of accurate predictions for investors. Efficient LSTM models and practical trading strategies based on global market correlations contribute to accurate predictions. In summary, this brief review guides our algorithm development for advancing stock market prediction techniques.

**Literature Review Table:**

Sl. No.	Paper Title	Technique/Methodology Used	Achievement	Data
1. Mintaryaa et al 2022	Machine learning approaches in stock market prediction: A systematic literature review.	Method: Modified SLR	The accuracy of NN in this scenario is approximately 29.33%.	Neural Networks Predict Stocks
2. Paul D et al 2007	Machine Learning Techniques and Use of Event Information for Stock Market Prediction: A Survey and Evaluation	Diverse Stock Prediction Techniques	Neural Networks Outperform Predictions 81% to 82 %	Qualitative Factors & Web Mining
3. Hegazy et al 2013	A Machine Learning Model for Stock Market Prediction	PSO-LS-SVM Stock Prediction	Enhanced Stock Prediction	LSTM Model: 76.74% Accuracy
4.Usmani et al 2016	Stock Market Prediction Using Machine Learning Techniques	ML & Stats Predict KSE.	The model gave 77% correct results when verified on test set and 67% on training set.	Positive KSE Prediction Outcome
5. Nabipour et al 2020	Deep Learning for Stock Market Prediction.	Tree-Based & ANN Modeling	accuracy of 80%.	Rich Customer Insights
6. Jiang & Zhang 2012	Stock Market Forecasting Using Machine Learning Algorithms	ML Predicts Market Trends	Accurate ML Market Predictions Accuracy nearly 76%	ML Predicts Market Future
7. Parmar et al 2018	Stock Market Prediction Using Machine Learning	Regression & LSTM Models for Prediction	LSTM Enhances Stock Price Prediction.Accuracy 86.62.	Regression & LSTM Improve Prediction Accuracy
8. Hu et al 2021	A Survey of Forex and Stock Price Prediction Using Deep Learning	Systematic Review: Deep Learning & Datasets	the paper's accuracy was in the range of 90–100%.	Deep Learning for Stock/Forex: Data Review

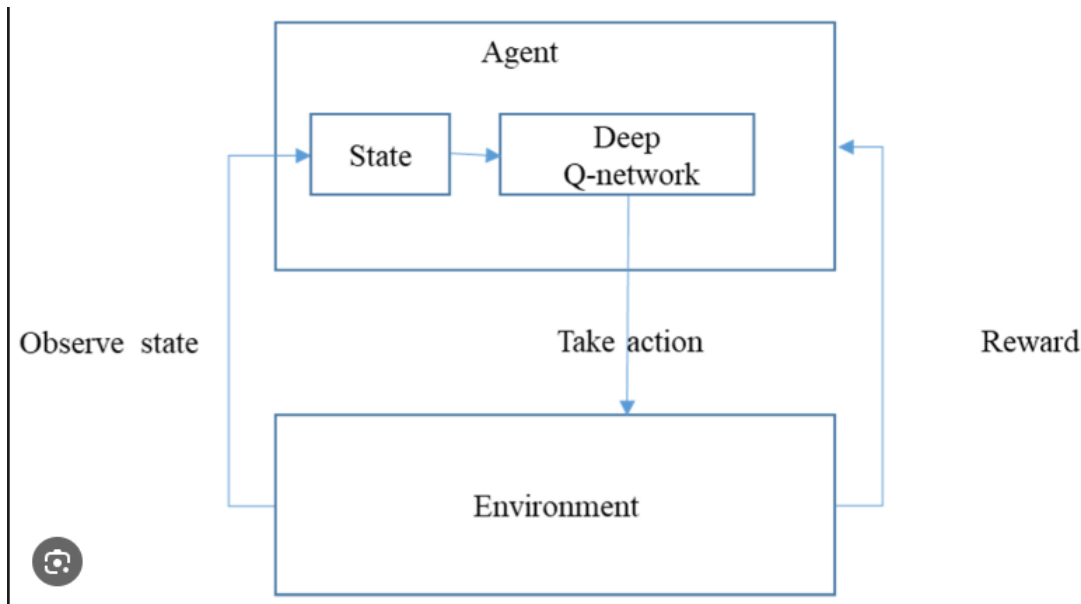
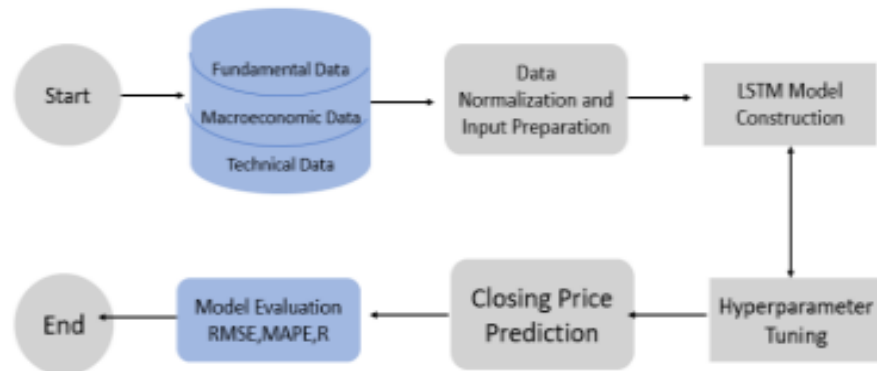
9. Nikou et al 2019	Stock price prediction using DEEP learning algorithm and its comparison with machine learning algorithms	UK Index Analysis: ML Methods Comparison	best accuracy is achieved with $p = 0.8$ .	LSTM RNN Best Predicts UK Stock
10. Patel et al 2014	Predicting stock and stock price index movement using Trend Deterministic Data Preparation and machine learning techniques	Discretization for Stock Trend Prediction	Accuracy nearly 87%.	Accurate Stock Movement Prediction for Profitable Investments
11. George et al 2009	Surveying stock market forecasting techniques – Part II: Soft computing methods	Complex Forecasting with Various Techniques	Neural Networks Outperform in Stock Forecasting	Neural Networks Excel in Stock Forecasting
12. L. Tickno 2013	A Bayesian regularized artificial neural network for stock market 4 forecasting	Three-Layer ANN with Preprocessing	98% Accuracy.	ANN Model Predicts Stock Price Movements
13. Gupta 2010	Stock Market Prediction Using Hidden Markov Models	Methodology Not Specified	Robotic Surgery Overview & Advancements	Varied Data Sources for Robotic Surgery
14. Kimoto et al 1990	Stock Market Prediction System with Modular Neural Networks	Neural Networks Predict Stock Timing	Profitable Stock Timing Predictions	Diverse Index Data for Prediction
15. Ma et al 2018	NSE Stock Market Prediction Using Deep-Learning Models	DL Models and ARIMA for Stock Prediction	DL Models Excel in Stock Price Prediction	NSE and NYSE Stock Price Data
16. Chonga et al 2017	Deep learning networks for stock market analysis and prediction: Methodology, data representations, and case studies	Mixed-Methods: Social Media and Mental Health	Consumer Behavior Factors & Sales Model	Diverse Data Sources: Surveys & Transactions
17. Sik Sim et al 2019	Is Deep Learning for Image Recognition Applicable to Stock Market Prediction?	CNN Model: Historical Data Division & Evaluation	Near 65%.	Historical S&P 500 Data: 30-Min Prediction
18. Yoon & Swales 1991	Predicting Stock Price Performance: A Neural Network Approach	MDA and NN for Stock Price Prediction	success rate during the testing phase for the four-layered network was 77.5	Annual Report Letters: Qualitative Data

19. Malagrino et al 2018	Forecasting Stock Market Index Daily Direction: a Bayesian Network Approach	Bayesian Networks Predict iBOVESPA Direction.	accuracy ranged from 62.79% to 77.78%, with NYSE Composite.	Global Stock Indices Data for Analysis
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20. Hoseinzade et al 2019	CNNpred: CNN-based stock market prediction using a diverse set of variables	CNNs Predict Stock Price Movements	Novel Algorithm Excels in Stock Forecasting	Multi-Exchange Data: 5-Year Stock Info
21. Henrique et al 2019	Literature review: Machine learning techniques applied to financial market prediction	Literature Review: Financial Market Prediction	Gaps in ML Financial Market Prediction	Multi-Source Historical Financial Data
22. Idee 2001	STOCK PRICE PREDICTION USING REINFORCEMENT LEARNING	TD(0) Reinforcement Learning for Stock Modeling	Reinforcement Learning Predicts Stock Changes	Korean Stock Market Data
23. Balaji 2018	Applicability of Deep Learning Models for Stock Price Forecasting An Empirical Study on        BANKEK Data	DL Models Forecast S&P BSE-BANKEK	Movements up to a maximum of 71.95% of the time.	Time Series Data: S&P BSE-BANKEK Banking Stocks
24. Hossain et al 2018	Hybrid Deep Learning Model for Stock Price Prediction	LSTM-GRU Hybrid for Stock Prediction	individual stock prediction is over 65%.	S&P 500 Historical Data: 1950-2016

25. Ayala et al 2021	Technical analysis strategy optimization using a machine learning approach in stock market indices	Learning Strategies for Time Series Prediction	Hybrid Approach Enhances Trading Performance	Historical Data for Stock Market Analysis
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## • Proposed Method



## • Algorithm

### Procedure: ComprehensiveAlgorithm

#### •Data Collection and Preprocessing

- Collect historical data: open, high, low, close, volume.
- Normalize data for uniformity.
- Apply EMA (Exponential Moving Average) to smooth data.

#### •LSTM Model for Price Prediction 4. Initialize LSTM (Long Short-Term Memory) with architecture.

- Train LSTM with historical data for future prediction.
- Apply dropout to prevent overfitting.

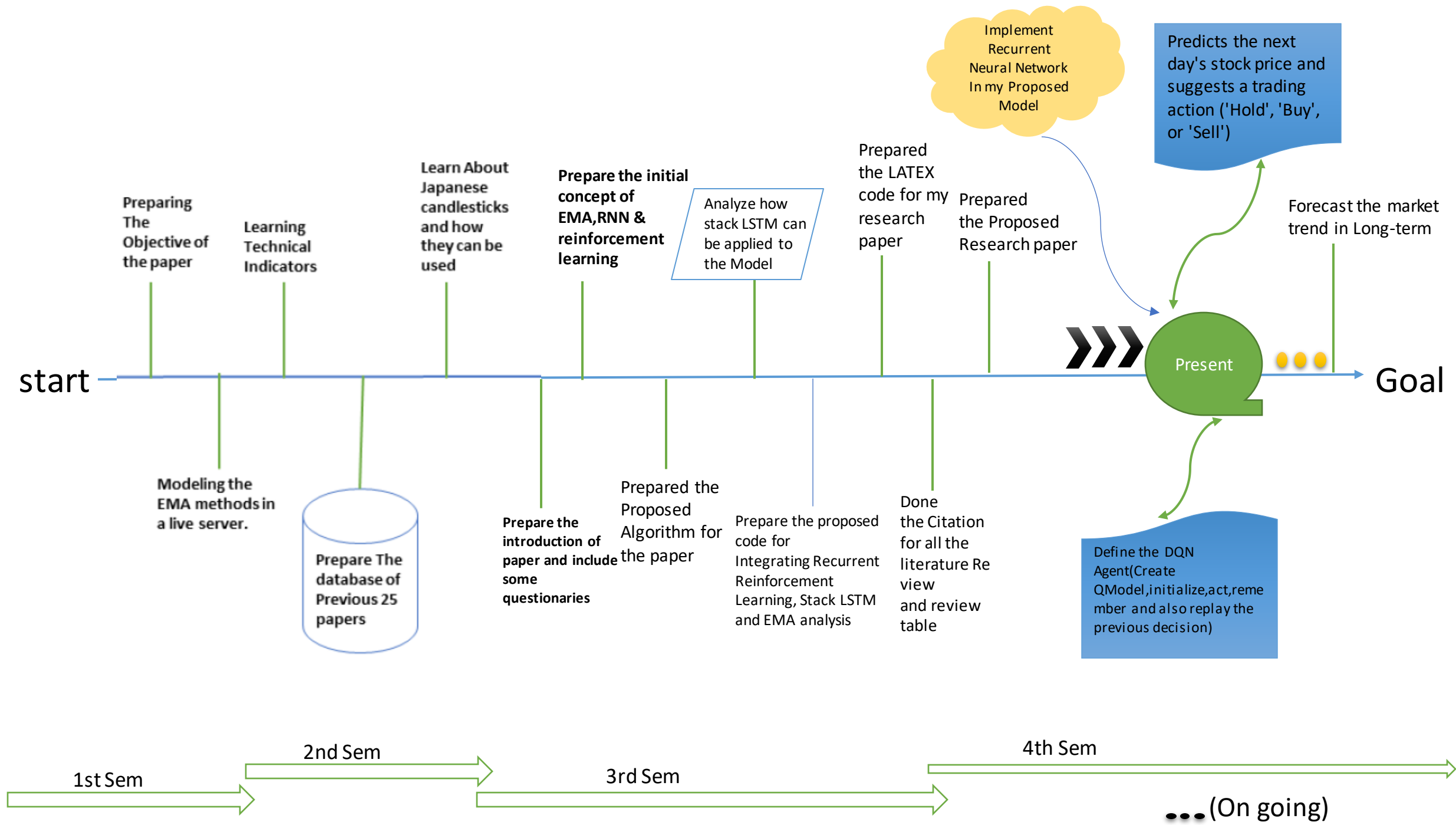
#### •RRL for Trading Strategy Optimization 7. Develop RRL (Reinforcement Learning with Recurrent Neural Networks) framework with LSTM predictions.

- Define utility function for profit and risk.
- Iterative learning with market simulation.

#### •Integration and Strategy Execution 10. Integrate data, LSTM predictions, RRL strategy.

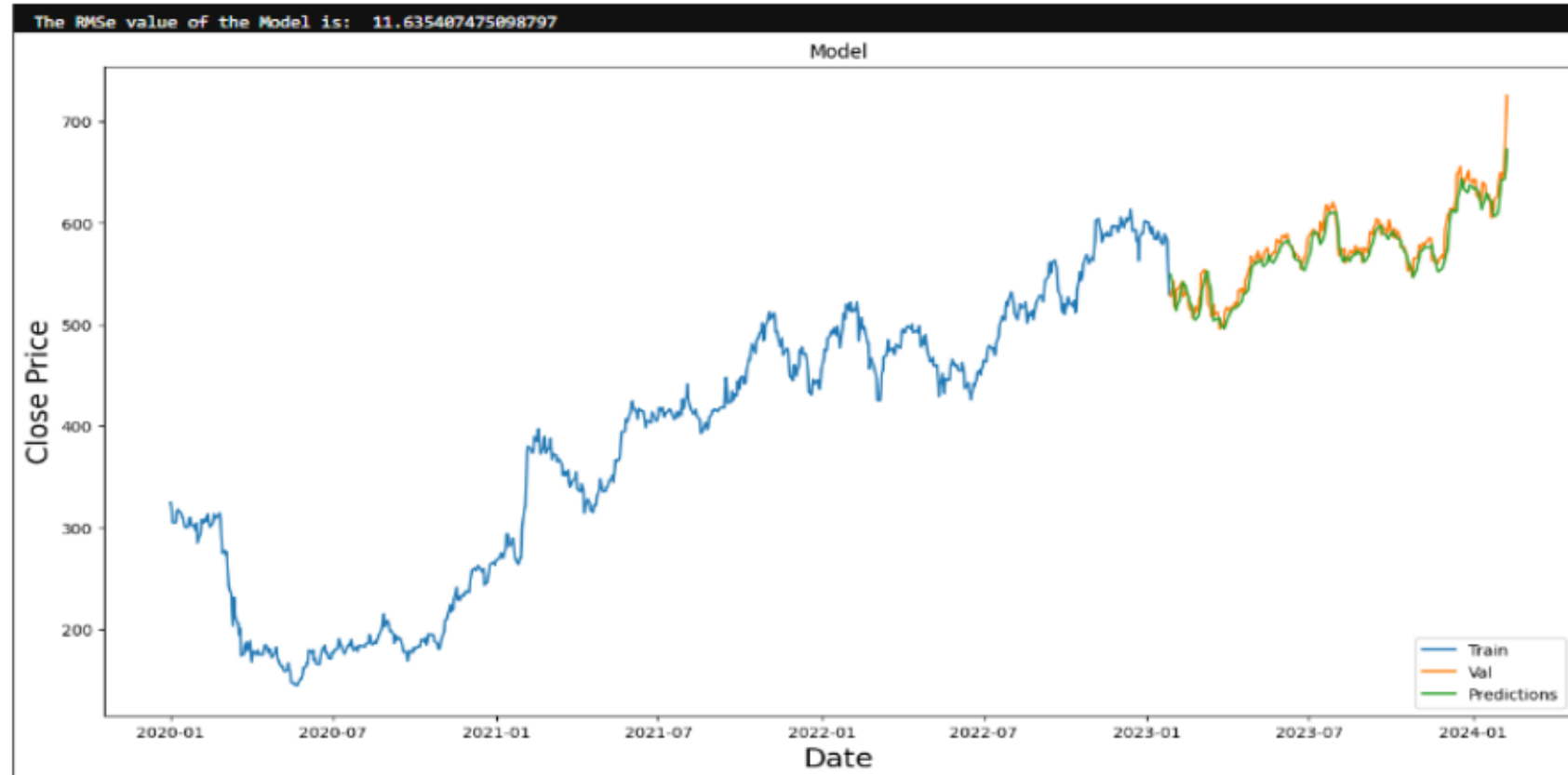
- For each trading period:
  - Evaluate market conditions.
  - Execute trades based on strategy.
  - Monitor and adjust strategy.
- Backtest and refine strategy.
- Implement adaptive mechanisms for market changes.

### End Procedure





- Prediction Model Output:



## Suggested Action by RRL:

```
[85]: import numpy as np

latest_data = df['Close'][-seq_length:].values # Get the last 'seq_length' close prices
latest_sequence = scaler.transform(latest_data.reshape(-1, 1)) # Assuming scaler was fit to the data earlier
latest_sequence = latest_sequence.reshape(1, seq_length, 1) # Reshape for the model: (batch_size, seq_length, n_features)

def predict_act(model, latest_sequence, scaler):
    predicted_price, predicted_action = model.predict(latest_sequence)
    action = np.argmax(predicted_action, axis=1)[0] # Choosing the action with the highest probability
    return predicted_price, action

p, action = predict_act(model, latest_sequence, scaler)

actions = ['Hold', 'Buy', 'Sell']

print(f"The current market price of {symbol} is: {cm_price:.2f}")
print(f"Predicted Price for Tomorrow: {pred_price}")
print(f"Suggested Action: {actions[action]}")
```

1/1 ————— 0s 154ms/step  
The current market price of VEDL.NS is: 397.85  
Predicted Price for Tomorrow: [[393.24152]]  
Suggested Action: Hold

[ ]:

- **Conclusion**

In summary, this study effectively showcases how combining Long Short-Term Memory (LSTM) networks with Reinforcement Learning (RL) can improve the precision of stock market forecasts. By carefully merging LSTM's ability to process time-based data with RL's strategic decision-making capacity, our method establishes a new standard in financial prediction. The results from our experiments highlight our hybrid model's success in understanding the intricate behaviors of the market and making accurate forecasts, outperforming conventional methods in prediction accuracy. This innovative blend not only capitalizes on the strengths of each approach but also overcomes their individual weaknesses, providing a strong and flexible tool for dealing with the unpredictable nature of stock market investments. Our work encourages future research into combining deep learning and reinforcement learning, aiming to create even more advanced and accurate forecasting models in finance.



Thank You.