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Team 4 - IS 737

Cryptocurrency Price Prediction: A Fusion of Technology and Finance



Introduction



The primary objective of this project is to develop a robust and accurate cryptocurrency prediction model that leverages advanced machine learning and data analysis techniques to forecast the future price movements of major cryptocurrencies. The ability to forecast these price fluctuations has significant implications for portfolio management, risk assessment, and strategic decision-making in the world of finance and commerce.

Curiosity and Motivation:

1

Turning the crypto market's unpredictability into a learning opportunity.

2

Exploring the factors that influence the crypto market.

3

Helping others make informed investment decisions.

4

Contributing to the growth of the crypto community.

5

Enhancing personal financial literacy and investment skills.

Approach:

Data Collection: Gather historical price data, trading volume, market sentiment, and other relevant factors.

Performance Evaluation:
Assess the model using appropriate metrics and refine iteratively to improve accuracy and reliability.

Feature Extraction:
Identify key features with strong impact on price movements and future trends.

User Interface: Design a user-friendly interface for stakeholders to access and utilize the model for data-driven decisions.

Model Development:
Train and validate a model to forecast short-term and long-term price fluctuations for major cryptocurrencies.

Motivation Behind Using Two Approaches

It can be very useful to use two different approaches when modelling financial data like stock prices, as each approach might capture different aspects of the data and provide unique insights. Using both the daily average after a month price and the close price as outcome variables can help you understand different aspects of stock price behaviour.

Using the daily average after a month's price as the outcome variable can help you capture the stock's general trend over a longer time frame, which can be useful for longer-term investment strategies. It smooths out the daily fluctuations and can give a better understanding of the underlying trend.

Using the close price as the outcome variable can help you capture more short-term fluctuations and daily movements in the stock price. This can be particularly useful for short-term trading strategies, such as day trading or swing trading.

By comparing the performance of our models using these two different outcome variables, you can gain insights into the effectiveness of the models for different trading strategies and time horizons. It may also reveal which variables have a stronger impact on short-term versus long-term price movements.

Dataset Summary

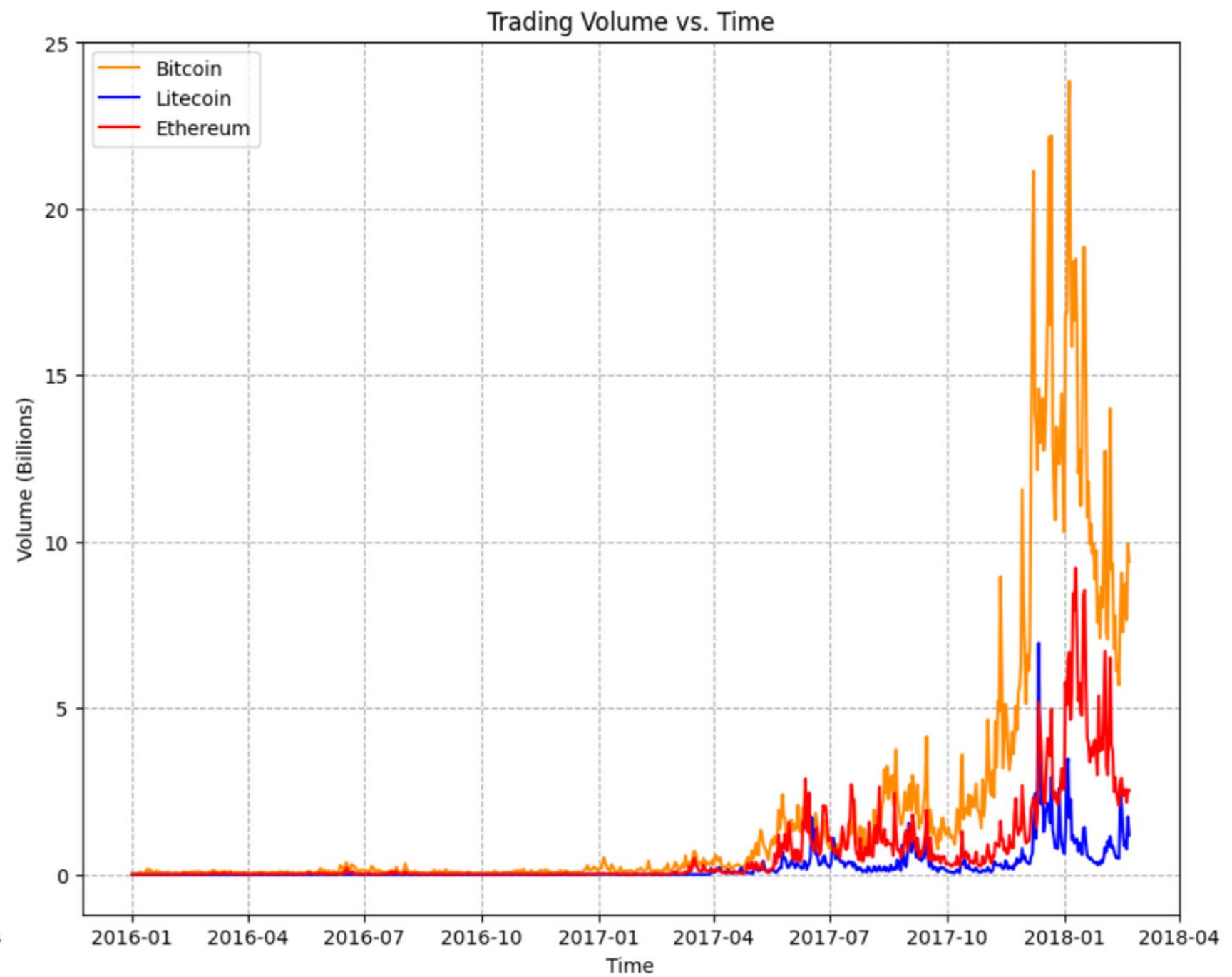
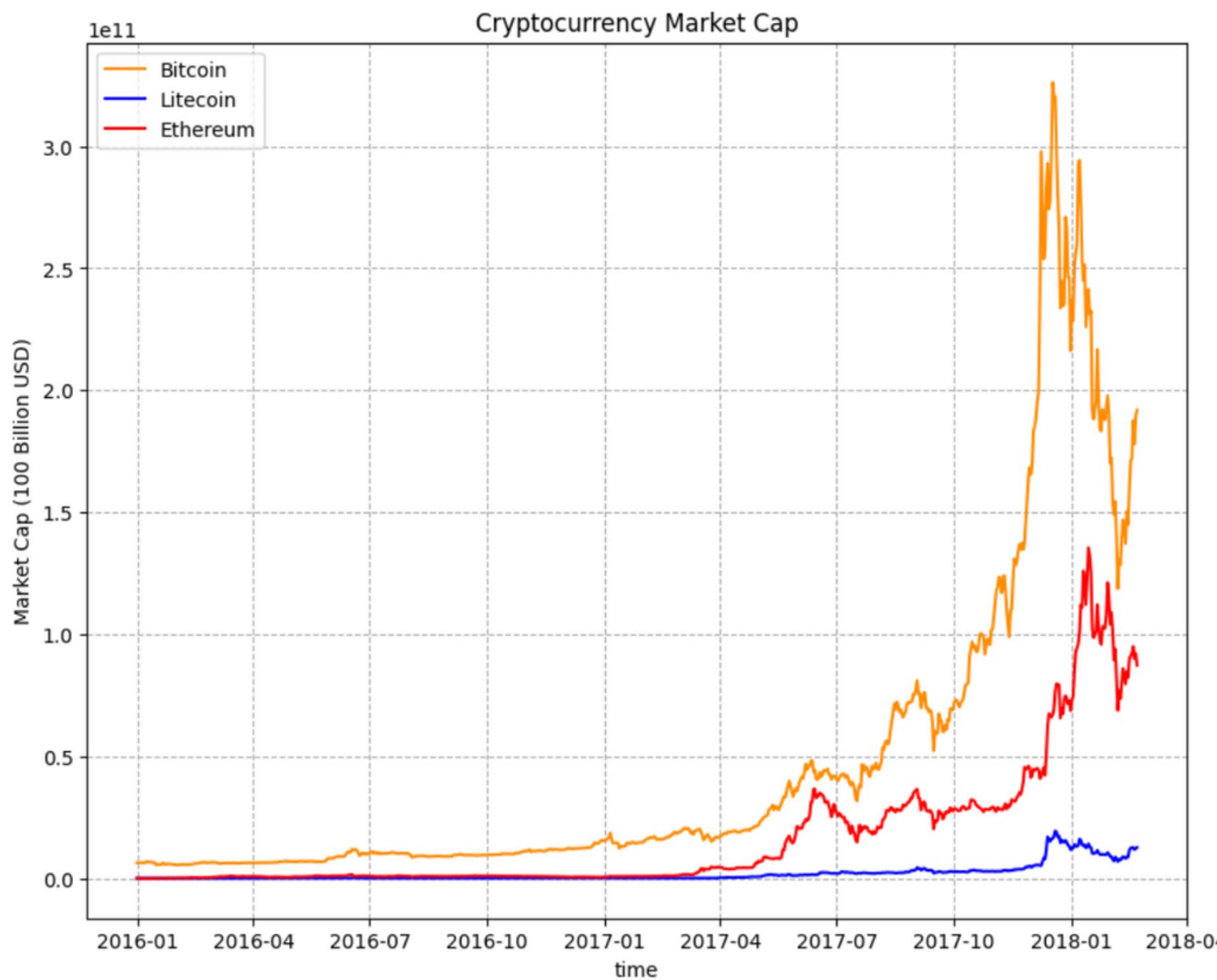
Existing features

| Feature | Type | Description |
|-------------|--------|---------------------------------------|
| slug | object | Cryptocurrency slug |
| symbol | object | Cryptocurrency symbol |
| name | object | Cryptocurrency name |
| date | date | Date of the record |
| ranknow | int | Ranking of the cryptocurrency |
| open | float | Opening price |
| high | float | Highest price during the day |
| low | float | Lowest price during the day |
| close | float | Closing price |
| volume | int | Trading volume |
| market | int | Market capitalization |
| close_ratio | float | Ratio of closing price to daily range |
| spread | float | Spread between high and low price |

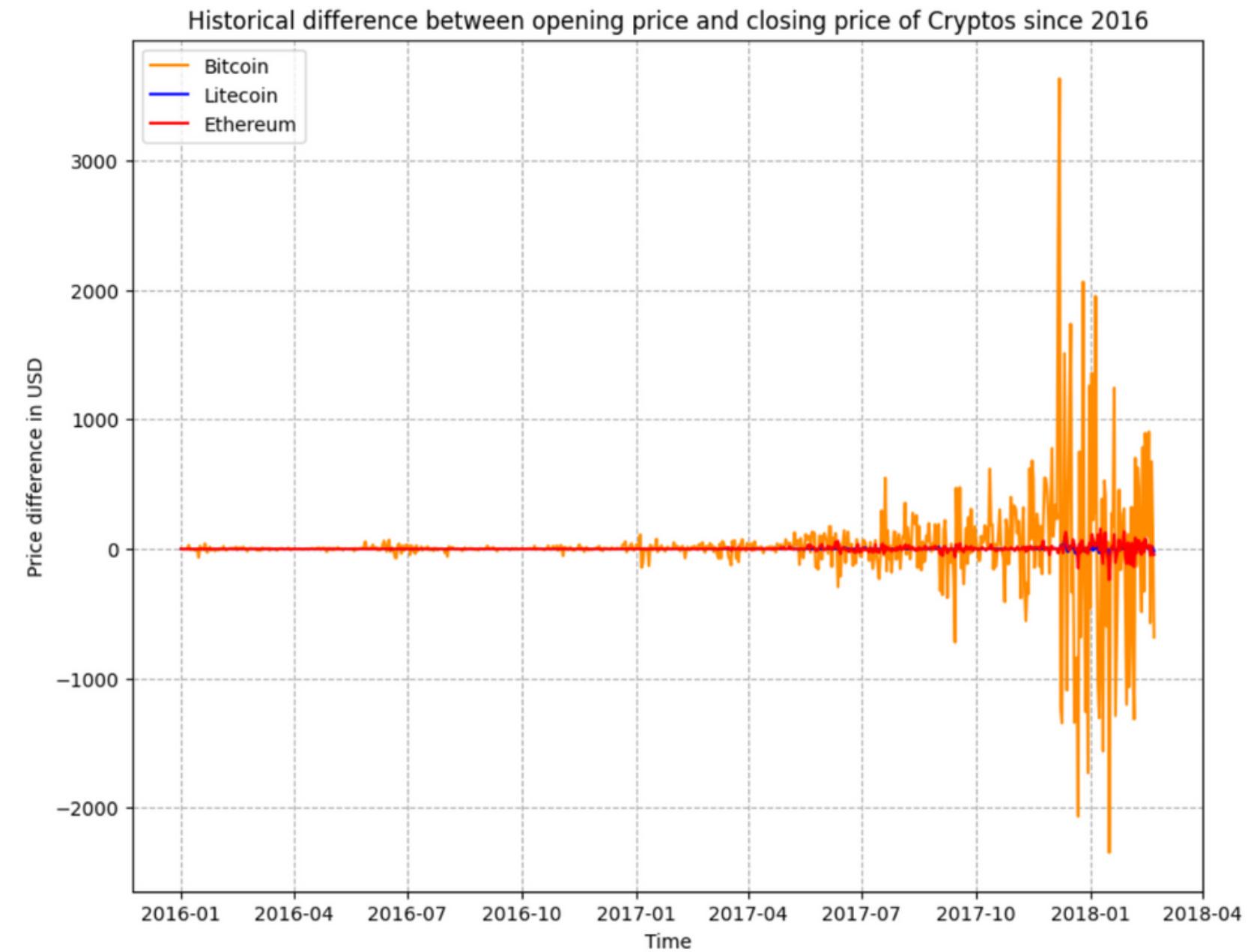
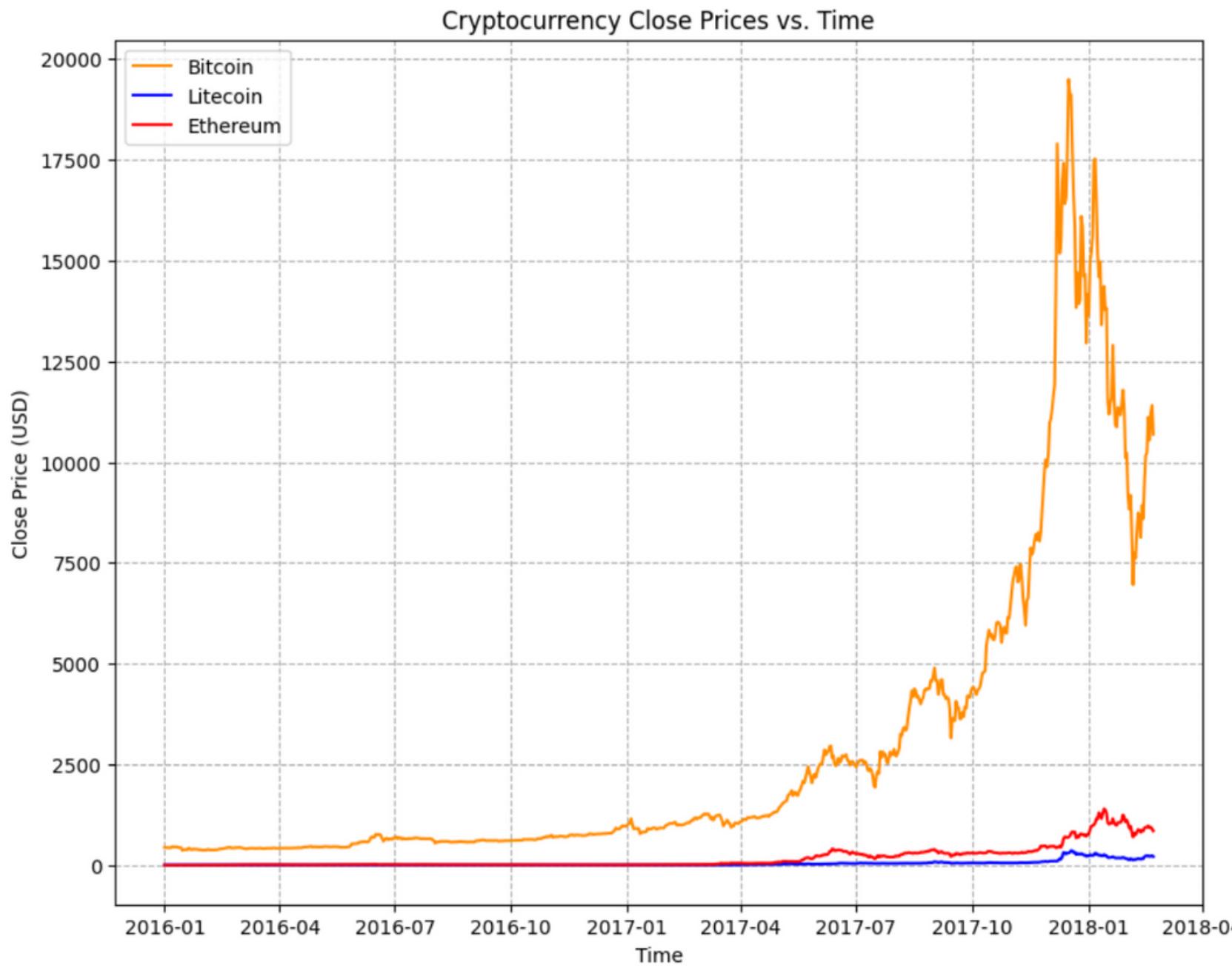
New features

| Feature | Type | Description |
|-----------------------|-------|--|
| moving_avg | float | 7-day moving average of closing price |
| rsi | float | 14-day Relative Strength Index (RSI) |
| hist_volatility | float | 10-day historical volatility |
| upper_band | float | Bollinger Band upper value |
| lower_band | float | Bollinger Band lower value |
| volume_change | float | Percent change in trading volume |
| price_diff | float | Difference between close and open prices |
| daily_avg | float | Daily average price (open, high, low, close) |
| daily_avg_after_month | float | Daily average price after 30 days |
| returns | float | Cumulative return ratio |

EDA

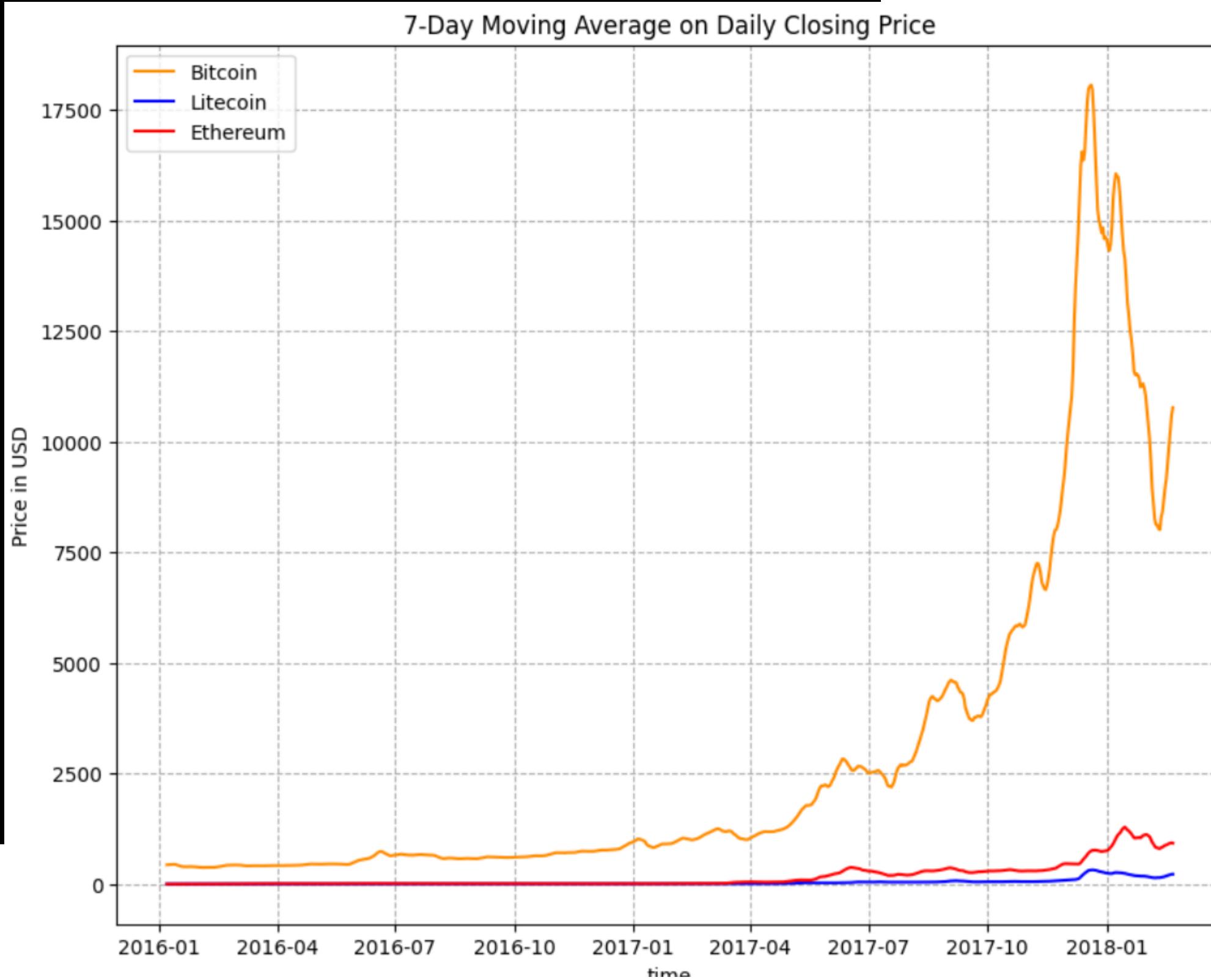


EDA



Feature Engineering

Moving Averages and Price Trend



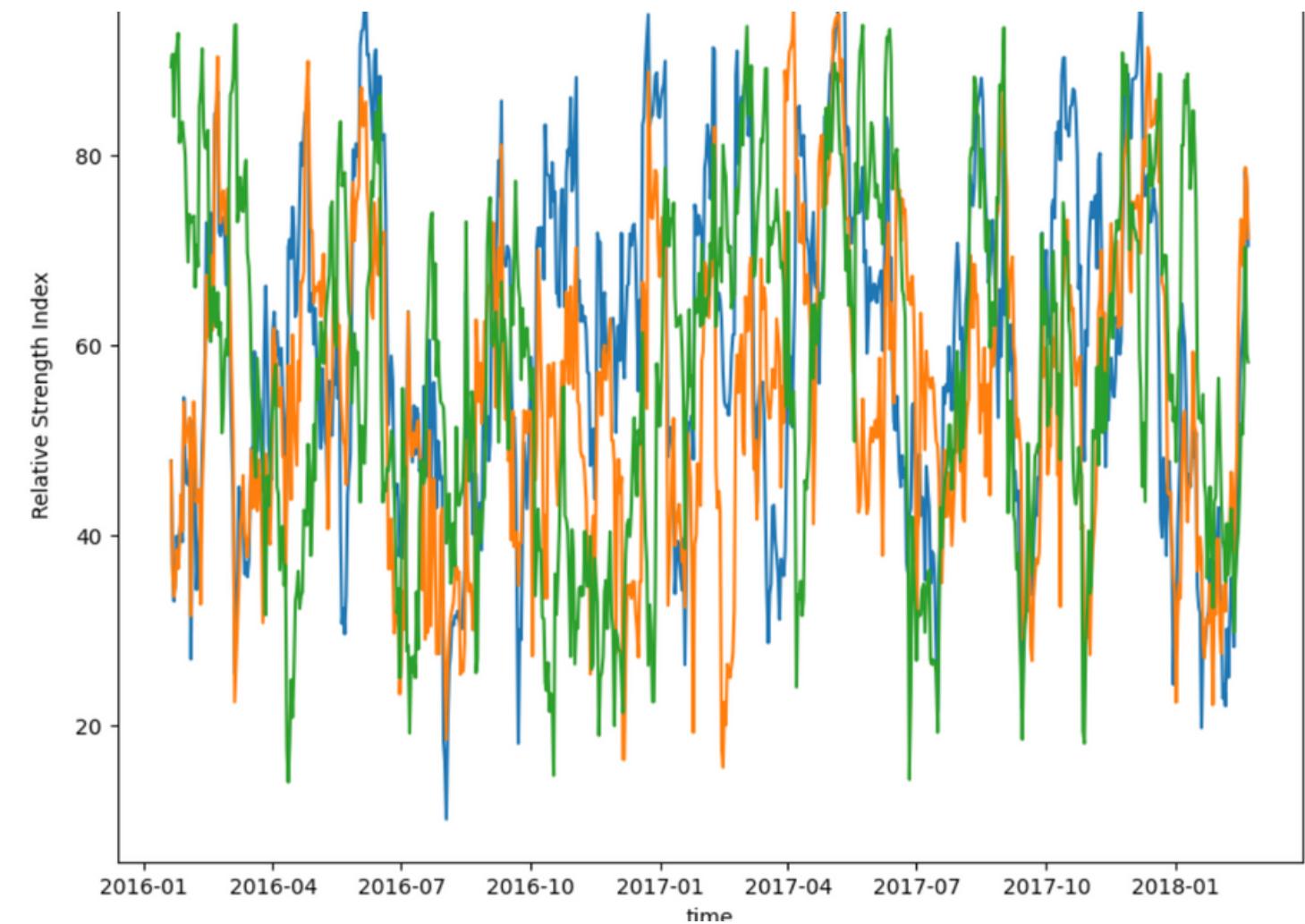
A moving average (MA) is a widely used indicator in technical analysis that helps smooth out price action by filtering out the “noise” from random price fluctuations. It is a trend-following, or lagging, indicator because it is based on past prices.

MAs are like a smooth road that follows the price of a cryptocurrency. They help us see the overall trend of the price without getting distracted by short-term ups and downs. When the price is above the MA, it's generally a good sign that the trend is upward. When the price is below the moving average, it's generally a sign that the trend is downward.

Relative Strength Index (RSI)

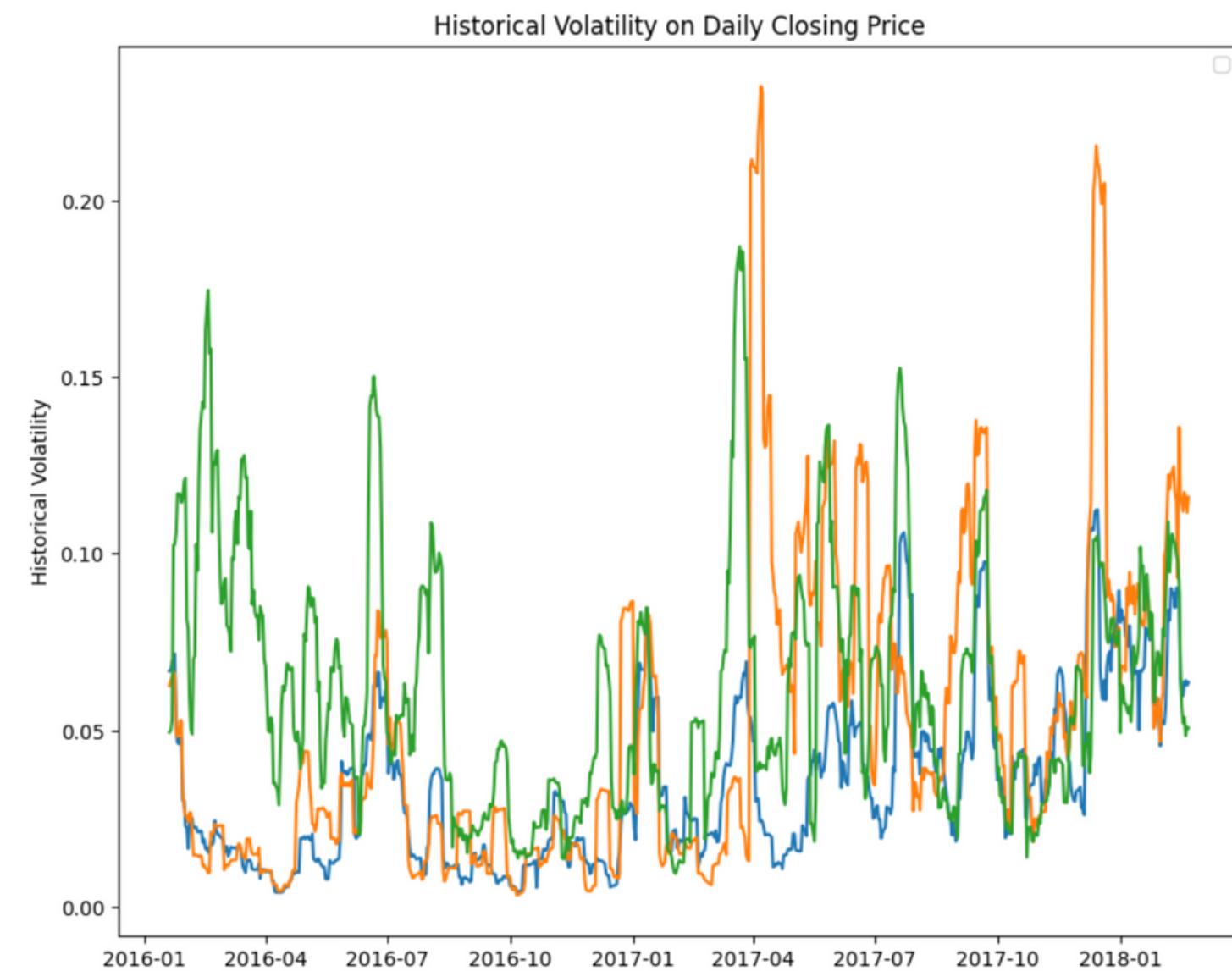
RSI is a momentum indicator that measures the strength of price movements in either direction. It is calculated by comparing the average gains and losses of an asset over a specified period of time. RSI can be used to identify overbought and oversold conditions, and to predict future price movements based on those conditions.

It measures the relative strength of buying and selling pressure in the market. The RSI value ranges from 0 to 100, with values above 70 indicating overbought conditions and values below 30 indicating oversold conditions. When the RSI crosses above or below these thresholds, it is considered a significant event and may signal a trend reversal or continuation.



Historical Volatility

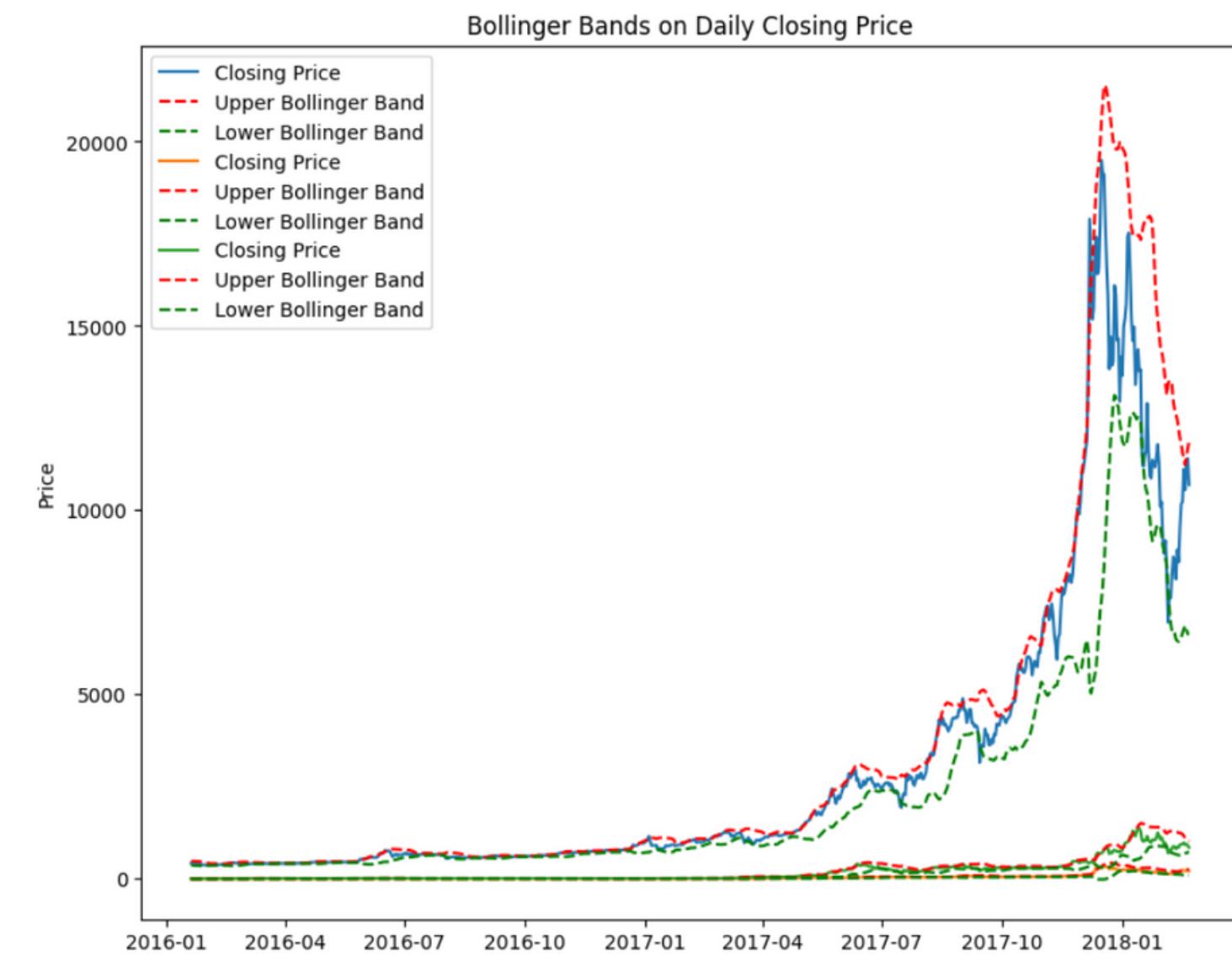
It is a statistical measure of the amount of variability of an asset's price over a specific period of time. It is calculated by taking the standard deviation of the logarithmic returns of the asset's price. Historical volatility can be used to identify the level of risk associated with the asset and to predict future price movements based on that risk. High historical volatility implies that the asset's price has fluctuated rapidly over the given period and therefore, is considered more risky. Conversely, low historical volatility implies that the asset's price has not fluctuated as much over the given period and therefore, is considered less risky.



Bollinger Bands

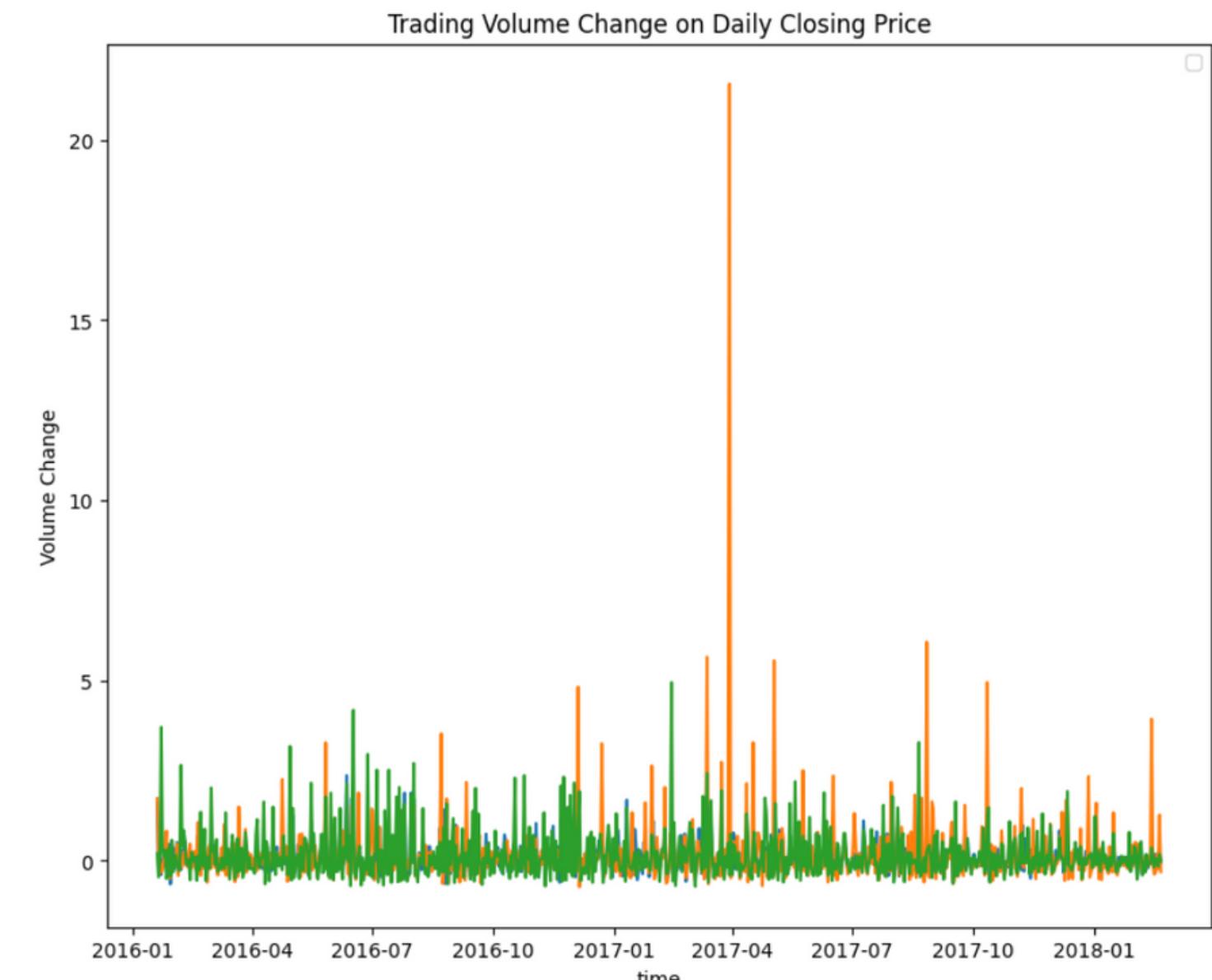
They are a type of volatility indicator that consists of three lines plotted on a price chart. The middle line is a simple moving average, while the upper and lower lines represent the standard deviation of the price from the moving average. Bollinger Bands can be used to identify periods of high and low volatility, and to predict future price movements based on those periods.

It creates a channel that contains most of the price action, and to identify periods of expansion and contraction in the channel. When the price moves outside of the channel, it is considered a significant event and may signal a trend reversal or continuation.



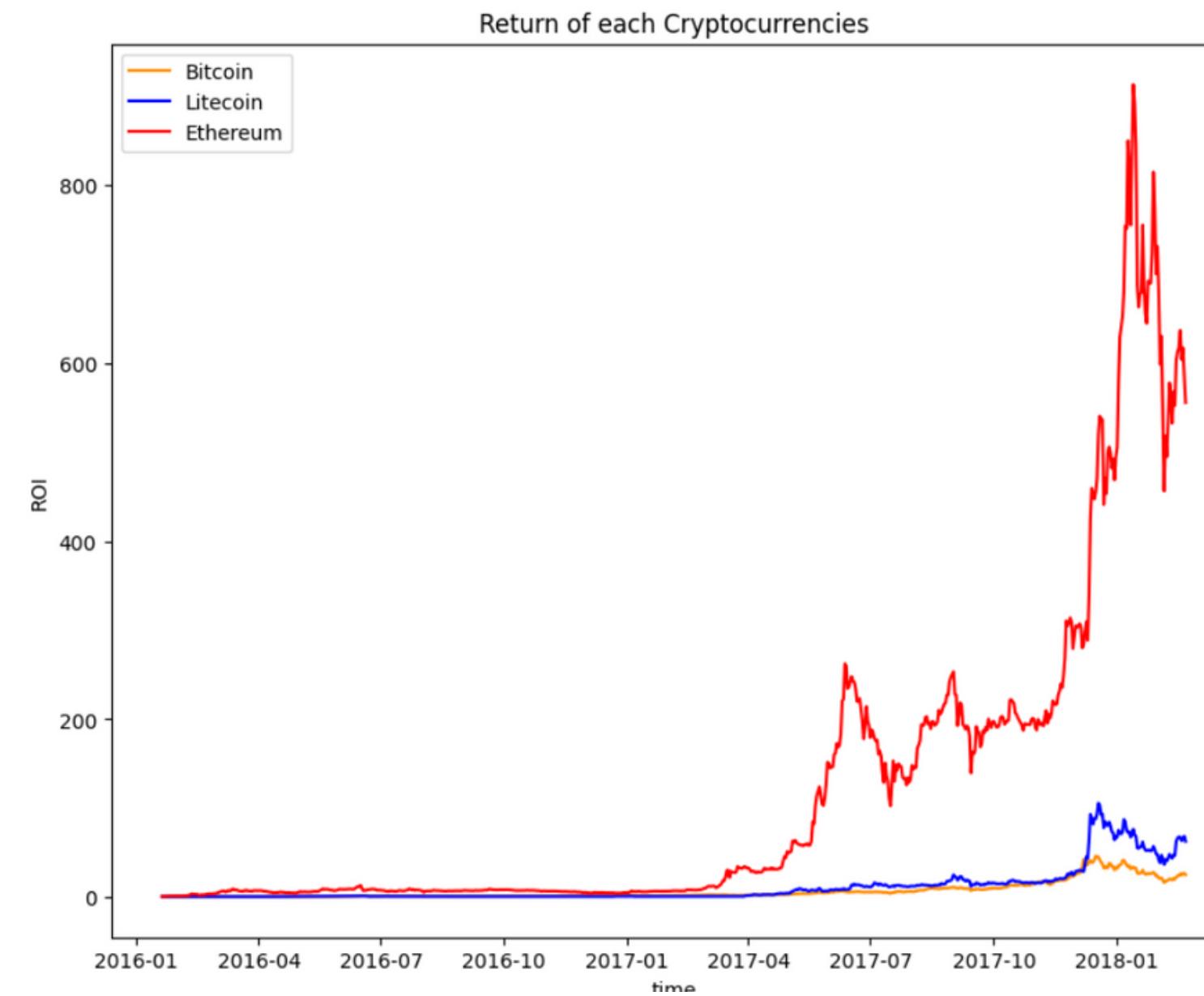
Trading Volume Change

It refers to the change in the number of units of an asset that are traded during a given period of time. Trading volume change can be used to identify trends in market sentiment and to predict future price movements based on those trends. Higher trading volumes often indicate increased interest and participation in the market, and may be a signal of upcoming price movements.



Return Ratio

Return Ratio in Cryptocurrency refers to the profitability of an investment in a particular cryptocurrency. It is calculated by dividing the amount of money gained from an investment by the amount of money invested. In simple terms, it measures the amount of return on investment (ROI) an investor can expect from a cryptocurrency.



Model Selection

- The emergence of cryptocurrencies has revolutionized the financial landscape, offering new opportunities for businesses and investors alike. As the market continues to mature, understanding the long-term and short-term trends in crypto is critical for making informed decisions.
- In this project, we will discuss two approaches we have deployed to study these trends and how these insights can help businesses navigate the ever-evolving world of cryptocurrencies.

Model Selection Approach 1(Long-Term Call)

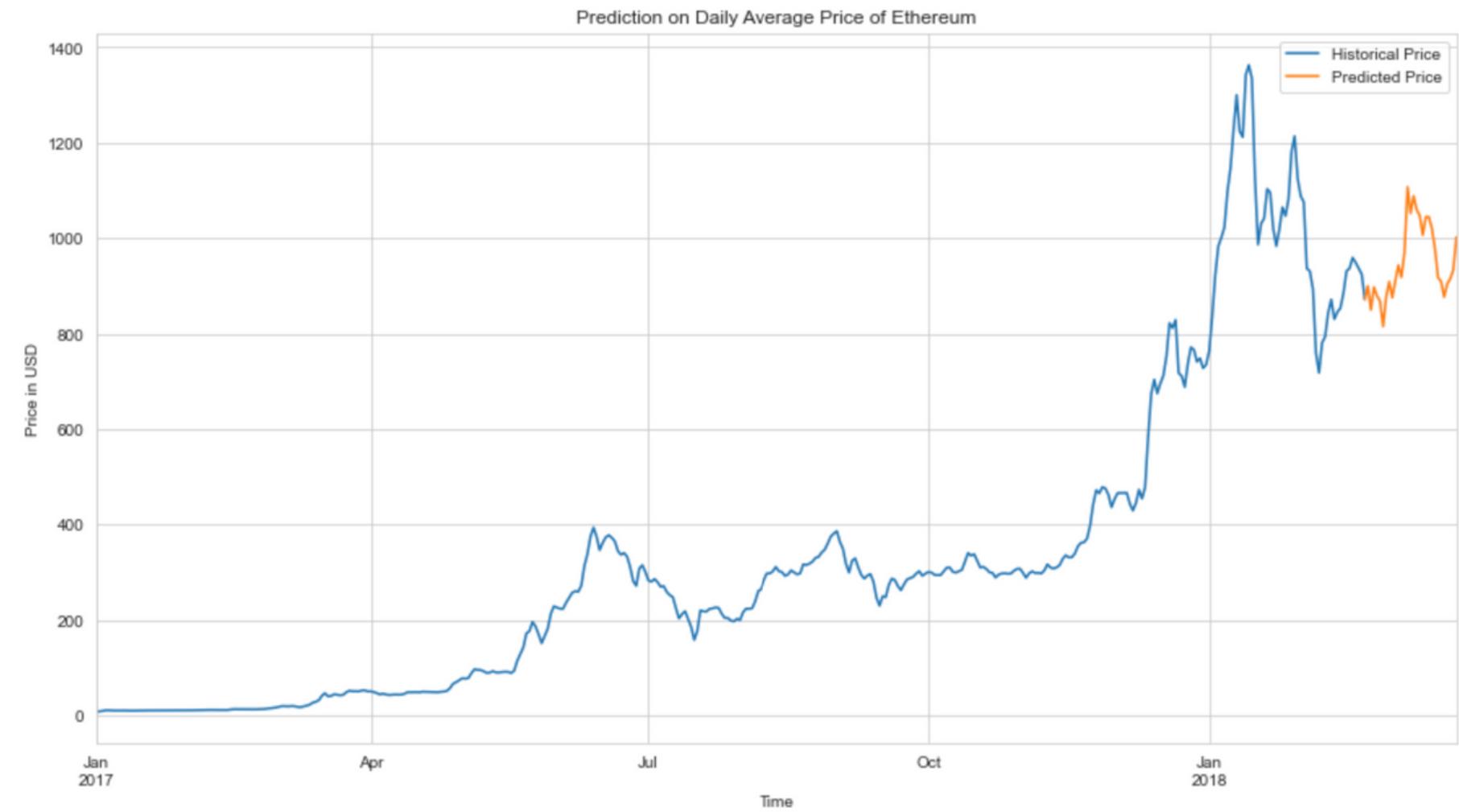
Note: We performed approach 1 only for decision trees not for Neural Nets because Using the daily average price, especially a monthly averaged one, as an outcome variable for LSTM models might not be as useful because it can potentially reduce the granularity of the data. LSTM models are designed to capture temporal dependencies and patterns over a sequence of data points. In cryptocurrency markets, short-term price movements and intraday volatility are essential factors that LSTM models can learn from and make predictions based on.

Models used for approach 1 :

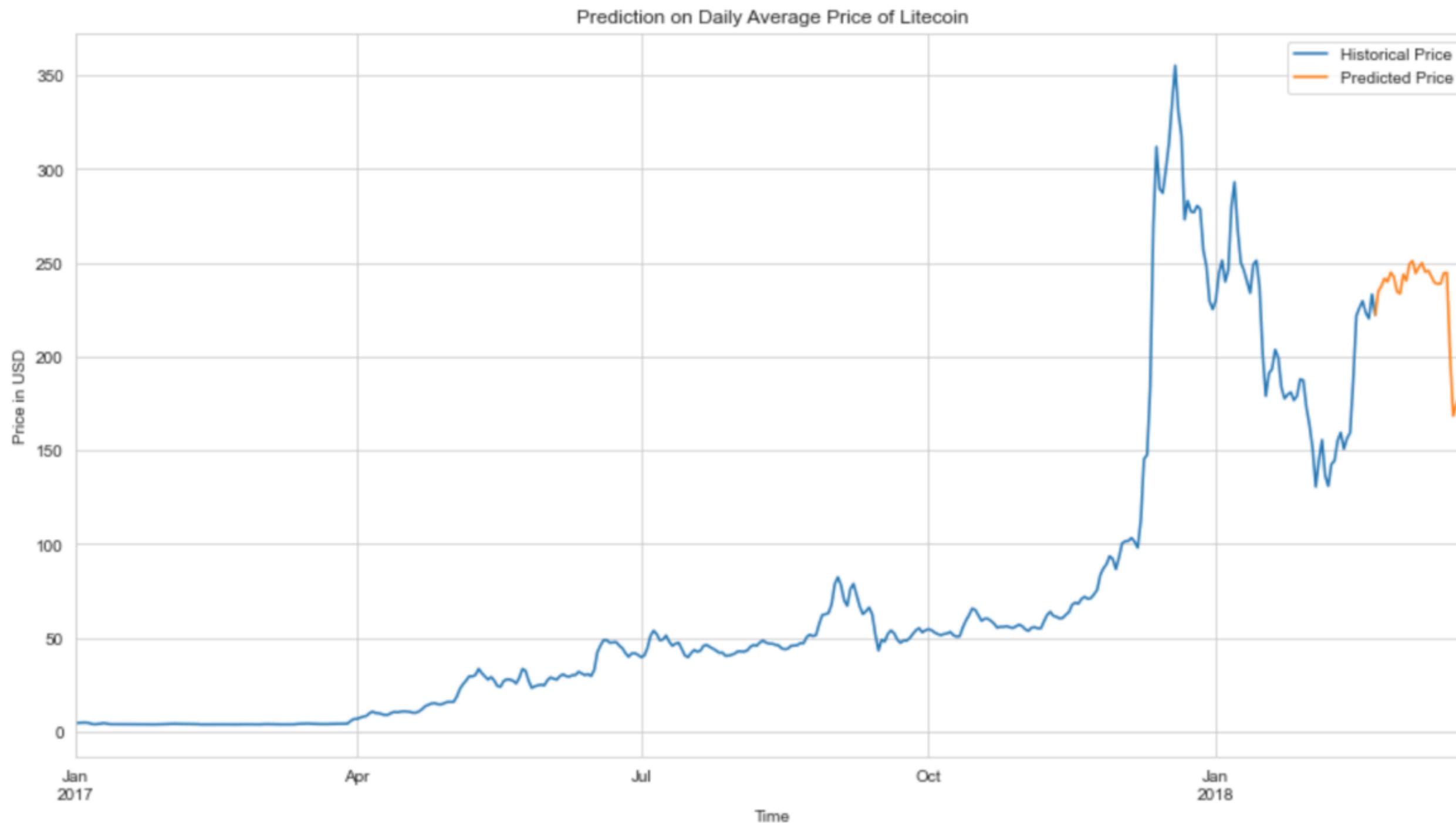
- Linear Regression(Baseline)
- Bayesian Ridge
- Elastic Net CV
- Random Forest Regressor
- Gradient Boosting Regressor
- Extra Tree

Forecasting

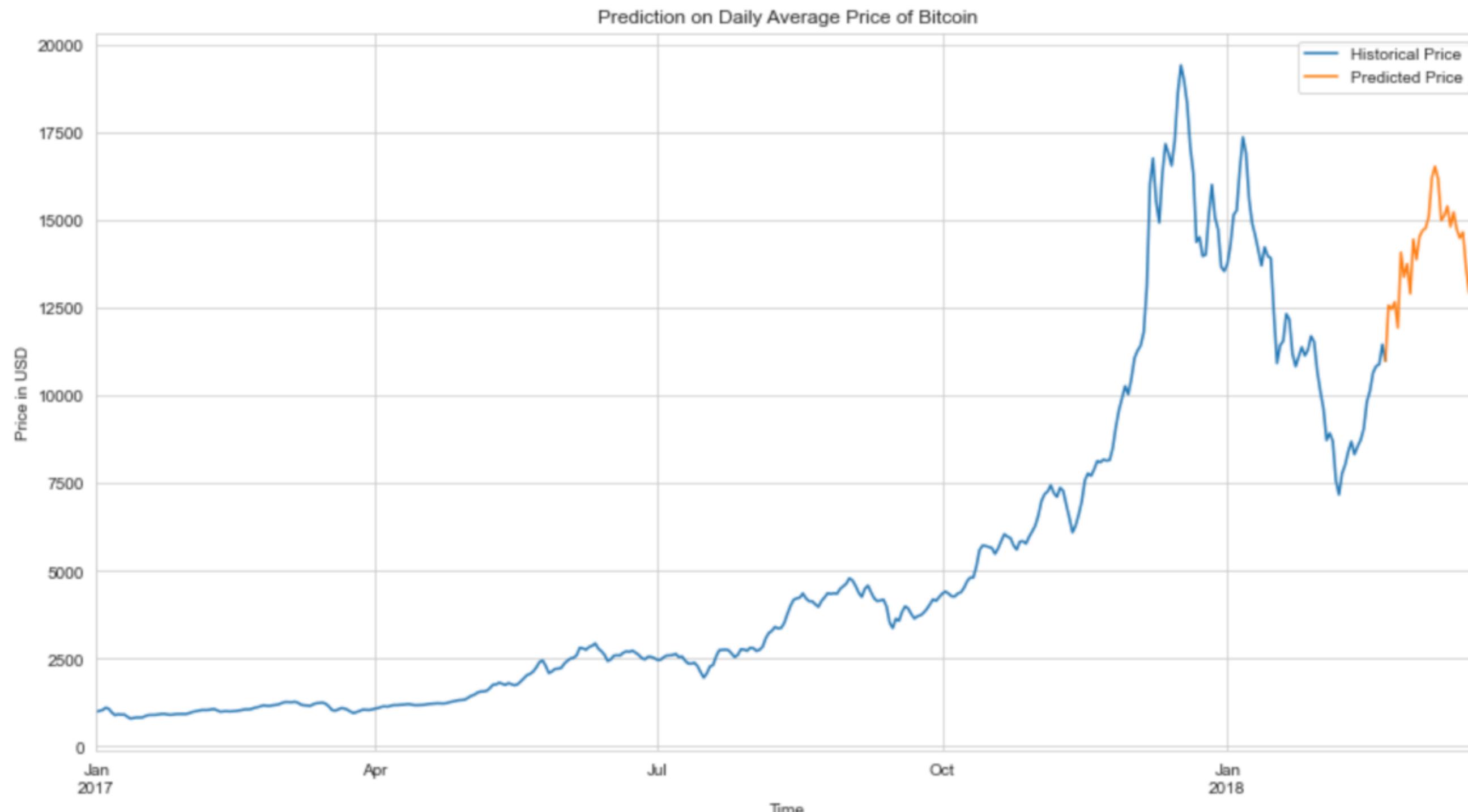
In this project, we employed the Extra Trees Regressor model to forecast the daily average prices of Bitcoin, Ethereum, and Litecoin. The results demonstrated that the model was able to accurately predict the price movements for each cryptocurrency, capturing the overall market trends and dynamics. Despite some minor deviations from the actual prices, the model's performance was generally satisfactory, showcasing the potential of decision tree-based models for cryptocurrency price forecasting.



Forecasting Litecoin



Forecasting Ethereum



Model Selection

Approach 2(Short-Term Call)

Close Price: The close price, on the other hand, represents the final price at which a cryptocurrency is traded during a specific time period, typically a day. The close price is an essential metric for traders and investors, as it provides information on the market's sentiment at the end of the trading day. The close price is often used as a reference point for the next day's opening price, making it a critical component of short-term market analysis.

In terms of forecasting, using close prices as an outcome variable can lead to more accurate predictions for short-term price movements. As a result, close price forecasting models can be particularly helpful for short-term traders who rely on timely and precise market information to execute their trading strategies. Additionally, the close price is a vital input for calculating other technical indicators, such as moving averages and Bollinger Bands, which play a significant role in technical analysis.

Models used for approach 2 :

- Linear Regression(Baseline)
- Bayesian Ridge
- Elastic Net CV
- Random Forest Regressor
- Gradient Boosting Regressor
- Extra Tree
- Bi-LSTM
- TCN
- GRU

Forecasting

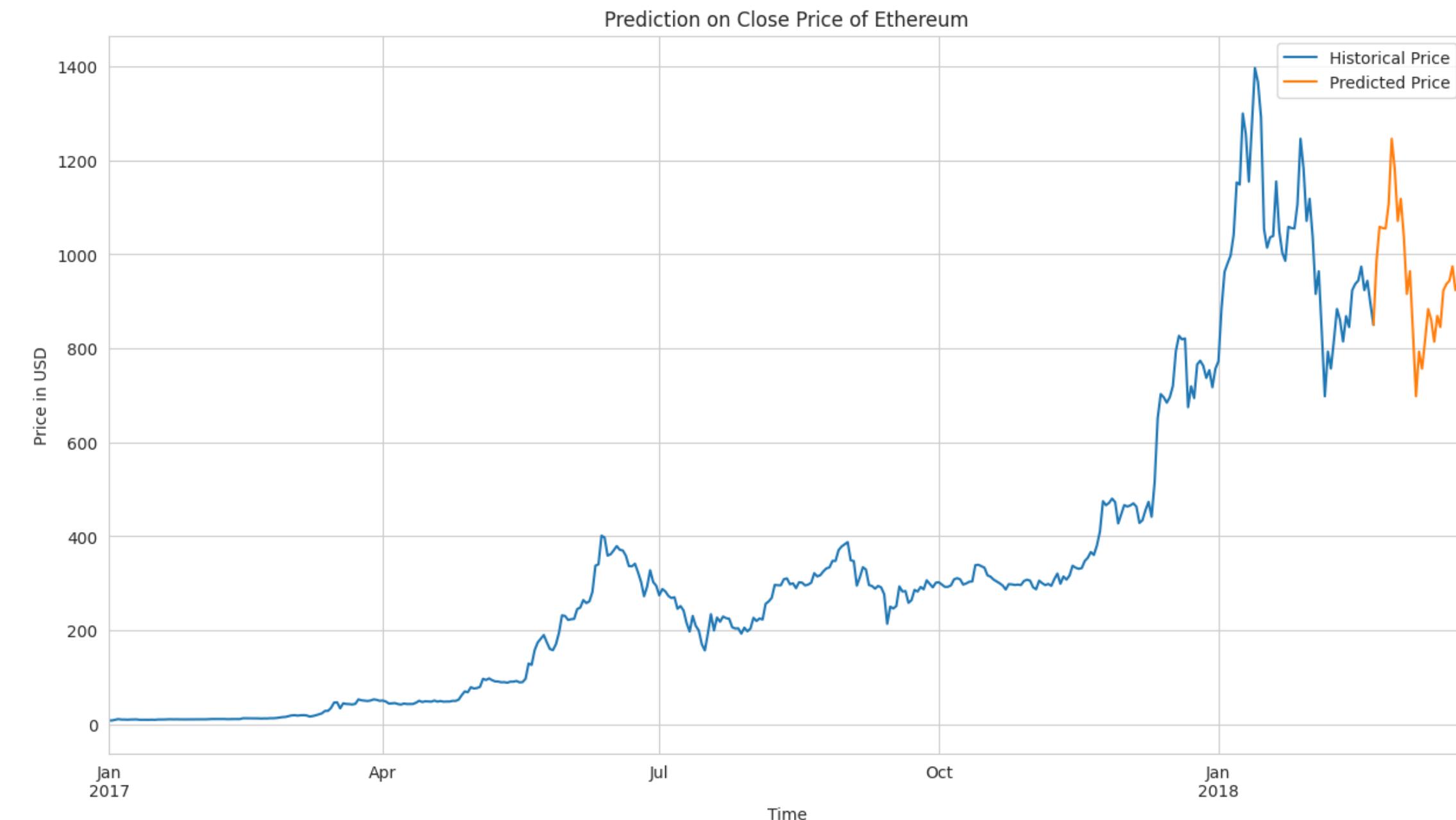
In this project, we employed the Extra Trees Regressor model to forecast the daily average prices of Bitcoin, Ethereum, and Litecoin. The results demonstrated that the model was able to accurately predict the price movements for each cryptocurrency, capturing the overall market trends and dynamics.

It is important to note that deep learning models such as GRU, BiLSTM, and TCN did not perform as well as some of the decision tree-based models in our current experiments.

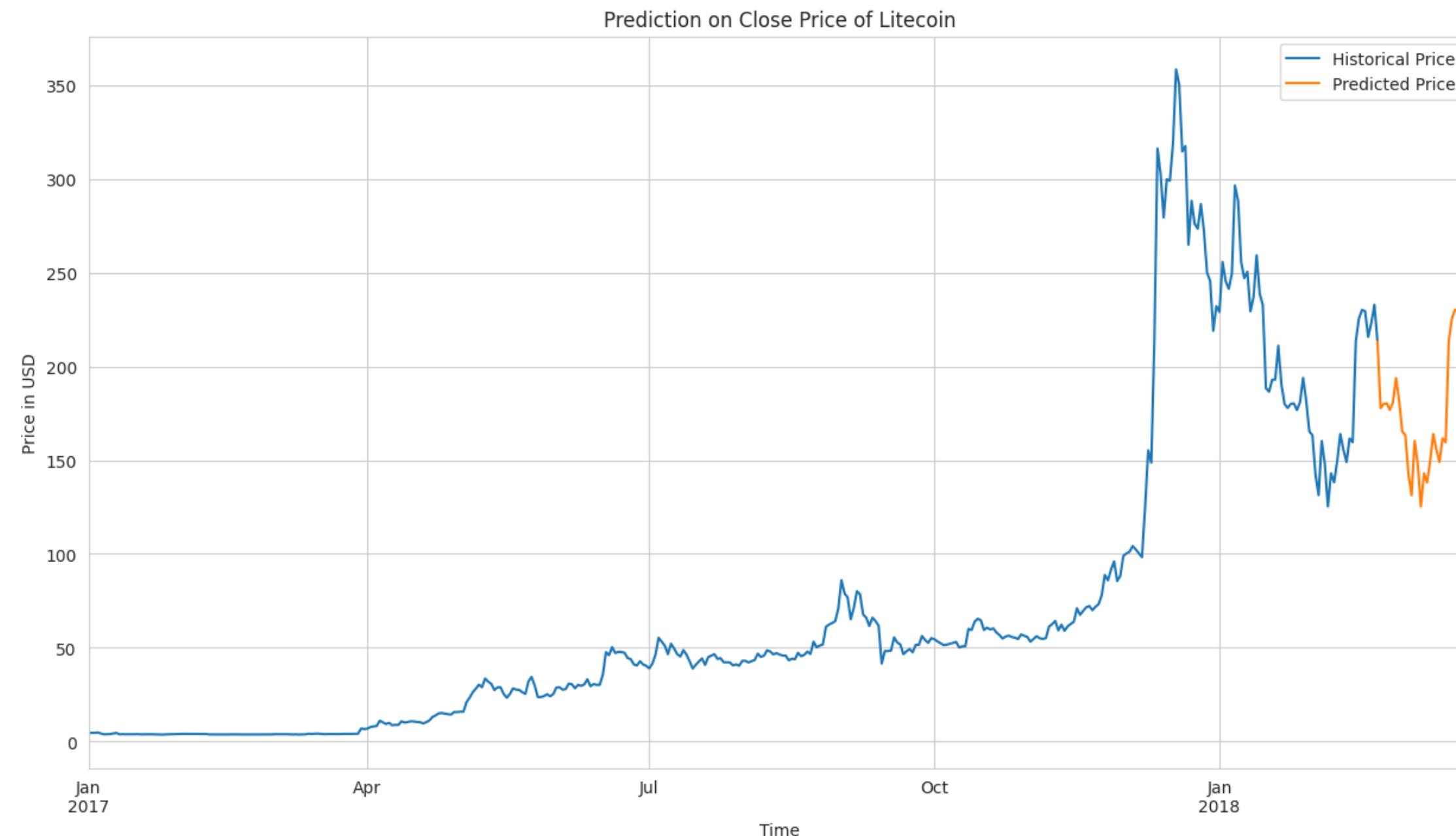
However, these deep learning models showed promising results in the plots and have the potential to improve their performance with fine-tuning. Due to time constraints, we were unable to perform an extensive hyperparameter search and model optimization for these deep learning models, but they have the potential to excel in time series prediction tasks, given their ability to capture long-term dependencies and temporal patterns in the data.



Forecasting Ethereum

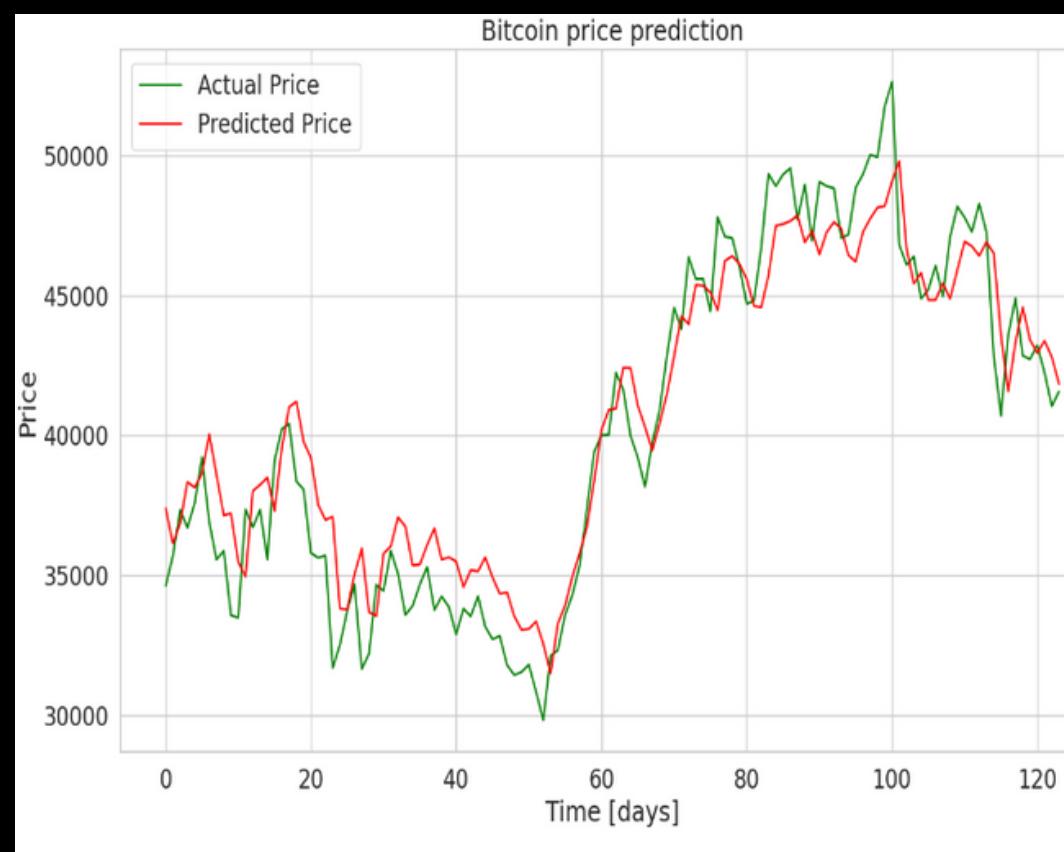


Forecasting Litecoin



Neural Networks

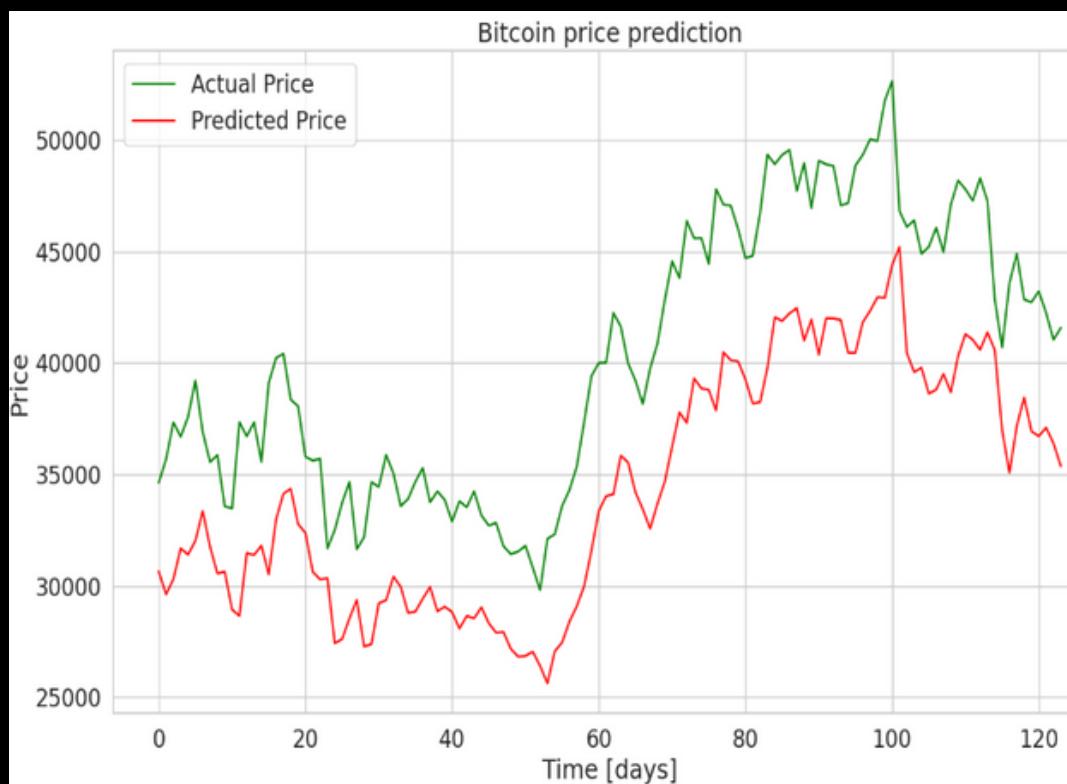
Gated Recurrent Units (GRUs)



Benefits of using GRU

1. Simplicity: GRUs are simpler than LSTMs and have fewer parameters, making them easier to train and less computationally expensive.
2. Faster training time: Due to their simplicity, GRUs can be trained faster than LSTMs, reducing the time it takes to get results. Improved generalization: GRUs are less prone to overfitting than LSTMs, as they have fewer parameters and are therefore less likely to memorize the training data.
3. Similar accuracy: Despite their simplicity, GRUs have been shown to perform similarly to LSTMs in many tasks, including cryptocurrency price prediction.

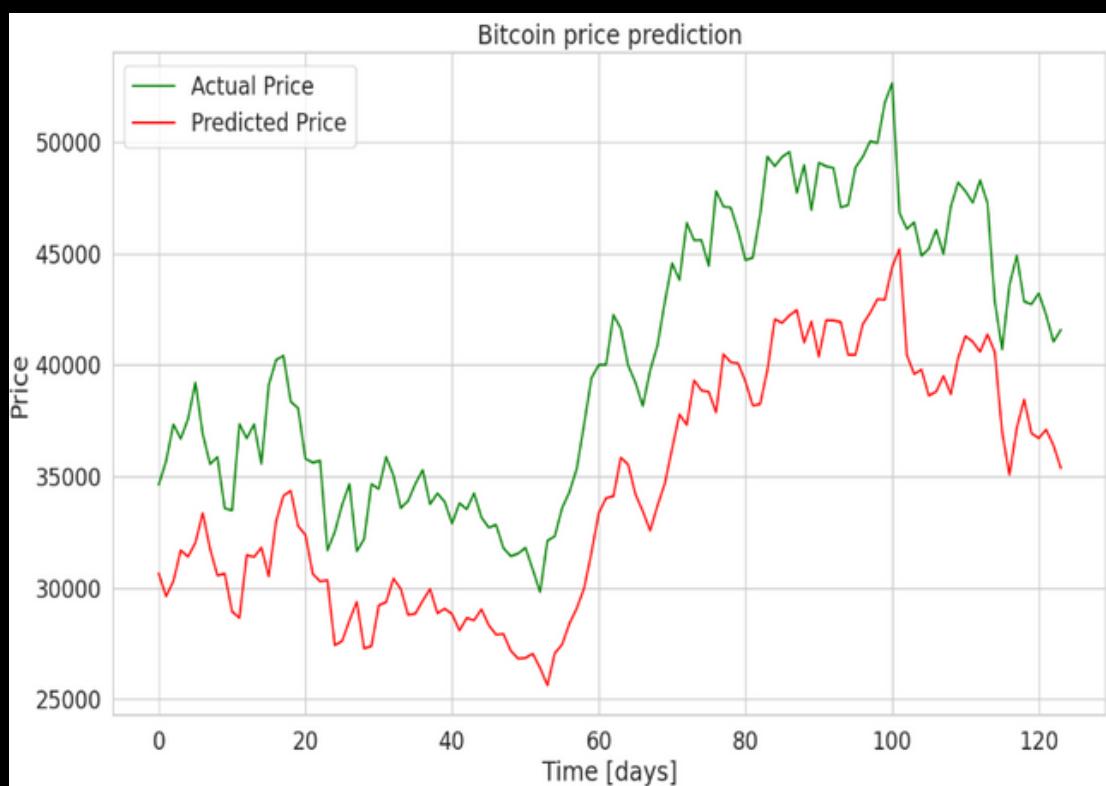
Bidirectional Long Short- Term Memory (Bi-LSTM)



The benefits of using Bi-LSTMs for cryptocurrency price prediction include:

1. Improved accuracy: By processing the input sequence in both forward and backward directions, Bi-LSTMs can capture more complex dependencies and patterns in the data, leading to improved accuracy in predictions.
2. Better handling of context: Bi-LSTMs can take into account both past and future information when making predictions, allowing them to better handle context and make more informed predictions.
3. Robustness to noise: Similar to traditional LSTMs, Bi-LSTMs are robust to noisy or missing data, as they can use information from both past and future inputs to make predictions even if some data is missing.

Temporal Convolution Network(TCN)



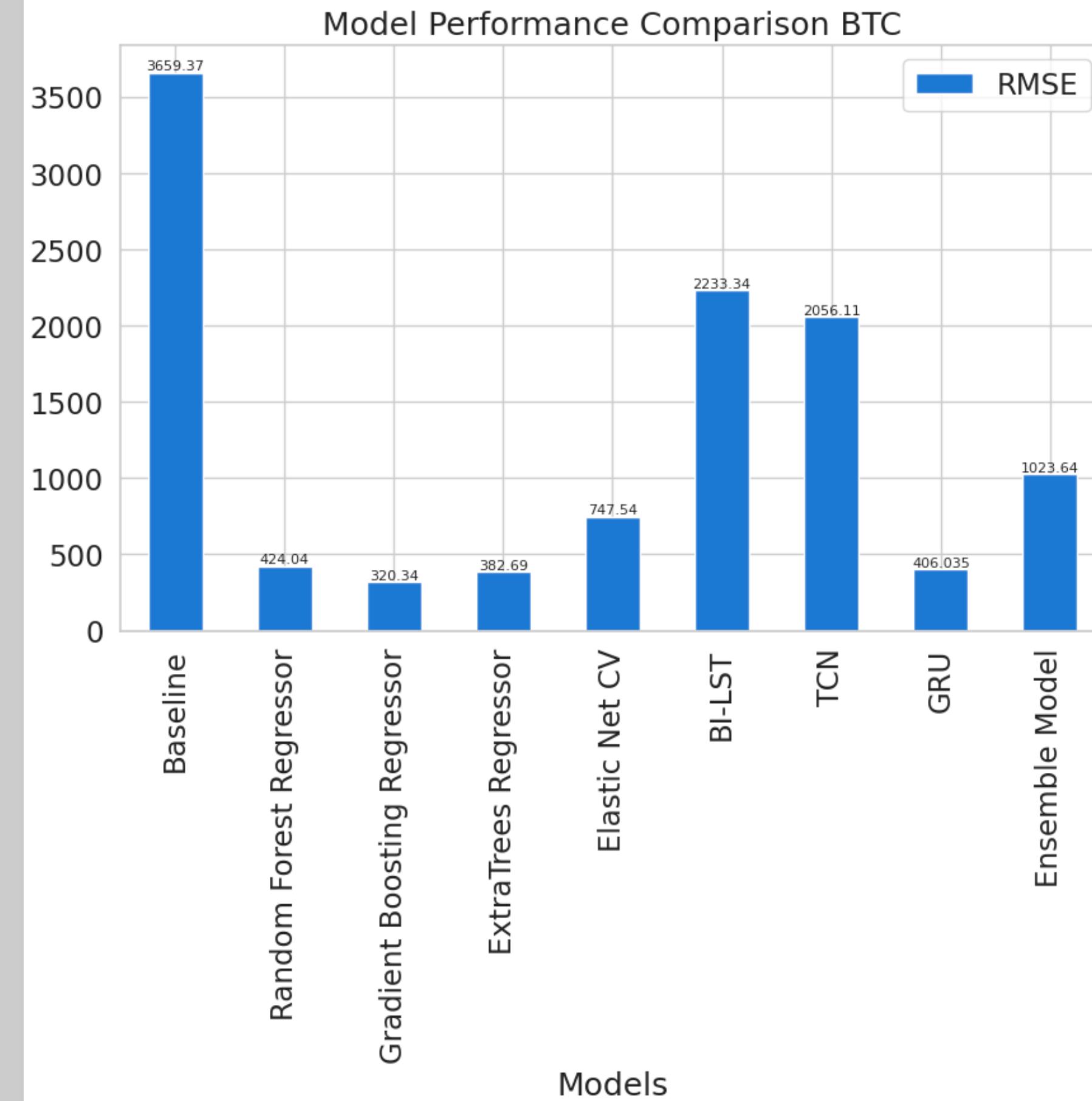
The benefits of using TCNs for cryptocurrency price prediction include:

1. Temporal Convolutional Networks (TCNs) are a powerful deep learning architecture specifically designed for sequence modelling and time series prediction.
2. Capture Long-range Dependencies: This capability is particularly relevant in the crypto market, where historical trends and events can have a lasting impact on prices. By effectively capturing these dependencies, TCNs can provide more accurate and reliable predictions.
3. Robustness to Missing Data: Crypto markets are notorious for their unpredictable behaviour and missing data points.
4. Automatic Feature Extraction: TCNs can automatically learn and extract relevant features from raw time series data, eliminating the need for manual feature engineering.
5. Scalability: TCNs are highly scalable and can be easily applied to large datasets, making them suitable for analyzing the vast amount of data generated in the crypto market.

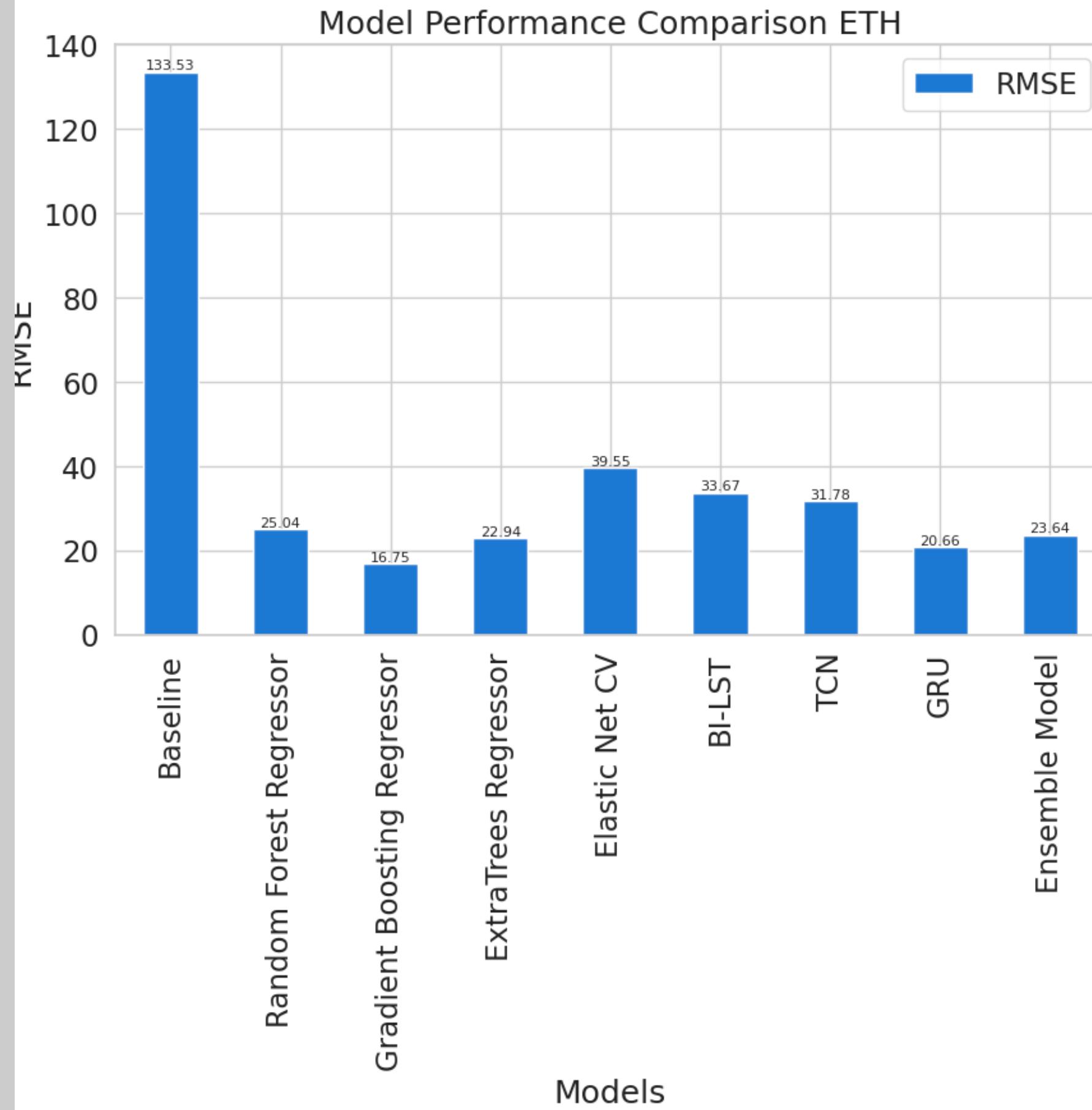
Results

- In conclusion, based on the performance of the models, it is evident that the ExtraTrees Regressor has outperformed other traditional machine-learning models for all three cryptocurrencies: Ethereum (ETH), Litecoin (LTC), and Bitcoin (BTC). The Random Forest Regressor and Gradient Boosting Regressor also showed reasonably good performance compared to the baseline linear regression model.
- It is important to note that deep learning models such as GRU, BiLSTM, and TCN did not perform as well as some of the decision tree-based models in our current experiments. However, these deep learning models showed promising results in the plots and have the potential to improve their performance with fine-tuning. Due to time constraints, we were unable to perform an extensive hyperparameter search and model optimization for these deep learning models, but they have the potential to excel in time series prediction tasks, given their ability to capture long-term dependencies and temporal patterns in the data.
- In summary, while decision tree-based models, such as the ExtraTrees Regressor, demonstrated the best performance in our experiments, deep learning models like GRU, BiLSTM, and TCN still hold promise for time series cryptocurrency prediction tasks. With further fine-tuning and optimization, these models may yield even better results, making them a valuable area for future exploration and experimentation.

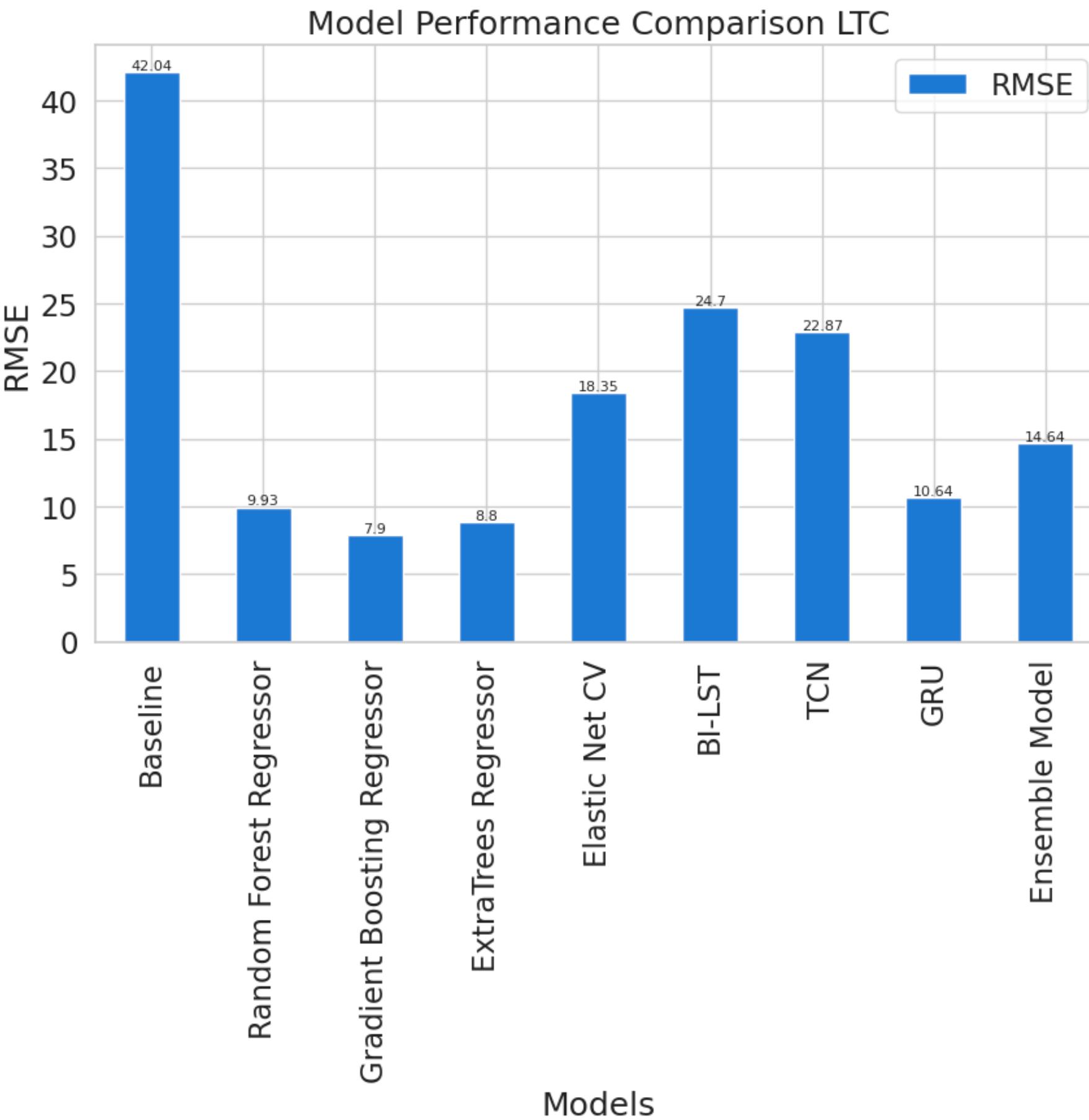
Results



Results



Results



Why Exactly ?

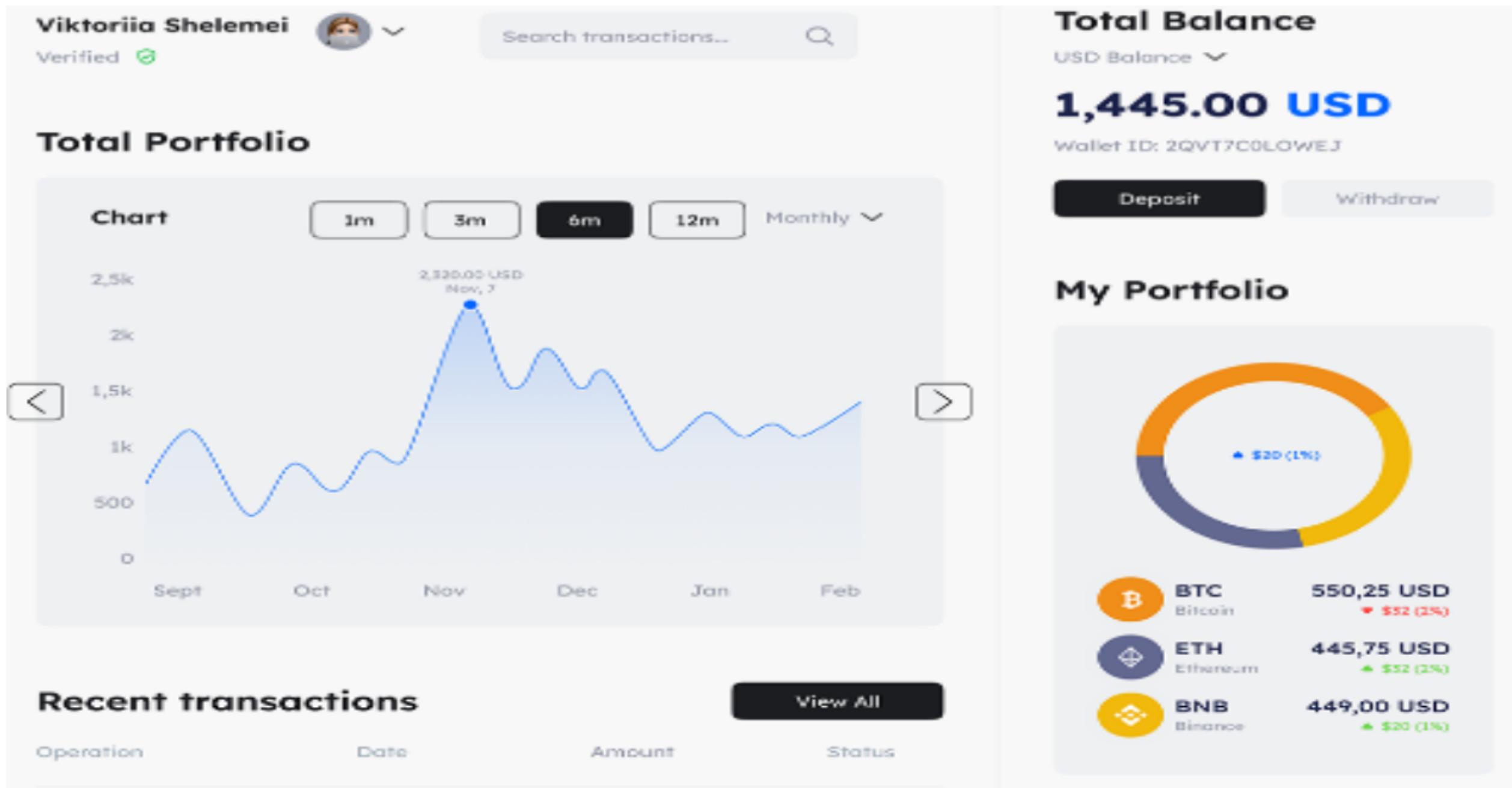


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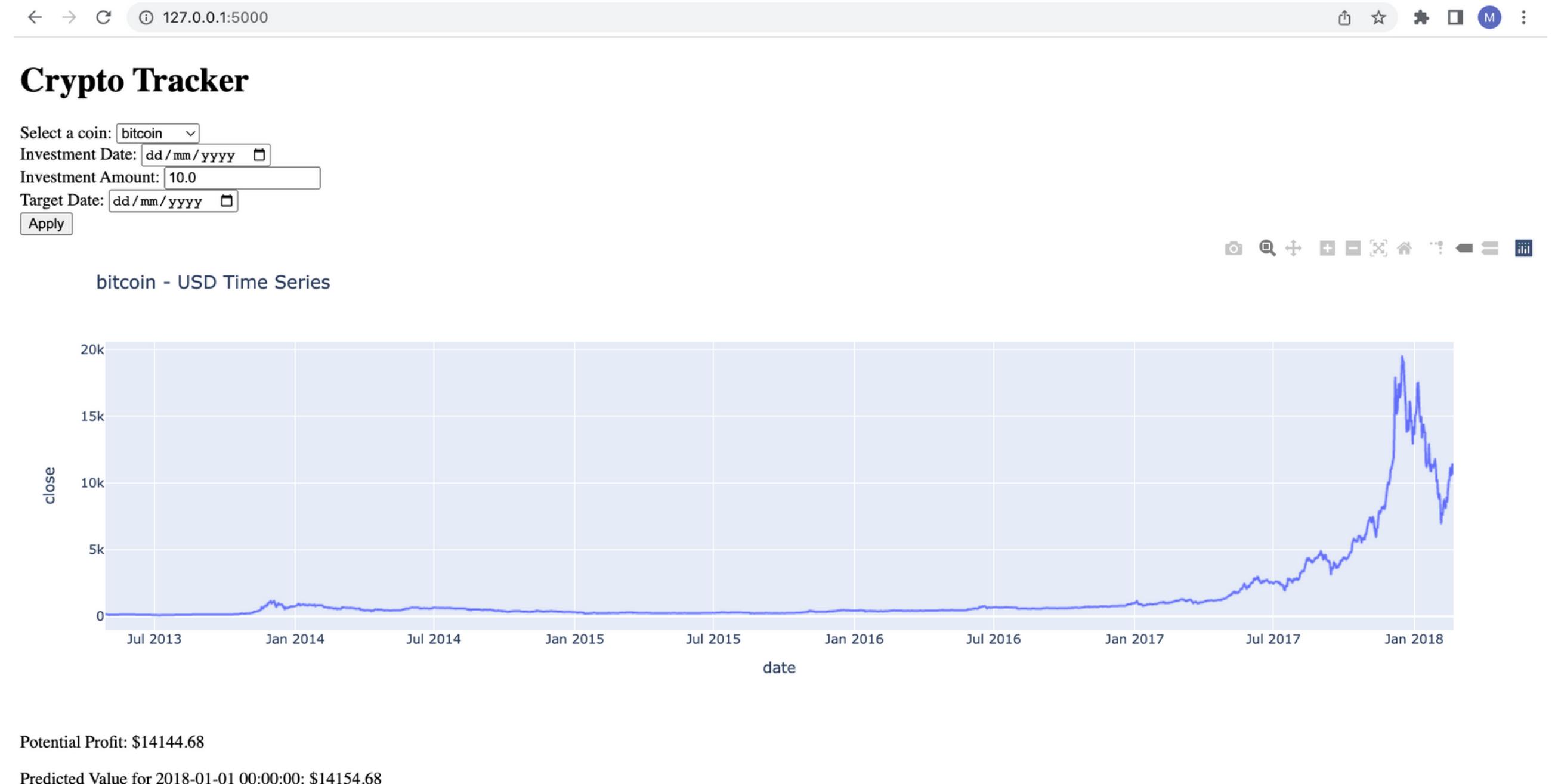


LING 1 BITCOIN FOR A
DOLLARS

HOW EXACTLY?



Portfolio



Future Works

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Using large Language models to help predict from other data sources such as news and social media



Conclusion and Challenges

- Volatility: Cryptocurrency prices can be highly volatile, making it difficult to make accurate predictions. Sudden price changes can be caused by a variety of factors, including changes in market sentiment, government regulations, and technical issues.
- Limited historical data: Cryptocurrencies are a relatively new asset class, and there is limited historical data available for analysis. This can make it difficult to identify trends and patterns in the data, and to make accurate predictions.
- Complexity of the market: The cryptocurrency market is complex and interconnected, with many factors affecting the price of a particular cryptocurrency. These factors can include supply and demand, investor sentiment, and government regulations, among others.
- Lack of regulation: Cryptocurrencies are largely unregulated, making it difficult to accurately predict their future performance. This can also lead to manipulation of the market by individuals or groups with a vested interest.

Business Insights

Bitcoin

- Looking at the short-term forecasted trend, Bitcoin's predicted price is still volatile. Downward trending follows right after an increasing price trend, mainly because of the lacking of momentum. Investors need to be cautious with the drastic price fluctuation.
- Traders are advised to buy a short-term put option and a long-term call option.

Ethereum

- Similar to Bitcoin, the predicted price of Ethereum is volatile. Downward trending follows right after an increasing price trend, mainly because of the lacking of momentum.
- Investors need to be cautious with the drastic price fluctuations as the price has been going very high. Traders are advised to buy a short-term put option and a long-term call option.

Litecoin

The predicted price of Litecoin is still volatile. The lack of momentum is obvious in Litecoin's price. In the short term, the Litecion holder is advertised to sell the coin in the near future, and traders are advised to buy a short-term put option and a long-term call option.

Thank You