Price forecasting - Cryptocurrency

Vishwa Pankajbhai Doshi (401329471)

Akshat Jain (401971879)

Jatin Raheja (401329770)

Nikhil Katariya (401975324)

Rohit Mehta (401324986)

Introduction

- Cryptocurrency is a virtual or digital currency used in financial systems
- As of March 2022, there are more than eighteen thousand cryptocurrencies in the market and the most famous of them all is Bitcoin
- Predicting the price of cryptocurrencies has become a popular trend as the technologies are emerging for potential investments

Project Description

In this project, we utilize three specialized Recurrent Neural Network, Long Short-Term Memory (LSTM), Bidirectional Long Short-Term Memory (BiLSTM), and Gated Recurrent Unit (GRU), to predict the closing price of Bitcoin

Goal

Our focus is to see how the recurrent neural network (RNN) predicts the price of cryptocurrency given a sequential dataset. By calculating the accuracy of the predicted value and the actual value, this data can be for investment

Bitcoin History

- Bitcoin is a decentralized digital money that was invented in 2008. The currency began use in 2009.
- It is classified as a cryptocurrency since it is protected by cryptography. There are no real bitcoins; instead, balances are recorded on a public ledger that anyone can see (although each record is encrypted).
- A large amount of computational power is used to verify all Bitcoin transactions, a process known as "mining."
- Ethereum (ETH), Litecoin (LTC), Cardano (ADA), and Polkadot (DOT) are some kind of cryptocurrency just like BitCoin.

Recurrent Neural Network (RNN)

- A neural network is interconnected layers having functionality like human brains
- RNN is a type of neural network used to develop speech recognition, time series prediction and natural language processing models since it retains a memory of what it has already process and so it can learn from previous states while in training
- It uses a feedback loop which helps to process the sequential data
- This loop allows the data to be shared to various nodes and predict according to the data available

Long Short-Term Memory (LSTM)

- One of the most emerging as an effective and scalable approach for a variety of learning problems involving sequential data in RNN (Recurrent neural networks) is long short-term memory (LSTM). Hochreiter and Schmidhuber introduced the LSTM network as a popular deep learning method in time series forecasting in 1997.
- The LSTM's key component is the memory cell Ct, as well as three gates (input gate, output gate, and forget gate) that control the information added to or removed from the cell.
- In LSTM there are mainly three activation functions sigmoid, tanh, reLu.

- Sigmoid function which regulates how much information to be passed through these gates, it is defined as:

$$\sigma(x) = 1/(1+e-x) = ex\ /(1 + ex)$$

- The output of the function ranges between 0 and 1. A value 0 represents “don’t let anything through” while 1 represents “let everything through”.
- Tanh function is hyperbolic function or tanh function whose output ranges between -1 and 1 which is defined as:

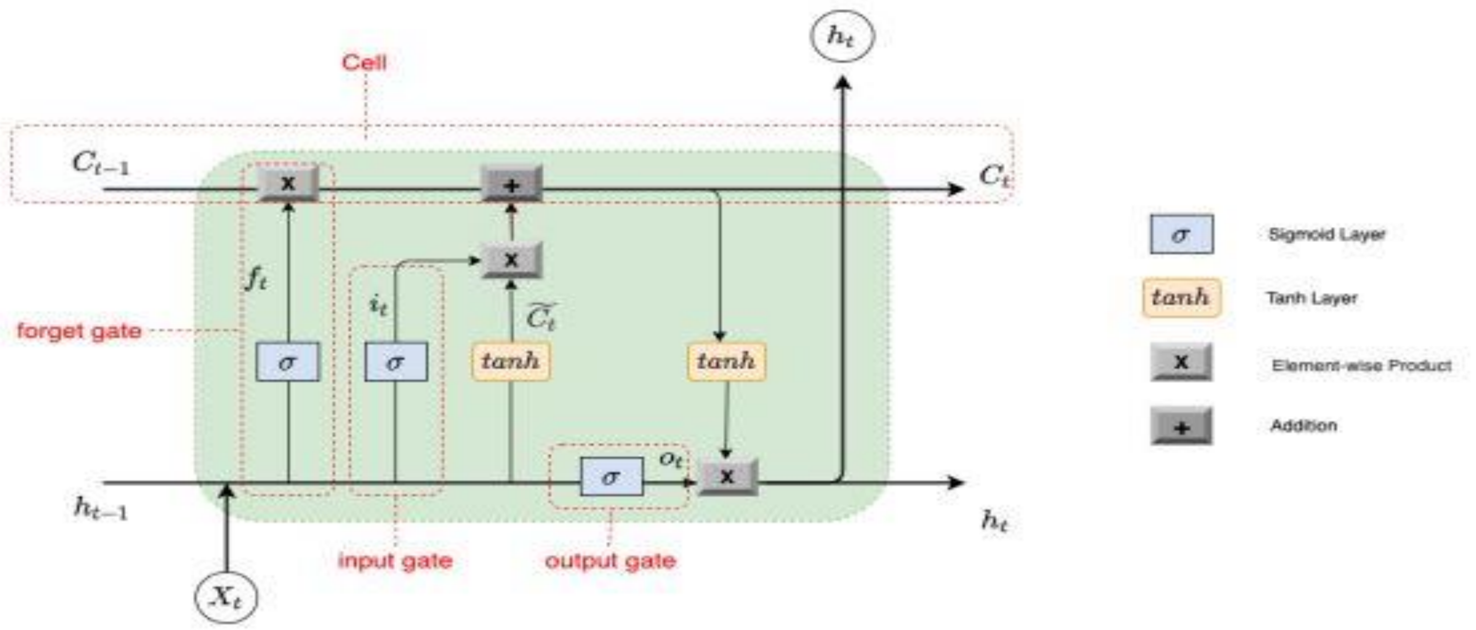
$$tanh(x) = (ex - e\text{-}x)/(ex + e\text{-}x)$$

- Rectified linear activation function or ReLU for short is a piecewise linear function that will output the input directly if it is positive, otherwise, it will output zero

$$ReLU=max\{0,a\}$$

- LSTM is made up of four parts which are:
    a. Forget Gate:- It determines which previous information is discarded from the cell.
    b. Input Gate:- It generates new data by utilizing an input gate layer and a tanh layer.
    c. Cell State:- The cell state then modifies it by combining the new information from the previous two parts.
    d. Output Gate:- It generates the output for the current state.
- The LSTM has the ability to remove or add information into the cell state that is regulated by different gates(forget, input and output).

Working of LSTM:

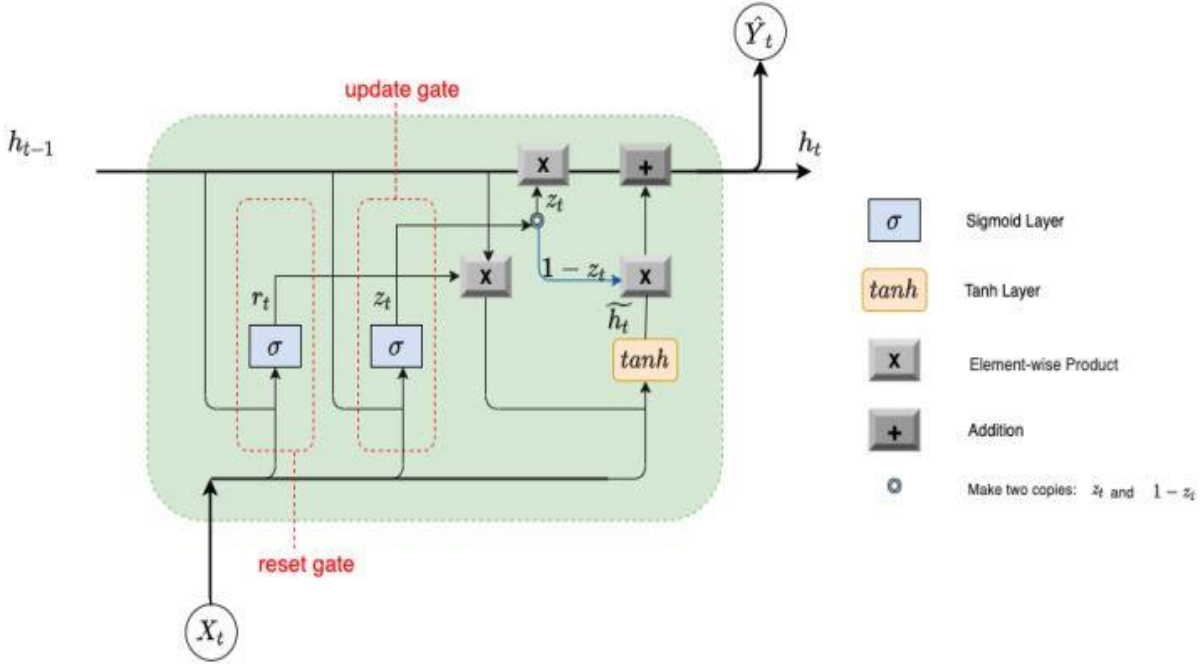


Gated Recurrent Unit (GRU)

- The GRU is a more recent type of recurrent neural network that resembles the LSTM. Instead of using the cell state to transport data, the GRUs used the hidden state. A reset gate and an update gate are the only gates on it.
- There are only two gates on it: a reset gate and an update gate. Since this GRU has fewer parameters but a similar design to an LSTM, it can operate better with fewer datasets. As a result, it works better for our bitcoin price dataset.
- Another intriguing feature of GRU is that, unlike LSTM, it lacks a separate cell state (C_t). It only has one state: hidden (H_t)
- The Reset gate is responsible for the short-term memory of the network i.e the hidden state (Ht) and for the long-term memory we have update gate.

$$\mathbf{r_t} = \boldsymbol{\sigma}(x_t * u_r + H_{t-1} * W_r) \qquad \mathbf{u_t} = \boldsymbol{\sigma}(x_t * u_u + H_{t-1} * W_u)$$

Working of GRU:



Bi-Directional long short term memory(Bi-LSTM):

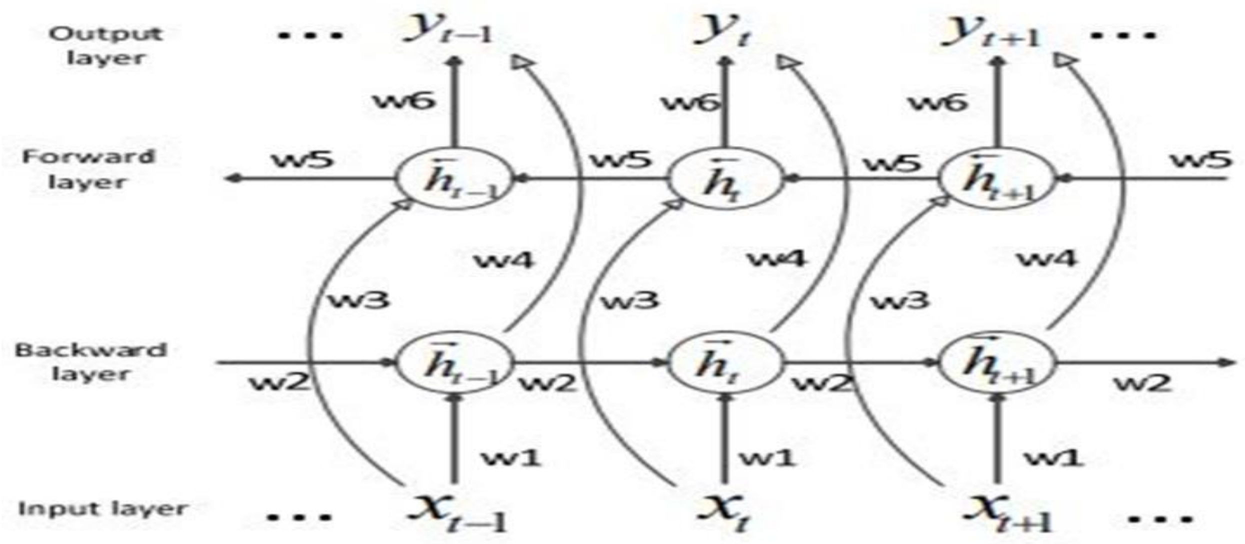
- Bi-directional long-short term memory networks are advancements of unidirectional LSTM. Basically Bi-LSTM is the process of allowing any neural network to store sequence information in both directions, either backwards (future to past) or forwards (past to future). The rest of the concept in Bi-LSTM is the same as LSTM.
- We can make the input flow in both directions, preserving both the future and the past.
- The forward and backward hidden state updates are as follows:

$$h_t = f\,(w_1 x_t + w_2 h_{t-1})$$

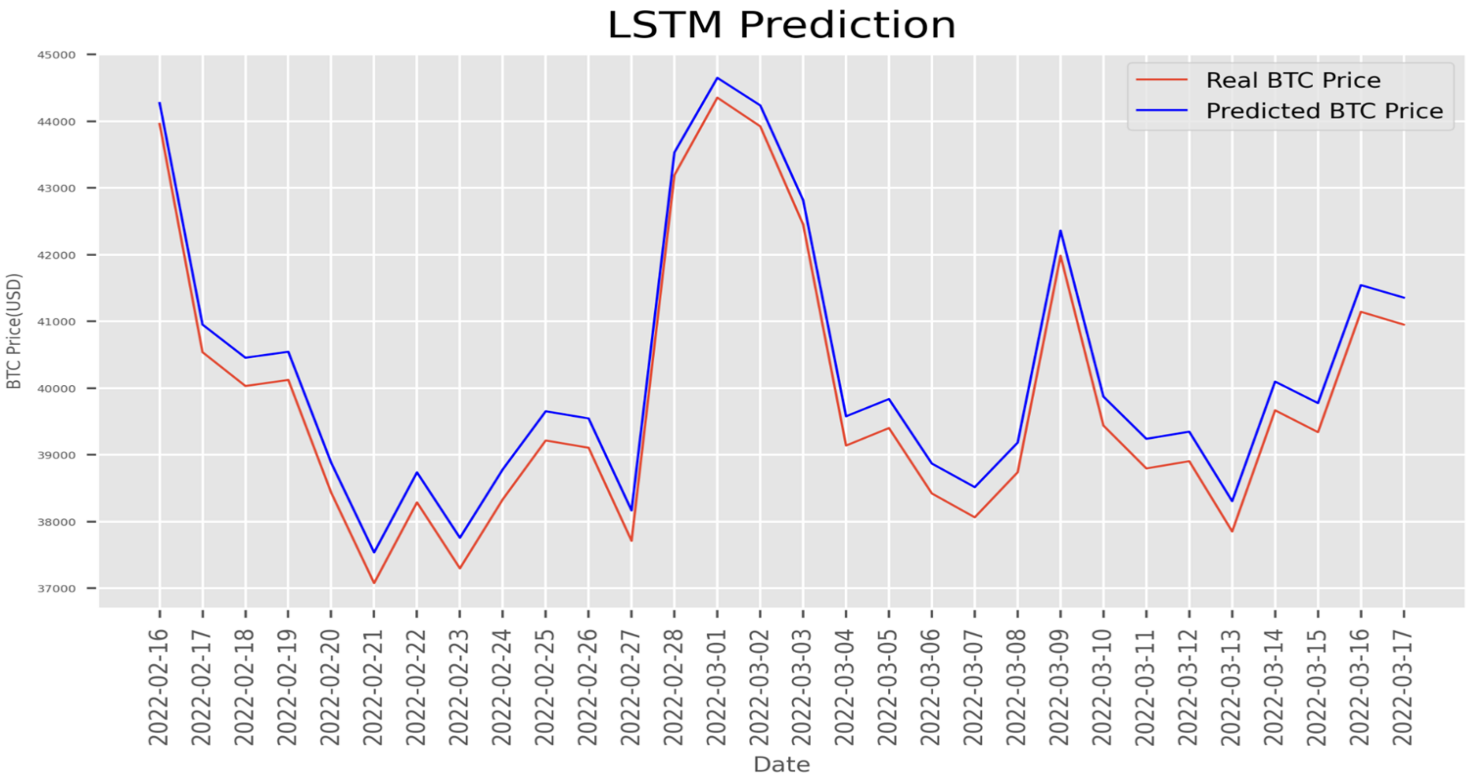
$$h_t' = f\,(w_3 x_t + w_5 h_{t+1})'$$

$$o_t = g\,(w_4 h_4 + w_6 h_t')$$

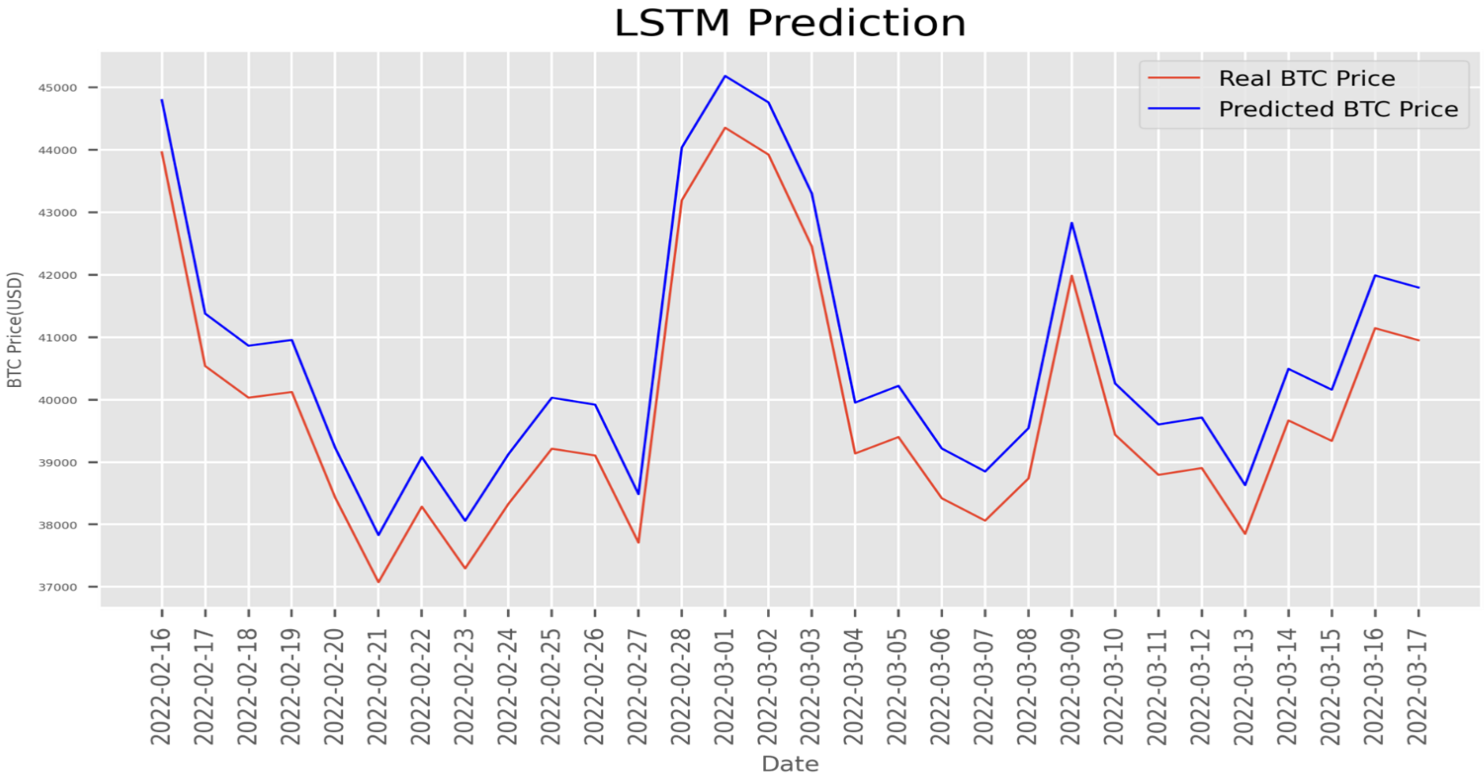
Working of Bi-Directional LSTM:



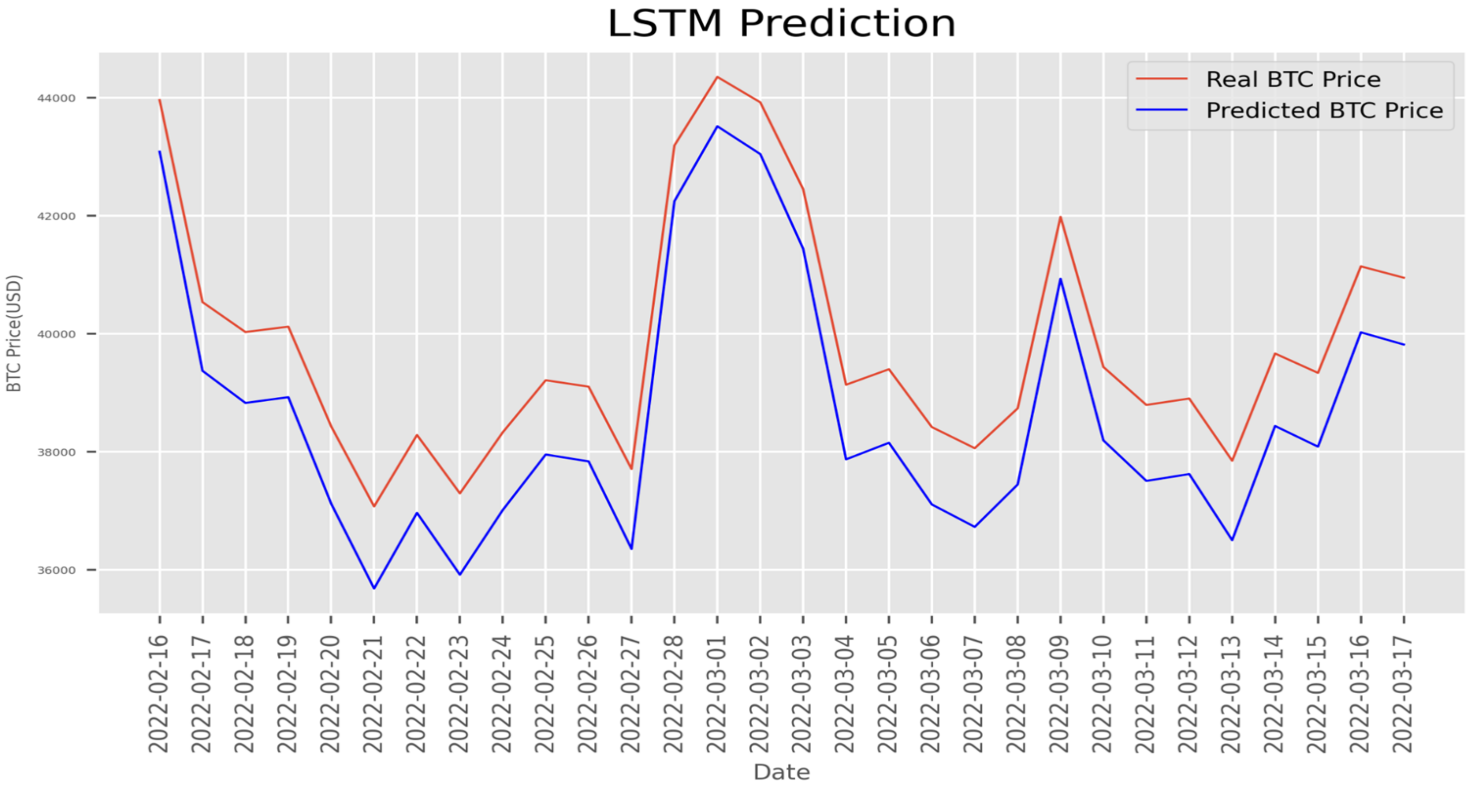
LSTM Prediction for Sigmoid Activation Function



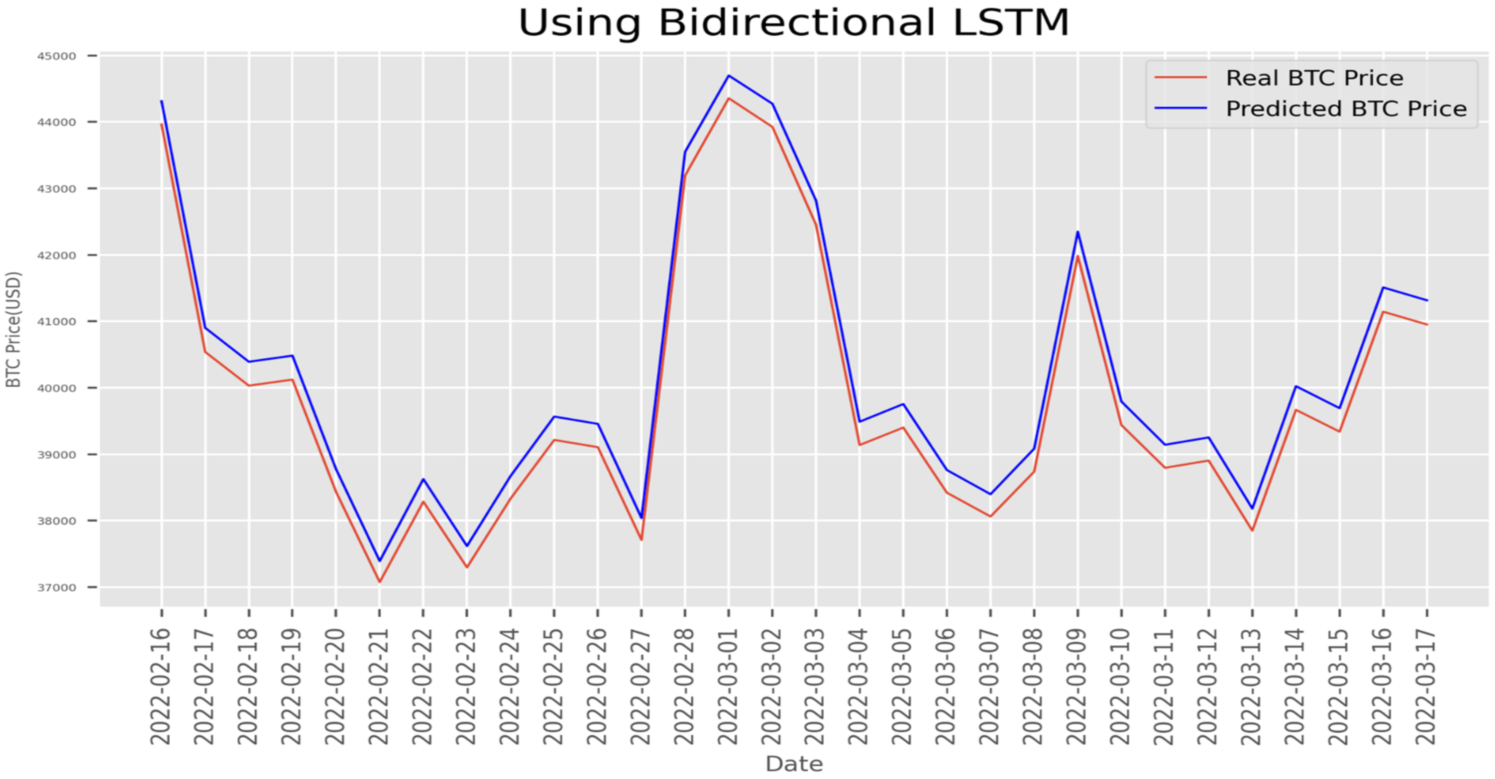
LSTM Prediction for tanh Activation Function



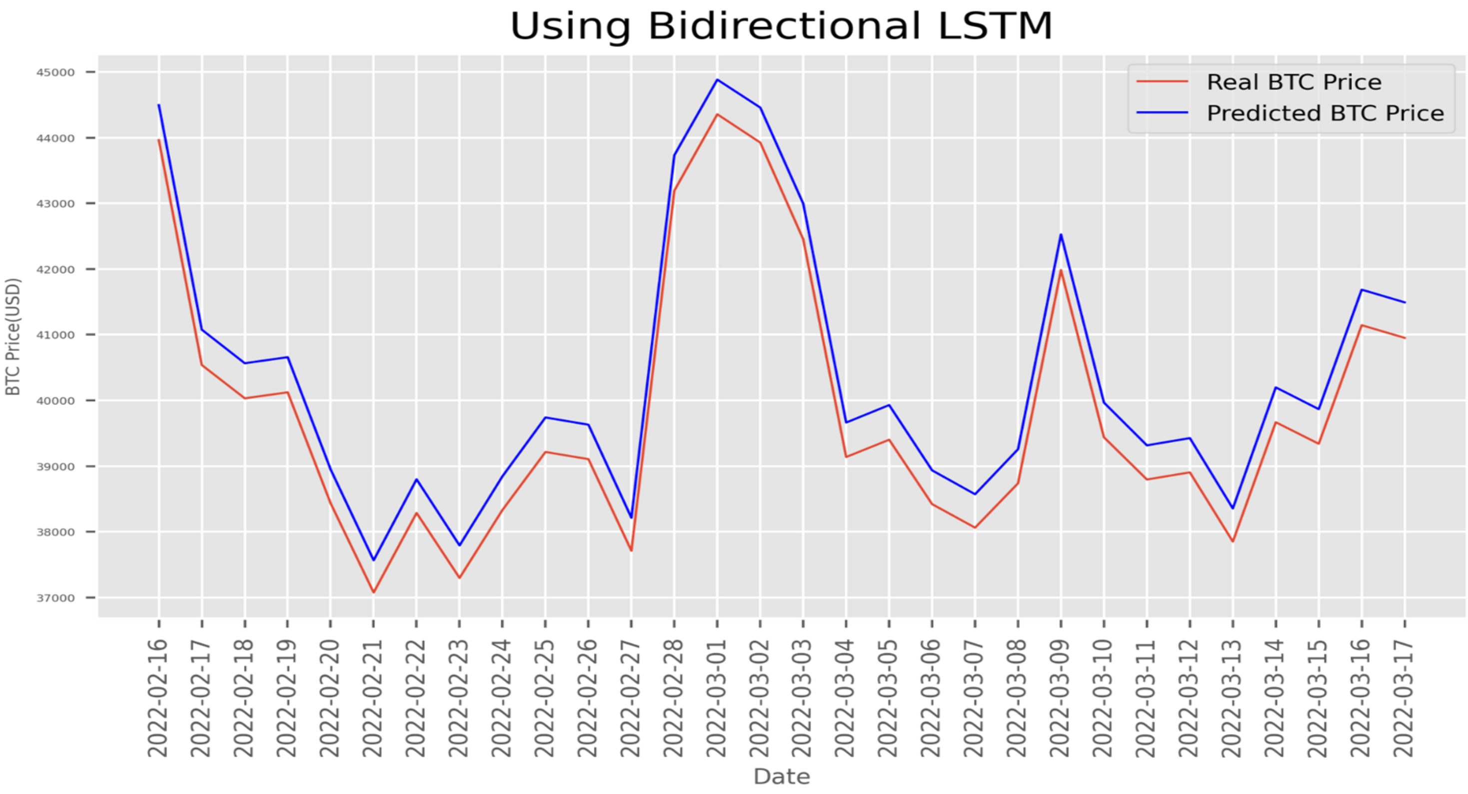
LSTM Prediction for ReLU Activation Function



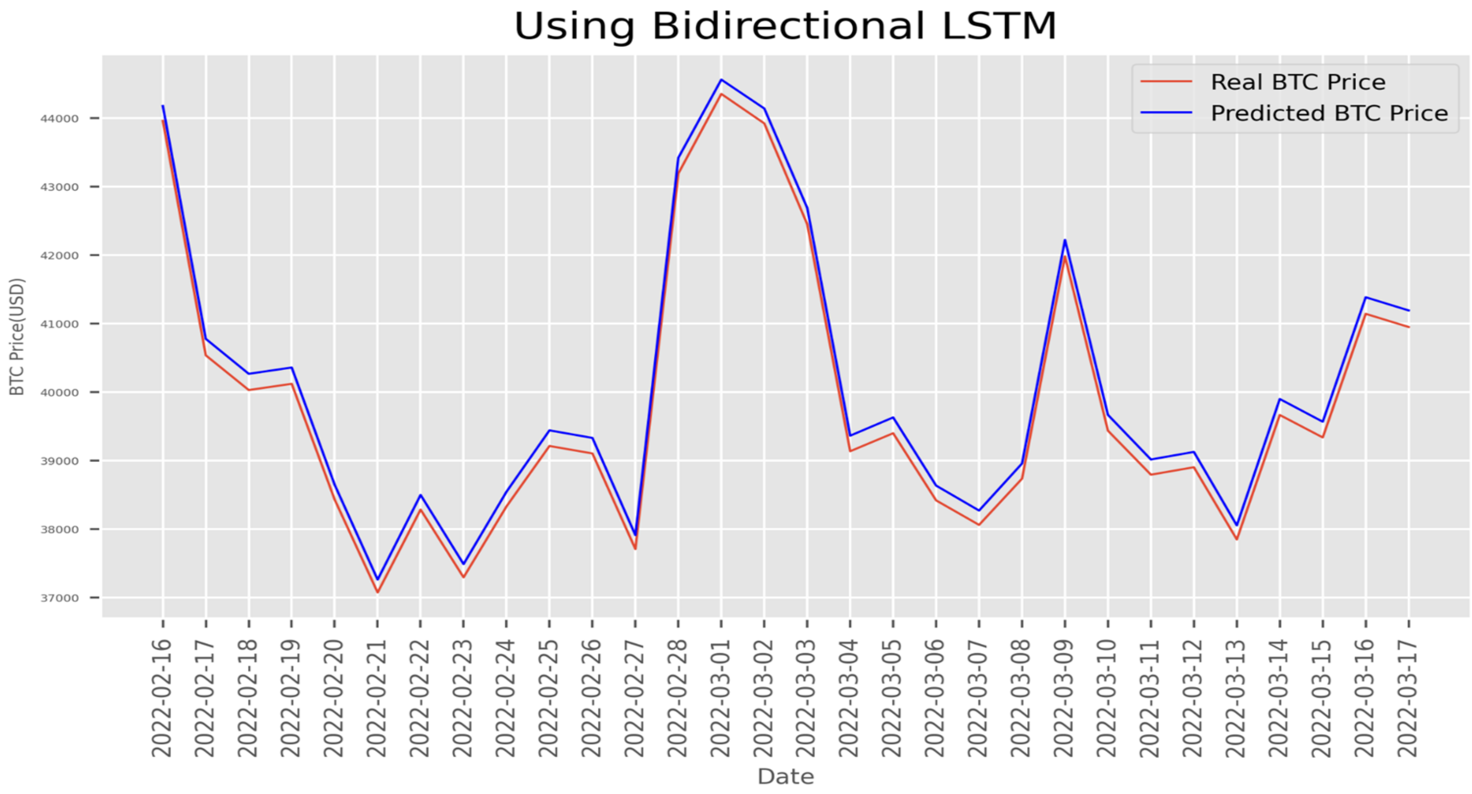
BiLSTM Prediction for Sigmoid Activation Function



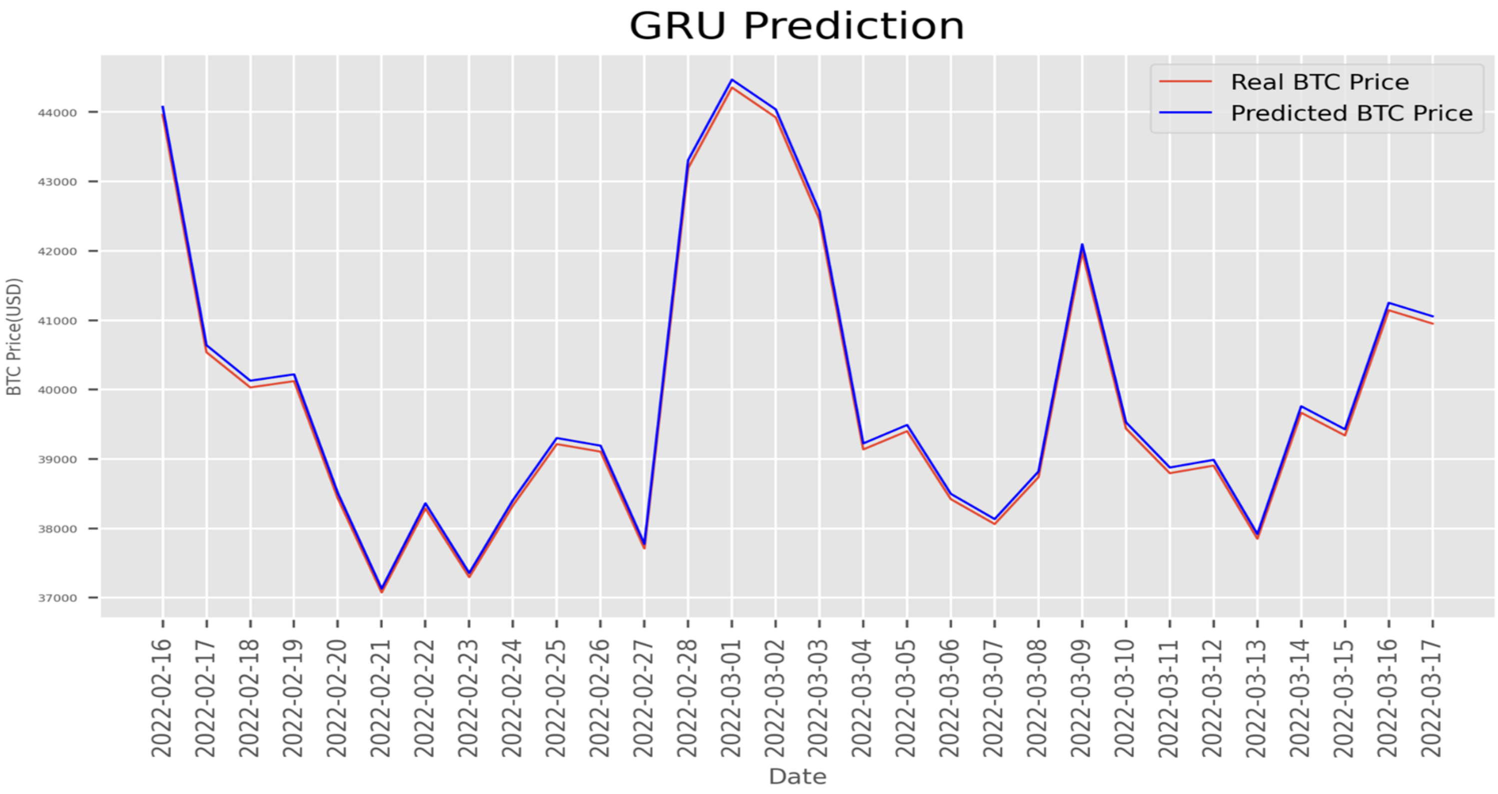
BiLSTM Prediction for tanh Activation Function



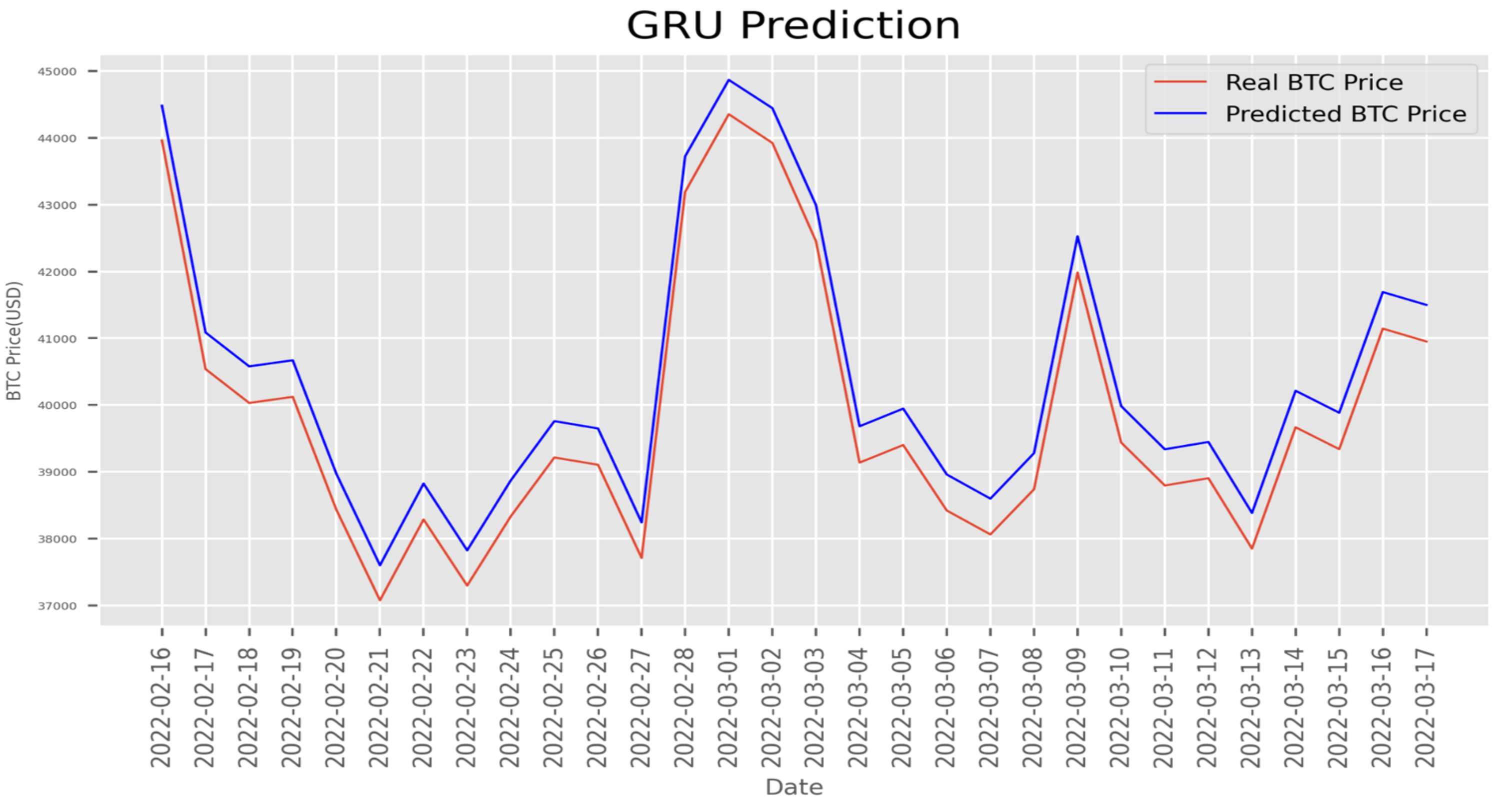
BiLSTM Prediction for ReLU Activation Function



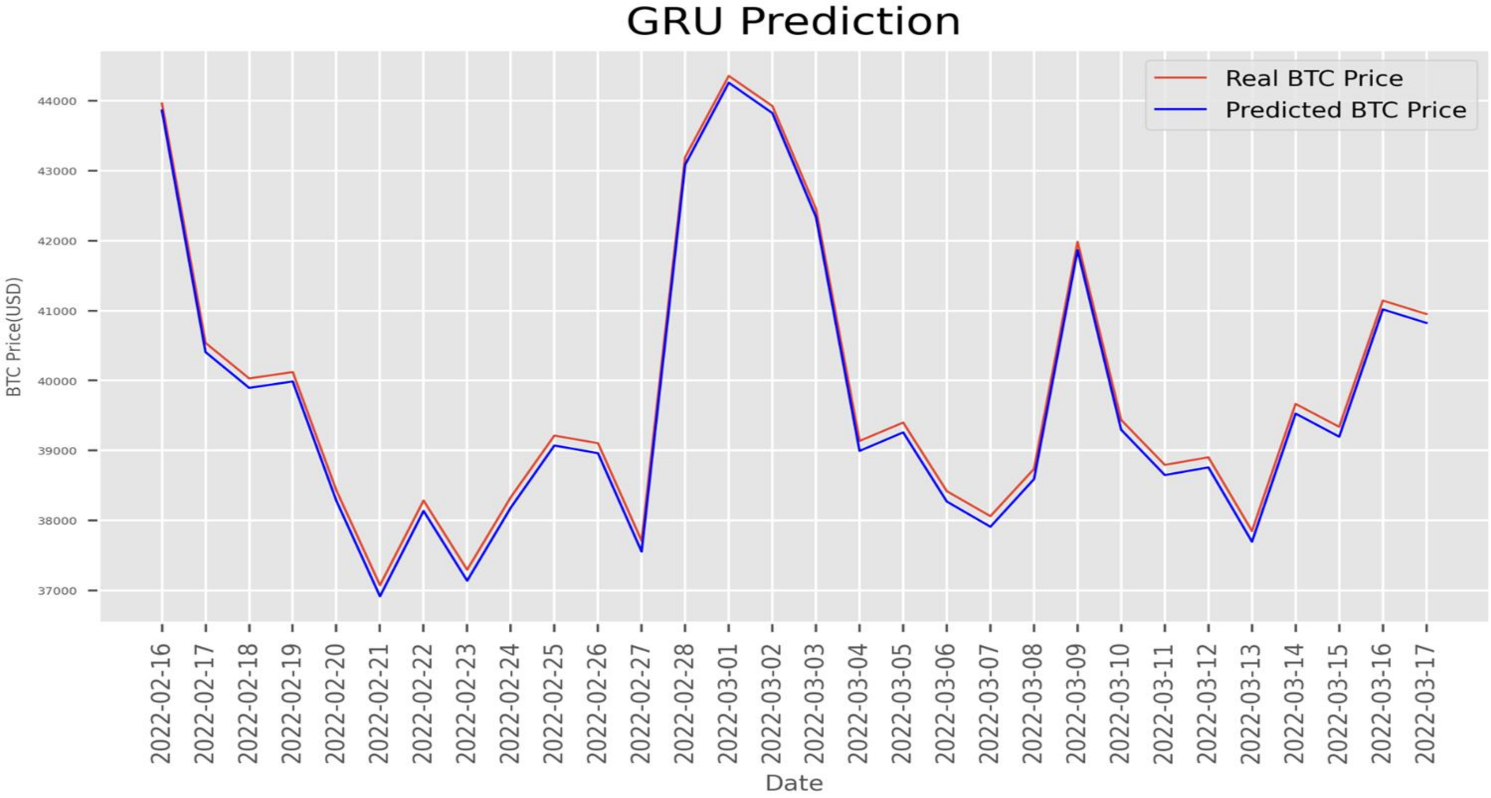
GRU Prediction for Sigmoid Activation Function



GRU Prediction for tanh Activation Function



GRU Prediction for ReLU Activation Function



Comparing Results

Results for the Sigmoid Activation Function

Model	Mean Square Error(MSE)	Root Mean Square Error(RMSE)	Mean Absolute Percentage Error(MAPE)
LSTM	176604	420.242	0.0105585
GRU	8335.09	91.2967	0.00223465
Bidirectional LSTM	121327	348.32	0.0087449

Results for the tanh Activation Function

Model	Mean Square Error(MSE)	Root Mean Square Error(RMSE)	Mean Absolute Percentage Error(MAPE)
LSTM	290067	538.579	0.0135139
GRU	467398	683.665	0.0171949
Bidirectional LSTM	36083.3	189.956	0.00476604

Results for the ReLU Activation Function

Model	Mean Square Error(MSE)	Root Mean Square Error(RMSE)	Mean Absolute Percentage Error(MAPE)
LSTM	42227.7	205.494	0.00516609
GRU	9435.4	97.136	0.00229278
Bidirectional LSTM	186718	432.109	0.0108247

Conclusion

- Since Bitcoin and Blockchain technology was introduced in 2008, it has taken a predominant place in the cryptocurrency domain. There are millions of users around the world, especially in the United States.
- Predicting the price of cryptocurrencies has been a popular topic, from which we can take advantage of the latest technology for investment.
- In this project, we used yahoo finance from the Kaggle website and performed 100 epochs for each model, so in total 300 epochs of information as we implemented three models, to forecast the price of the cryptocurrency.
- Three models were implemented: Long Short-term Memory Model (LSTM), Gated Recurrent Units Model (GRU), and Bidirectional Long Short-term Memory Model (BiLSTM).
- We also tested the efficiency and accuracy of LSTM, BiLSTM, and GRU model in predicting Bitcoin prices. The Bi-Directional LSTM model was found to be a better indicator of trend, which would be more relevant from a trading perspective.

Future Work

- We can take maybe the trends in the market as an additional input and further train the models to improve the accuracy of the prediction
- We can also take into consideration the real world market values, economic situation, competition cryptocurrency price, and supply and demand, and then incorporate these parameters into different suitable neural networks and further predict the value of cryptocurrency

DEMO

Thank You..!!