Leveraging Machine Learning for Cryptocurrency Price Prediction in the Digital Asset Market

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Abstract. The amount of money invested in Bitcoin and cryptocurrencies is growing right now. Thus, forecasting the price of a bitcoin may assist one avoid losing money. Moreover, bitcoin prices change in lockstep with market pricing. In order to estimate the price of the cryptocurrency, this research study produces evaluations based on inquiries connected to bitcoin stock utilizing LSTM (Long Short Term Memory) and GRU(Gated recurrent units). To anticipate the price of Bitcoin based on stock demand, the suggested LSTM model creates a link with Yahoo Finance.

Keywords: Cryptocurrency, Bitcoin, Machine Learning, LSTM (Long Short Term Memory), GRU(Gated recurrent units), ARIMA, MAE

1 Introduction

Recently there has been a growing concern about the increase in road accidents. A cryptocurrency is a digital or virtual money protected by encryption, which makes it almost hard to fake or double- spend [1]. utmost cryptocurrencies reside on decentralized networks employing blockchain technology – a distributed census done by a remote network of computers.

Cryptocurrency is a sort of digital asset that is web-based and distributed over a huge number of computers[2]. This decentralized structure enables them to live beyond the jurisdiction of governments and central agencies. Bitcoin and Ethereum, comparing their features and they secure data on the shared ledger[3].

2 Related Work

Sanjay Roshan R [4] The proposed system accurately predicts cryptocurrency prices using Facebook Prophet, a machine learning algorithm with significant accuracy and speed in time series predictions.

Ramya N [5] proposed system will be able to help the investors or traders on when to infuse their money in cryptocurrencies. For Bitcoin price prediction, ANN beat other models for short term intervals, while LSTM marginally outperformed for long term

intervals.[6]. B.Murali Krishna[7] in his research paper used LSTM mode to explore how bitcoin prices vary and deliver valuable predictions. Shreepriya Wali[8] finds that there are several methodologies/ Algorithms for estimating the price of cryptocurrency but the LSTM algorithm delivers more accuracy in comparison to other algorithms.

In 2022 Rashika Bangroo [9]effectively established the machine learning algorithms that properly anticipated the daily price behavior of major 4 cryptocurrencies including Bitcoin, XRP, Ethereum, and Stellar with 95-97 percent validation accuracy. Monisha Mittal [10] used GRU, a deep learning-based artificial neural network model, accurately predicted bitcoin future prices based on past price information, providing a high risk-free investment option for investors.Mayukh Samaddar [11] compares different Machine learning algorithms, such as neural networks and supervised learning algorithms, that can effectively predict future Bitcoin prices.

In 2021 V. Derbentsev [12] Machine learning ensemble methods, such as Random Forests and Stochastic Gradient Boosting Machine, effectively forecast short-term cryptocurrency prices with accuracy rates within 0.92 - 2.61 %.LSTM models have superior accuracy in predicting cryptocurrency values compared to GRU models. Specifically, GRU models excel in accurately predicting downward stabilization trends in BTC and ETH, while LSTM models are more effective in predicting upward stabilization trends in ETH.[13]

In 2023 Muhammad Shahzeb Khan[14] concluded that The GRU neural network has high efficacy in predicting cryptocurrency prices, indicating significant prospects for further research in this domain.The CNN-GRU model, which combines 1D-CNN with GRU, achieves superior performance compared to other hybrid models in predicting stock prices.[15].

In 2019 M. Rizwan[16] studies that The Gated Recurrent Network model (GRU), a type of deep learning model, demonstrates superior performance in predicting Bitcoin values compared to the commonly used ARIMA method. It achieves a 52% identification accuracy and 8% RMSE (Root Mean Square Error). Yash Sharma[17] work suggests that The LSTM model effectively forecasts stock prices by utilizing important parameters such as RMSE and MAPE, where lower values indicate greater accuracy in predicting future prices.

3 Proposed Model

1.GRU: The Gated Recurrent Unit (GRU) is a kind of recurrent neural network (RNN) that has advantages over long short term memory (LSTM) under some circumstances. While LSTM performs better on datasets with longer sequences, GRU is faster and uses less memory. Cho et al. [17] introduced the concept of a gated recurrent unit (GRU) to enable each recurrent unit to effectively capture dependencies of varying time scales.

2.Long Short Term Memory(LSTM): LSTM networks, commonly referred to as LSTMs, are a specific type of Recurrent Neural Networks (RNNs) that have the ability

to learn and capture long-term dependencies. They were introduced by Hochreiter & Schmidhuber [18]. LSTM recurrent unit is designed to "remember" all of the prior information the network has seen thus far and "forget" any superfluous data. This is achieved by introducing different activation function levels, often known as "gates," for different purposes.The use of LSTM neural network, augmented with an attention layer, exhibits a notable capability to accurately forecast stock values by scrutinizing past data and uncovering intrinsic patterns within the stock market.[19].

The Long Short-Term Memory (LSTM) network is the most widely utilized kind of Recurrent Neural Networks (RNNs). The input and forget gates, along with the memory cell itself, are key components of the long short-term memory (LSTM). The memory cell's internal contents are governed by the input and forget gates[20]. The geometrical properties of RNN and LSTM [21] are similar, however LSTM contains a hidden layer.

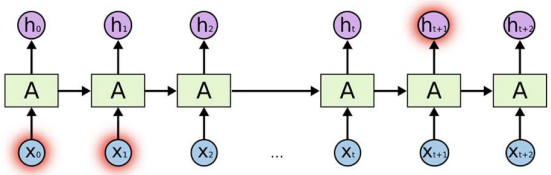

Fig 1: *LSTM Diagram*

Limitations in the RNN architecture that are obvious early on are indicated in Figure 1. In the context of Recurrent Neural Networks (RNNs), the retrieval of relevant data is facilitated by the higher variability seen in the recordings at time steps Xo and X1 compared to those at Xt and Xt+1. Nonetheless, Bengio et al. (1994) stated that RNN finds it difficult to form linkages between data points like Xo, X1, and the whole RNN architecture because new memory is added to or replaces old memory.[22]

A special kind of RNN called LSTM (Long Short Term Memory) has been used in the suggested strategy. Compared to RNN, this technique's primary advantages are its ability to enable long-term dependencies and its accuracy in prediction-making.

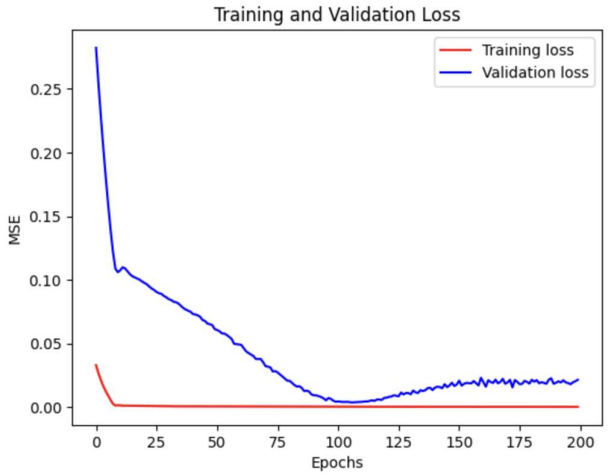

Fig. 3 :*Validation vs Train Loss*

The above graph is plotted using mat plot library of LSTM (LONG SHORT TERM MEMORY) neural network.

The main reason for using "Root Mean Squared Error" (MAE) as an evaluation metric instead of RMSE is because MAE is more interpretable when combined with RMSE and is therefore more difficult to grasp[23]. Therefore, MAE has been utilized as an evaluation metric. Since the concept is designed to be explained to both general audiences and experts, MAE seems like a better option in this regard.[24]

Fig 4: *Performance Analysis on the basis of price*

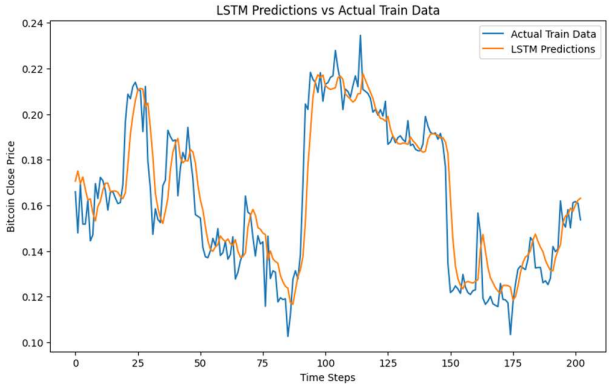

Fig 5 *: Graph of LSTM*

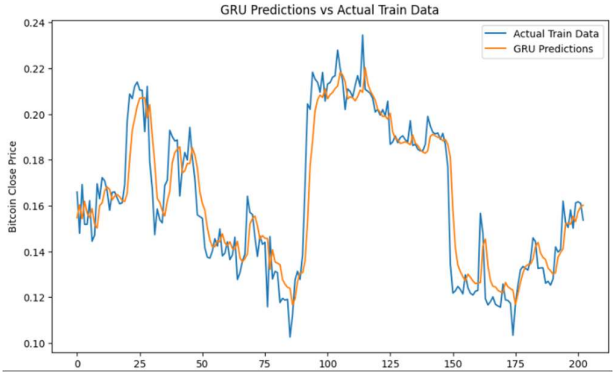

Fig 6 *: Graph of GRU*

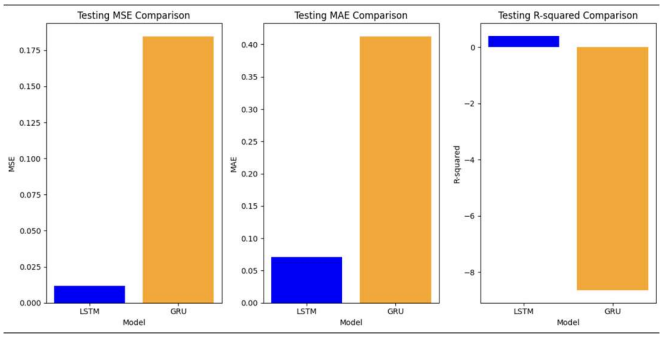

Fig 7: *Performance of ML models with test size 20%*

Approach	MSE	MAE	R-Square
LSTM	**0.01161**	**0.07101**	**0.39260**
GRU	0.18439	0.41210	-8.6390

Table 1. Performance of ML Models with test size 40%

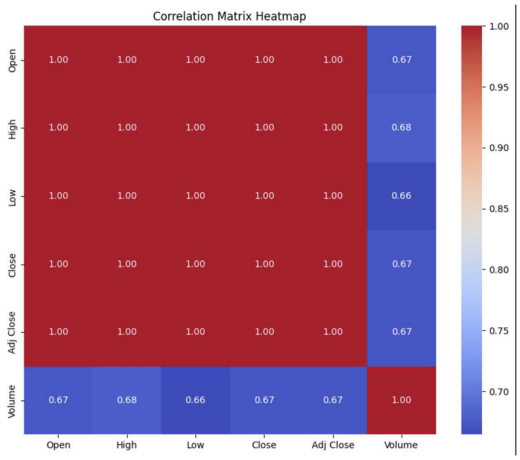

***Fig 8**: Correlation Matrix*

4 Conclusion

The proposed methodology is applicable to the Yahoo Finance bitcoin inventory Request. In this study, we use LSTM and GRU algorithms to forecast the price of bitcoin.In comparison to GRU models, the LSTM model exhibits enhanced efficacy in forecasting Bitcoin values. The Mean Absolute Error (MAE) evaluation measure demonstrates that the LSTM model outperforms the other two models in terms of accuracy.

The design of the Long Short-Term Memory (LSTM) model facilitates efficient learning and retention of long-term relationships, making it highly suitable for tasks related to time series forecasting.

In this investigation, it was shown that the GRU model, albeit classified as a recurrent neural network, had worse performance compared to the LSTM model. This disparity may arise from variations in their architectural designs and their approaches to managing long-term relationships within sequential data.

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