

LSTM GRU MODEL

# STOCK PRICE PREDICTION

Deep Learning  
By Muhammad Ghaza Eka Putra

# Overview - Background

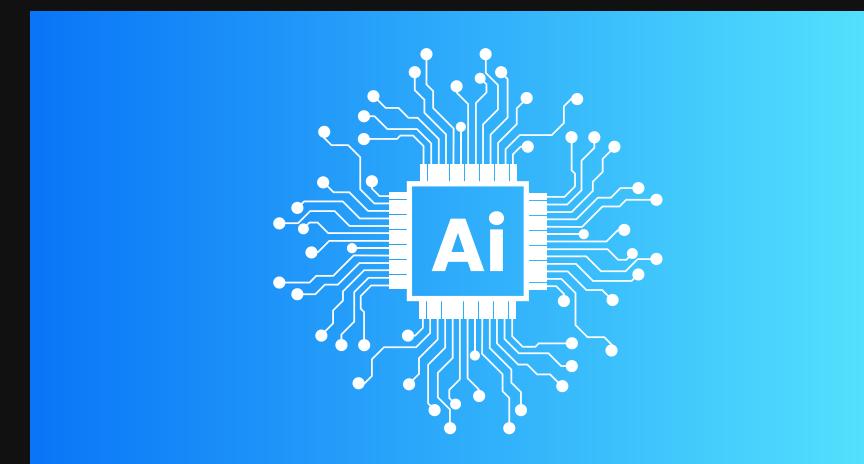
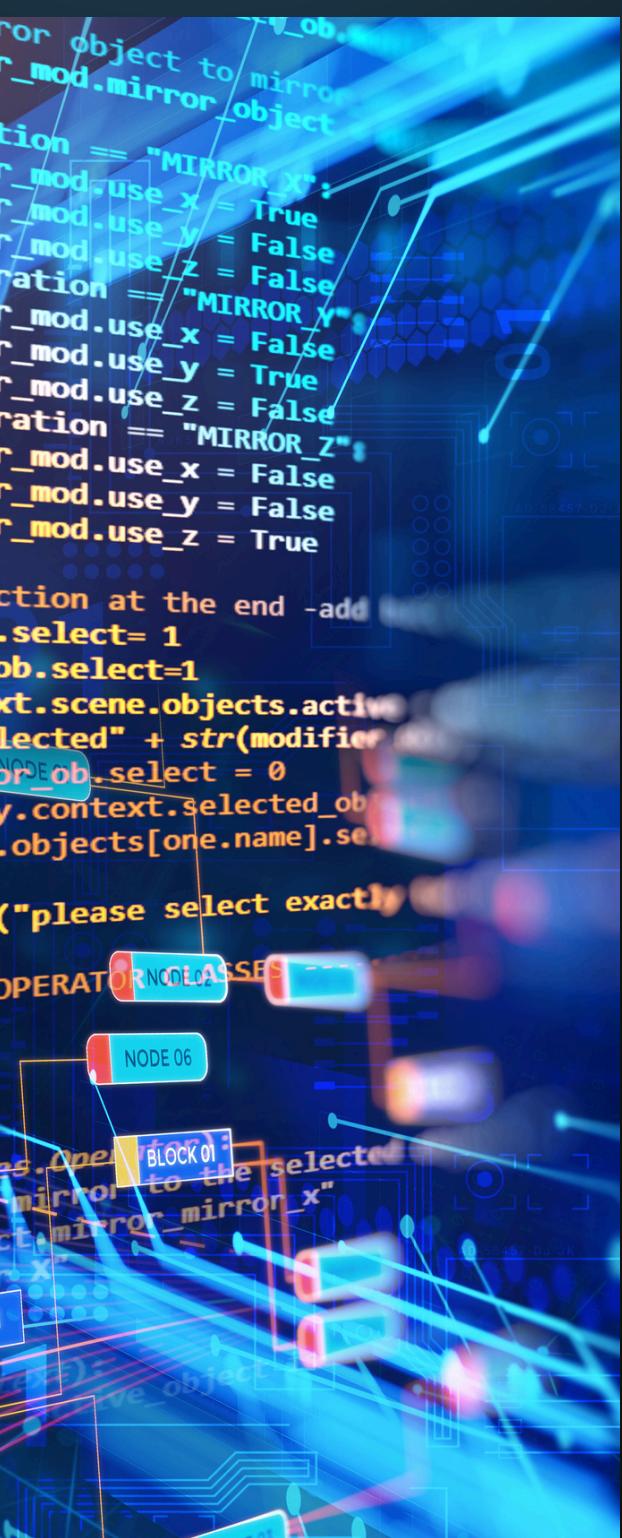
## Problem Project

- Predicting ADRO stock prices in the future based on historical data using deep learning models.
- The data is taken from the ADRO.csv dataset (Kaggle), which contains historical stock prices of PT Adaro Energy Indonesia Tbk. This time series data reflects dynamic and complex market movements, making it suitable for deep learning approaches such as LSTM and GRU.

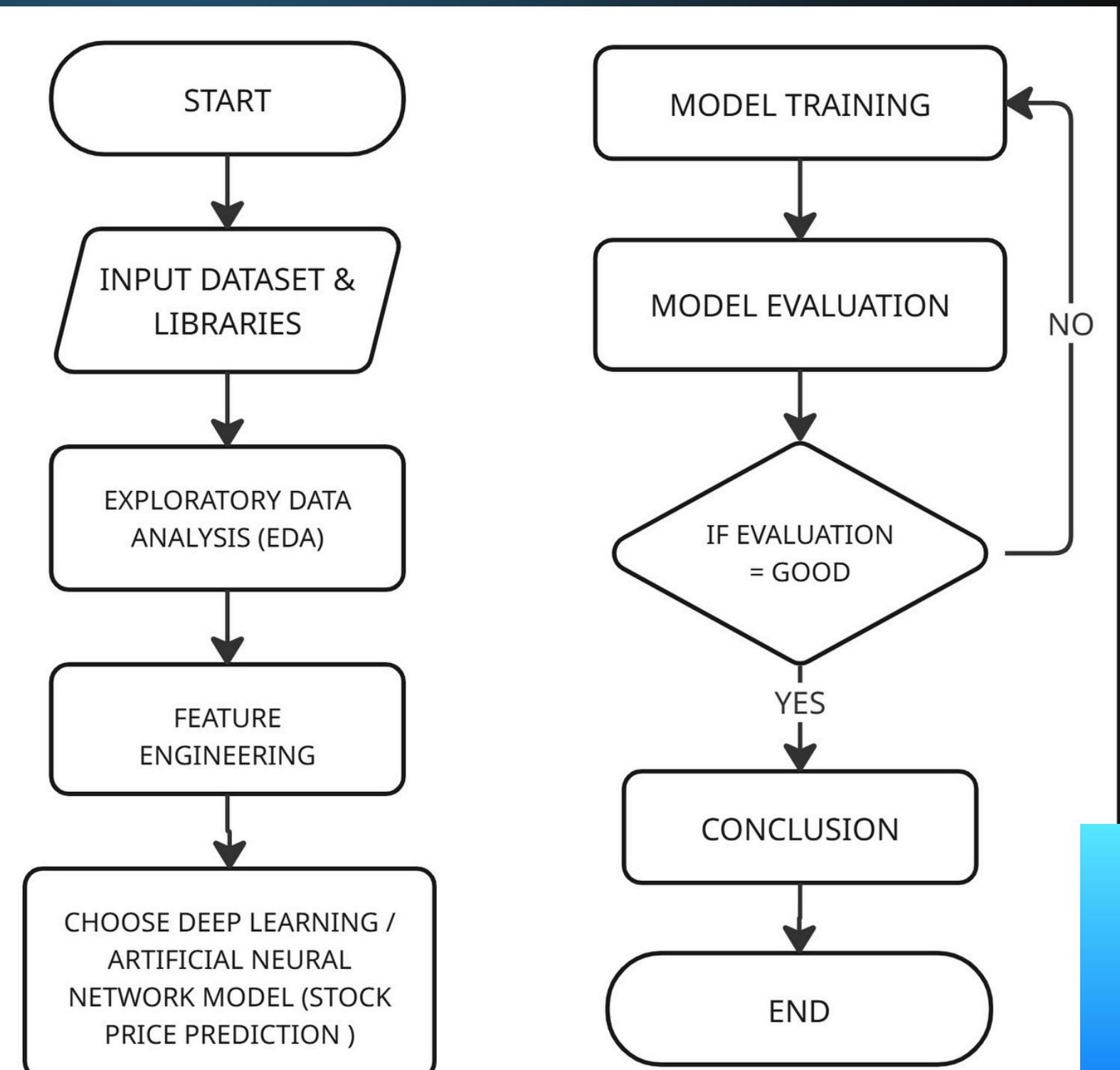


# Overview - Background Problem Project

- This project aims to develop LSTM and combined LSTM+GRU models that can learn historical patterns and provide accurate predictions.
- The ADRO.csv dataset from Kaggle was analyzed using Exploratory Data Analysis (EDA) to understand stock price trends. Feature engineering was performed, including normalization and time series data structuring. LSTM and LSTM+GRU models were used for prediction and evaluated using MSE, RMSE, and R<sup>2</sup> metrics.



# Flowchart - Project



- 01 Load the dataset 'ADRO.csv' and import necessary libraries.
- 02 Perform Exploratory Data Analysis (EDA) including data visualization and extracting insights.
- 03 Conduct feature engineering or data processing to prepare the dataset.
- 04 Select Deep Learning / Artificial Neural Network models (LSTM, GRU) and perform model training.
- 05 Evaluate the model to assess the training performance.
- 06 Draw conclusions from the results of the model evaluation.

# Exploratory Data Analysis (EDA)

## Insight:

The dataset contains 3,778 stock records from July 16, 2008, to January 6, 2023, with no missing values. A total of 108 duplicate rows were retained as they reflect normal market fluctuations.

```
dataset.isnull().sum()
```

	0
open	0
low	0
high	0
close	0
volume	0

dtype: int64

Check for Missing Value

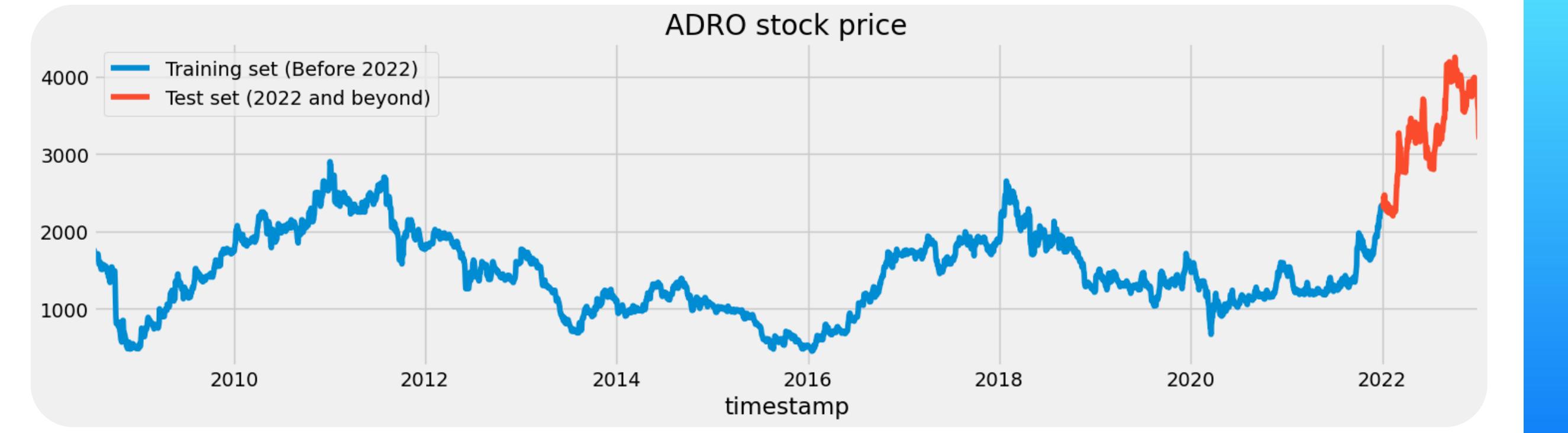
```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 3778 entries, 2008-07-16 to 2023-01-06
Data columns (total 5 columns):
 #   Column   Non-Null Count  Dtype  
--- 
 0   open      3778 non-null   int64  
 1   low       3778 non-null   int64  
 2   high      3778 non-null   int64  
 3   close     3778 non-null   int64  
 4   volume    3778 non-null   int64  
dtypes: int64(5)
memory usage: 177.1 KB
```

Check the data, data types, and total number of records

# Feature Engineering

Based on the ADRO stock price plot, the dataset was split into two parts: data prior to 2022 was allocated for training purposes to help the model learn historical patterns, while data from 2022 to early 2023 was reserved as the test set to evaluate the model's predictive performance on unseen data.



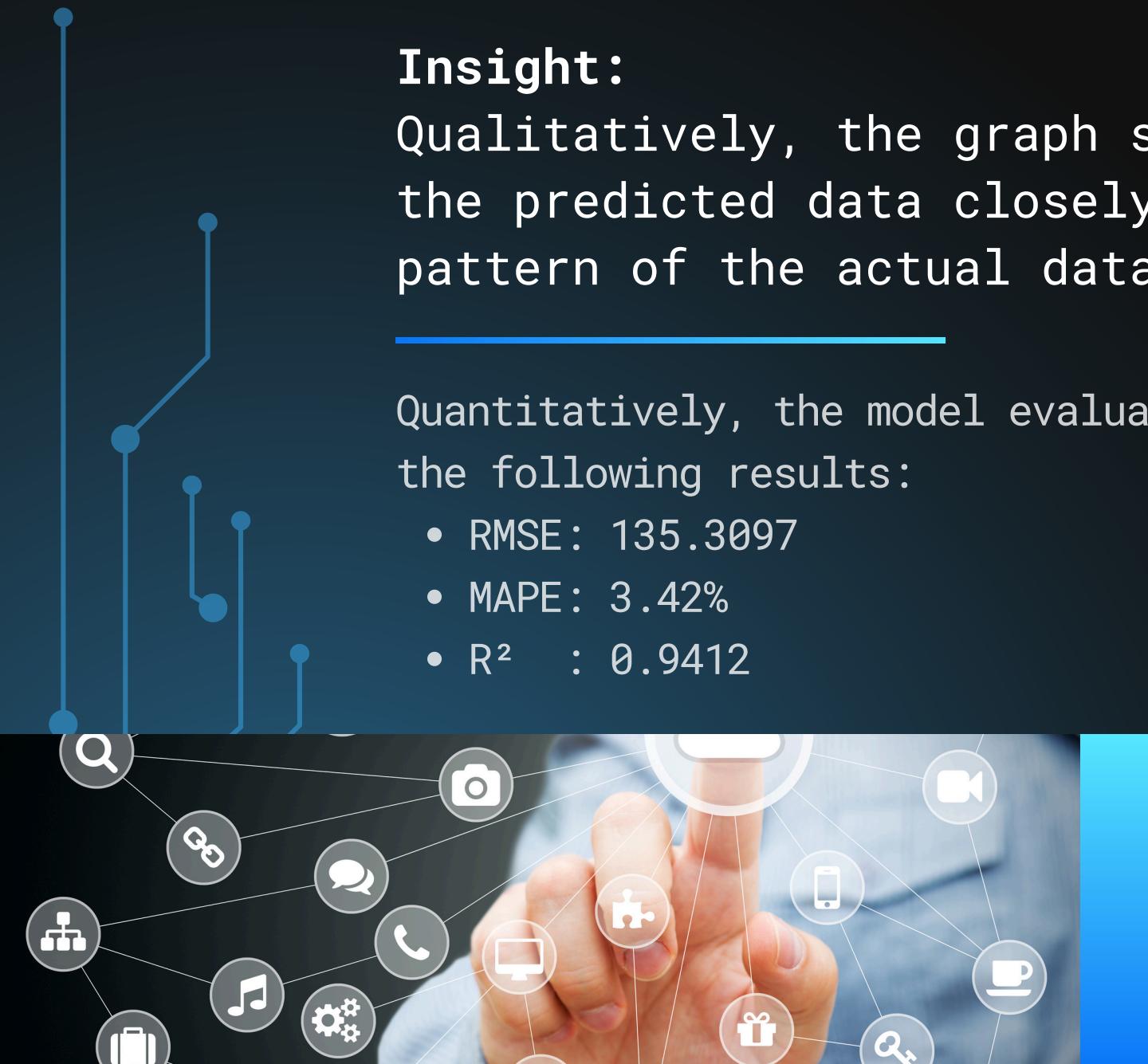
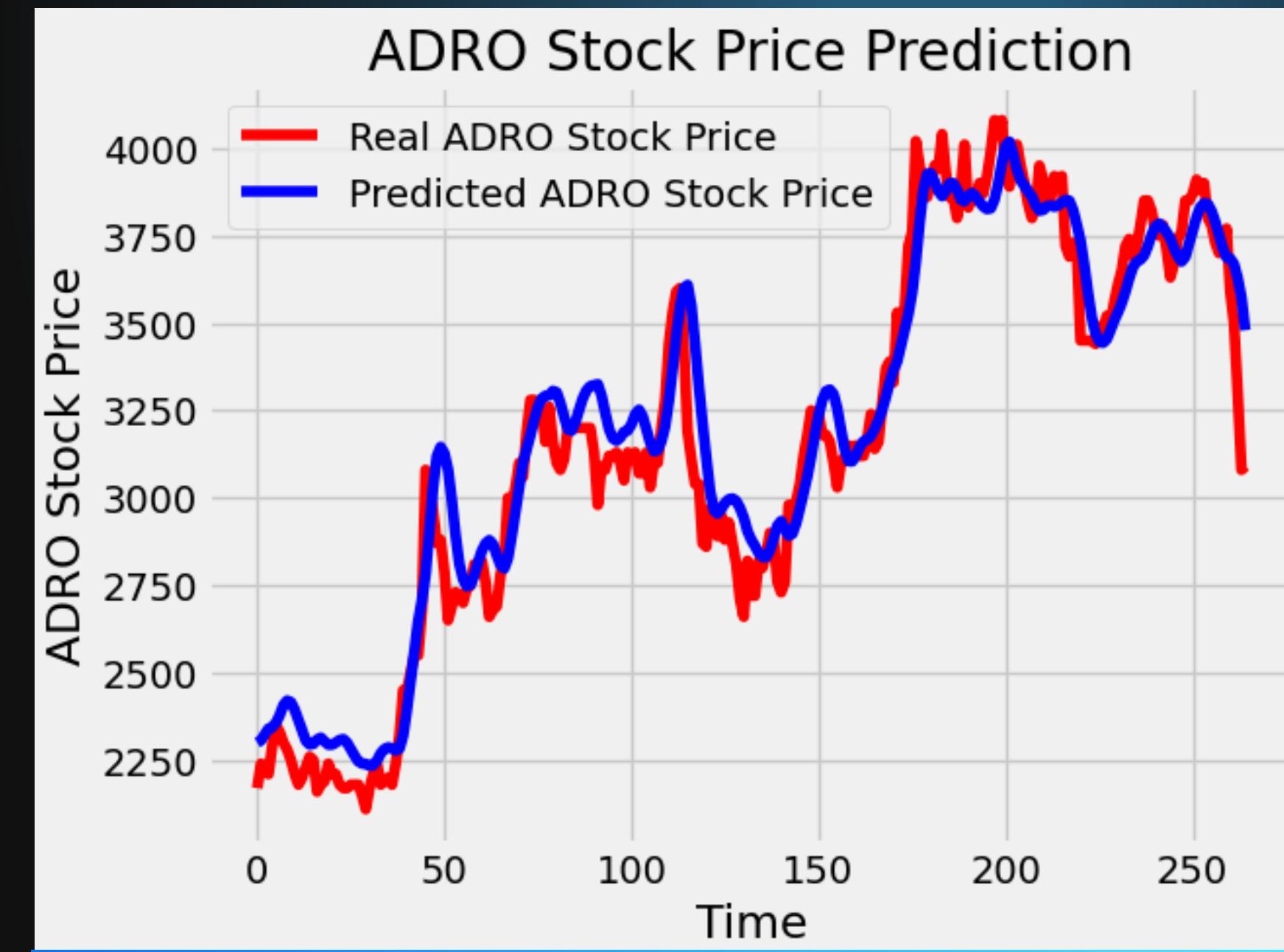
# LSTM Model Evaluation

## Insight:

Qualitatively, the graph shows that the predicted data closely follows the pattern of the actual data.

Quantitatively, the model evaluation produced the following results:

- RMSE: 135.3097
- MAPE: 3.42%
- $R^2$  : 0.9412



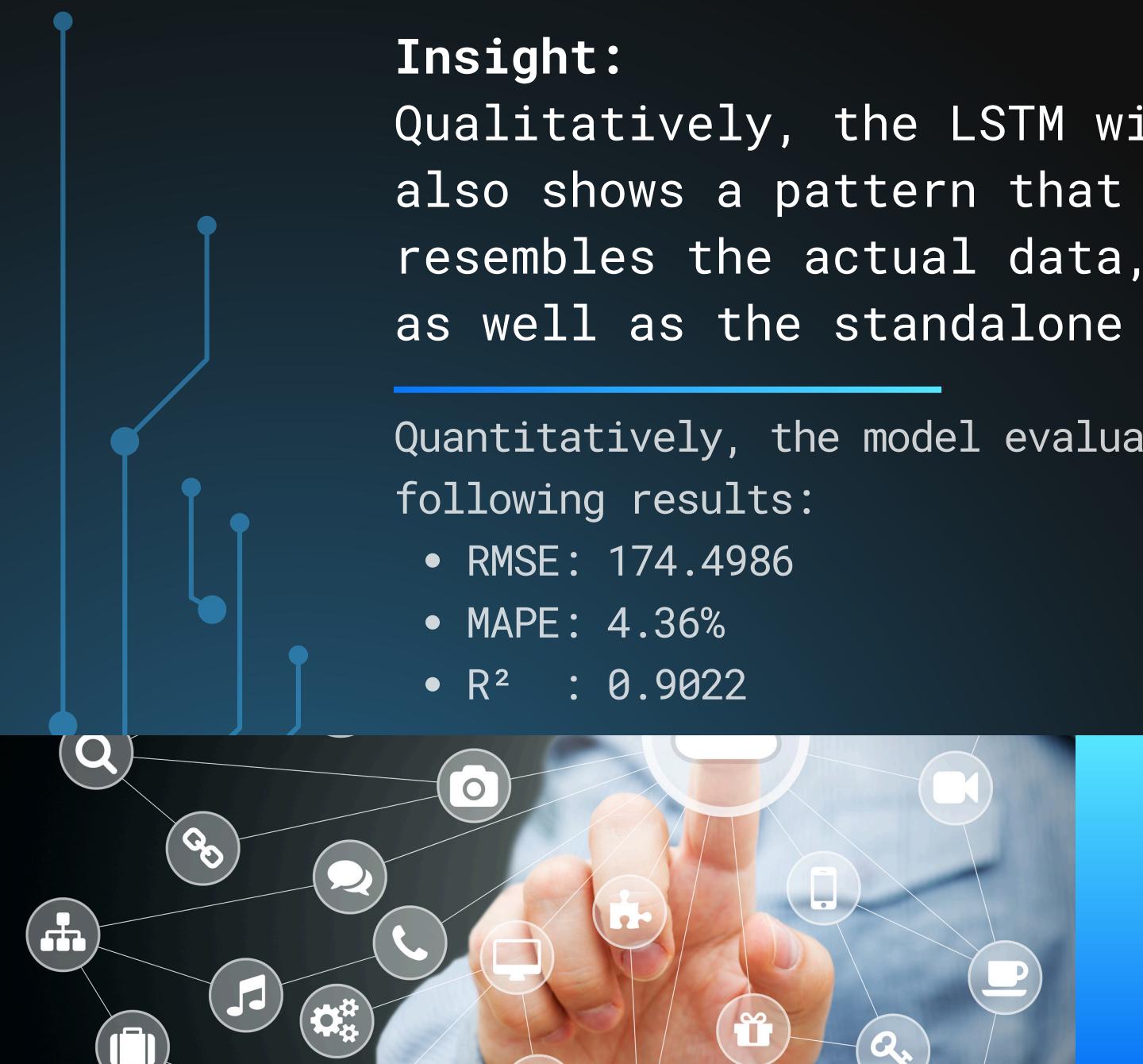
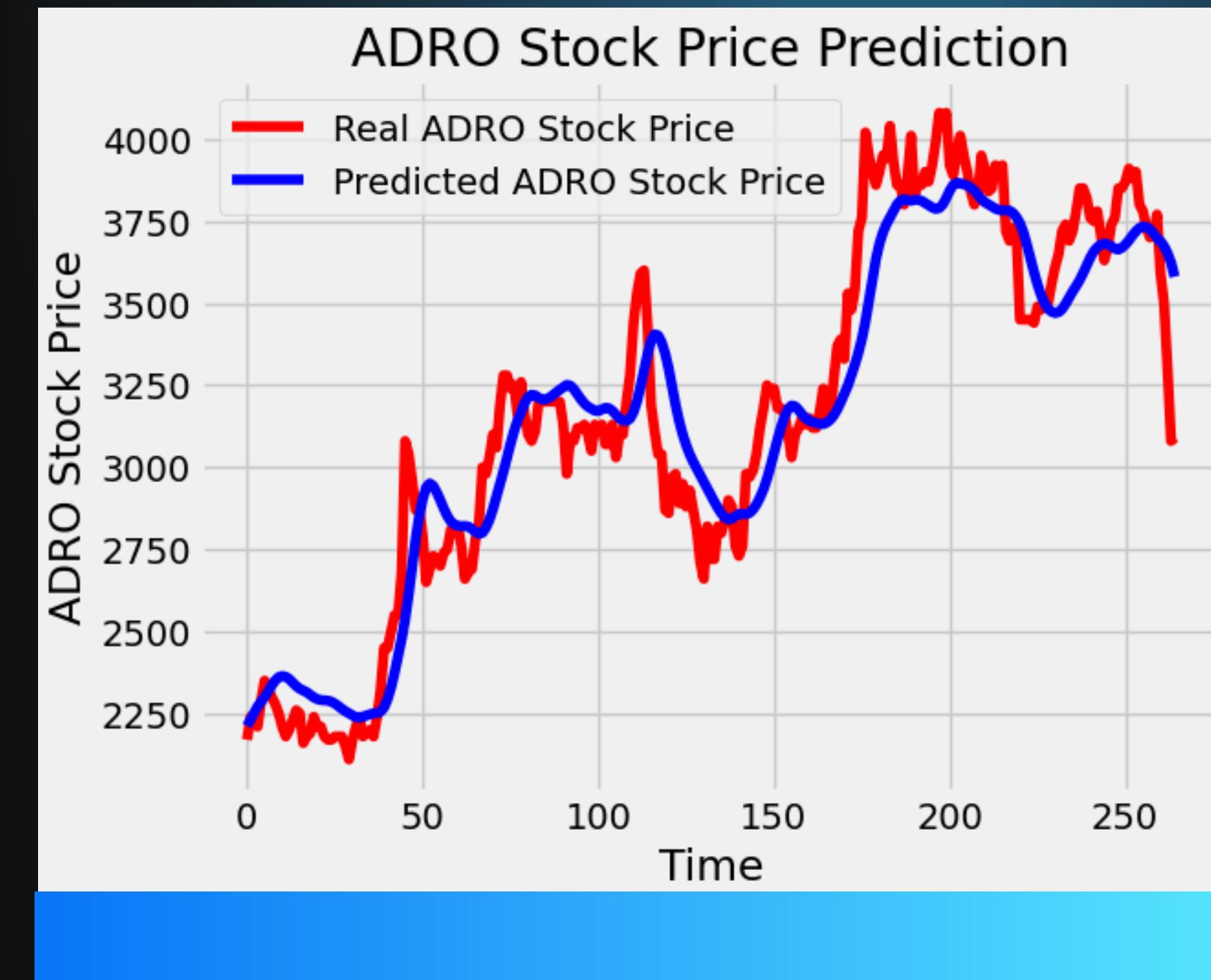
# LSTM with GRU Model Evaluation

## Insight:

Qualitatively, the LSTM with GRU model also shows a pattern that closely resembles the actual data, although not as well as the standalone LSTM model.

Quantitatively, the model evaluation yielded the following results:

- RMSE: 174.4986
- MAPE: 4.36%
- $R^2$  : 0.9022



# Conclusion

Based on the prediction results, the model evaluation metrics are as follows:

## LSTM Model

- RMSE: 135.3097
- MAPE: 3.42%
- $R^2$  : 0.9412

## LSTM with GRU Model

- RMSE: 174.4986
- MAPE: 4.36%
- $R^2$  : 0.9022

From these results, it is evident that the LSTM model without GRU performs better than the combined LSTM with GRU model. The relatively high RMSE value is due to the large scale of stock prices in the dataset; however, despite the high RMSE, the error percentage (MAPE) remains low and the  $R^2$  value is close to 1. Therefore, the model's accuracy can be considered acceptable.



# Thank You

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