



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 4, April 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

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A Study on Price Prediction of Bitcoin Using Deep Learning

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ABSTRACT: The development of cryptocurrencies has result in fast increase in their usage. The high fluctuation of those currencies is that the motivation to analyse and predict their price within the market. Cryptocurrencies are a digital approach of money within which all transactions are held electronically. it's a soft currency that doesn't exist within the variety of form of notes physically. Here, we are emphasizing the distinction of fiat currency that is decentralized that with none third-party intervention all virtual currency users will get the services. However, obtaining services of those cryptocurrencies impacts on international relations and trade, because of its high price volatility. There are many virtual currencies like bitcoin, ripple, ethereum, ethereum classic, doge coin, binance coin, etc. In our study, we particularly targeted on a popular cryptocurrency, i.e., bitcoin. From many types of virtual currencies, bitcoin contains a nice acceptance by totally different bodies like investors, researchers, traders, and policy-makers. To the most effective of our information, our target is to implement the efficient deep learning-based prediction models specifically long short-term memory (LSTM) and gated recurrent unit (GRU) to handle the value volatility of bitcoin and to get high accuracy. Our study involves comparison these 2 time series deep learning techniques and verified the effectivity in prediction the value of bitcoin.

KEYWORDS : Crypto Currency, Bitcoin, RNN, LSTM, GRU

I. INTRODUCTION

Virtual currencies are a kind of cryptocurrency that is a powerful technical achievement in digital marketing, nevertheless. Virtual currencies go on, and that they couldn't fully replace order or standard currencies. within the current study, we are trying to indicate a motivating new perspective from that read of economics queries surrounding currency governance, the characteristics of money, political economy of financial intermediaries, and also the nature of currency computation.

Virtual currencies become the foremost favorable and used for business enterprise transactions everywhere the world [1, 2]. the recognition is due to its innovative characteristics like transparency, simplicity, and increasing acceptance through the world [3]. within the current time, bitcoin is that the popular flourishing virtual currency. reported to the web site <https://bitcoin.org>, viewed on April 01, 2021, the virtual currency value is about 500 billions of dollars, however it varies from time to time. Bitcoin April be a peer-to-peer cryptocurrency within which all transactions don't seem to be regulated or controlled by any third party. Third-party intervention between customers is not possible. it's extremely volatile value operating 24/7. capitalisation of bitcoin is increased through time to time. within the current time, over five hundred billions of dollars publically traded. due to its open-source nature, clear, transparent, simple, and time is saving that leads all virtual currencies within the world.

Bitcoin is a worldwide and most well liked cryptocurrency, initial introduced in 2008 and exploited as open source in 2009 by a person known as Satoshi Nakamoto, however it became extremely well-liked in 2017. Bitcoin functions as a decentralized moderate of electronic cash, with transactions well-tried and transcribed in a public distributed ledger (blockchain) without any third-party intervention. Transaction blocks contains secure shell rule that is used to connect one another, and blocks are served as a non-editable knowledge that is recorded once the transaction is being held. Then any virtual currency particularly bitcoin has been adopted by the people, and also the virtual currency market trend has been growing up. The popularity of bitcoin is increased within a brief amount of time. different technologies and business companies are joined with bitcoin.

As different researchers assured that once 2015 around 100,000 technology and business companies have started the bitcoin market. a number of the popular companies which are joined with bitcoin are Amazon, Microsoft, Overstock, [1] this paper several works are done to predict time series, further as BTC value. However, any deep learning models



haven't been much used however to predict the BTC price value. Knowing the deep learning models become progressive neural spec that improves prediction accuracy in varied domains as well as time series, we tend to applications of deep learning to predict the BTC value worth. In returning sections, we will explore previous works done on BTC price prediction, discuss deep learning models to predict the time series, and focus on 3 main articles which is able to function foundation of our work.

Primarily, the most challenge of bitcoin rate of exchange is its high rate of price fluctuation. High value volatility implies a particular live should be taken to predict the value of bitcoin accurately. Knowing the statement activity is important to inform regarding the longer term value of bitcoin and build trust further as acceptance throughout the world. Influenced by a range of things, like political system, public relations, and market policy of a country, will confirm economical role of bitcoin and international relation of nations on completely different market methods. Lastly, doesn't have an official road map: few key challenges and developments arising for bitcoin prediction are in consistent, as a result of there's no clear description of the exchange platform on that the transactions associated with buying and selling aren't regulated. the target of our current study is to forecast the bitcoin worth with improved efficiency using deep learning models and minimizing the risks for investors further as policy-makers.

II. LITERATURE SURVEY

In[1] the author has observed that the prediction of cryptocurrencies using machine learning don't seem to be much enough, especially on deep learning models. according to the analysis of 2020, more than a thousand papers are published on this topic. Our literature survey covers work done on bitcoin (BTC) value prediction using completely different techniques, the need, and analysis of recurrent neural network (RNN) and its system design. In [4] this paper used completely different attribute choice mechanisms to get the foremost important features and applied machine learning methods like artificial neural network (ANN), support vector machine (SVM), and recurrent neural network (RNN) furthermore as k-means cluster within the bitcoin price prediction. How ever, one limitation of this study is only a lot of targeted on the investors. Policy-makers should be considered as a significant partner of the system as a result of cryptocurrency will change the dynamics of world economy. In [5] this analysis focuses on computational intelligence technique especially hybrid neuro- fuzzy controller so as to predict the exchange rate of bitcoin. This model used neuro-fuzzy approach and artificial neural networks.

In [5] this paper proposed a deep direct reinforcement learning framework for financial signal illustration and trading. They combined the reinforcement learning, deep learning, and their current deep neural network to get precise prediction results. They used to validate the proposed approach using commodity future markets moreover as stock market data. In this paper author has tried to predict the value of bitcoin using machine learning and investigate the trends of BTC surrounding. they have used twenty-five attributes concerning bitcoin to forecast the daily price variation. In this paper they enforced machine learning algorithms to predict the exchange rate of daily value of high data availability cryptocurrencies like BTC, ripple, and digital cash. They applied RNN and GRNN to induce the prediction rate of high liquidity cryptocurrencies.

III PROPOSED METHODOLOGY

The proposed methodology considers 2 totally different deep learning-based prediction models to forecast daily price of bitcoin by identifying and evaluating relevant features by the model itself. once applying each the models for bitcoin prediction, we are able to verify that model is way a lot of correct for the future fulfillment of our target and select appropriate parameters to get a much better performance. during this work, we've got proposed deep learning mechanisms like Long-Short term memory and Gated recurrent Units that are the latest and efficient techniques for the forecasting of bitcoin price. As bitcoin is that the most popular cryptocurrency, the price volatility issue should be handled among a short period of time.

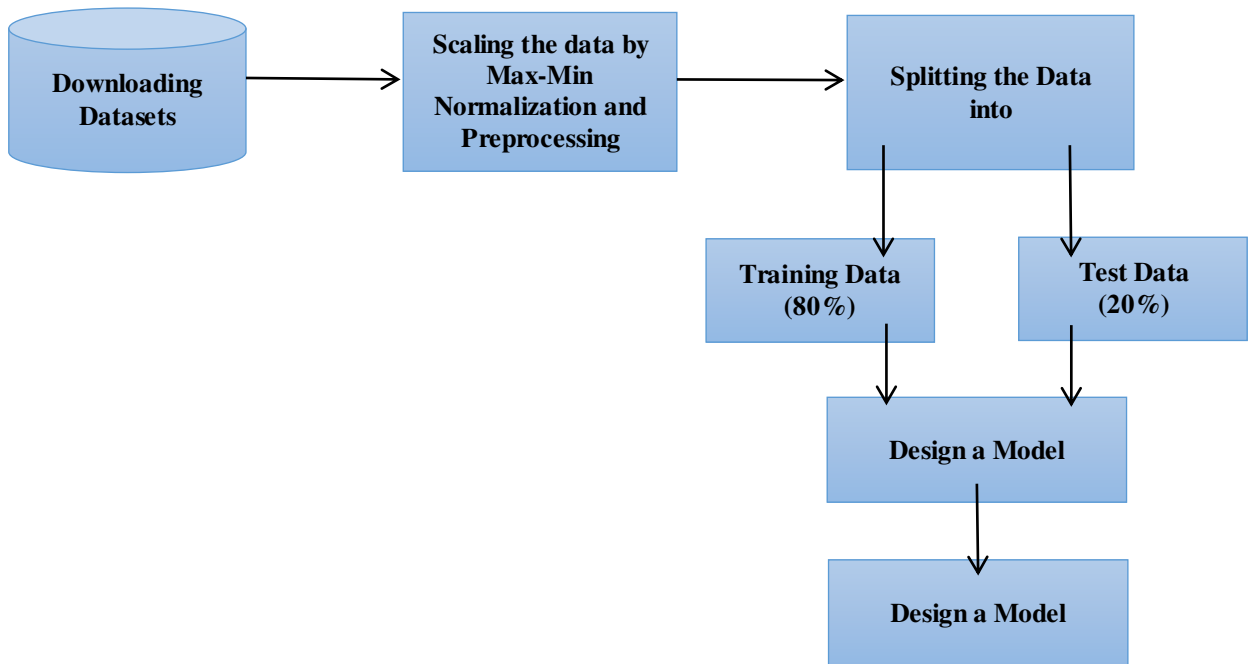


Figure 1:Block diagram of proposed workflow

3.1 RNN (Recurrent Neural Network)

RNN Aprilbe a deep neural network characterized as a recurrent connection between the input and output of its neurons or layers and capable of learning sequences designed to capture temporal contextual data on time series data. they have recently gained popularity in deep learning due to their ability to overcome the limitation of existing neural network architecture wherever it involves learn over long sequences. 2 common RNN networks are LSTM and GRU and presented in the resultant sections.

i. LSTM (Long - Short Term Memory)

LSTMs are expressly designed to avoid the long-term dependencyproblem.Remembering data for long periods of time is much their default behavior, not something they struggle to learn. All recurrent neural networks have the form of a chain of continuation modules of neural network. In customary RNNs, this continuation module can have a very easy structure, like a single tan h layer.

The deep learning LSTM neural network overcome the issues with RNN related to vanishing gradients, by replacing nodes within the RNN with memory cells and gating mechanism. during this regard, it's an attractive deep learning neural architecture mostly on the account of its efficacy in memorizing long- and short-term temporal data at the same time, and it can be viewed an equivalent in LSTM design depicted in Figure. 2.

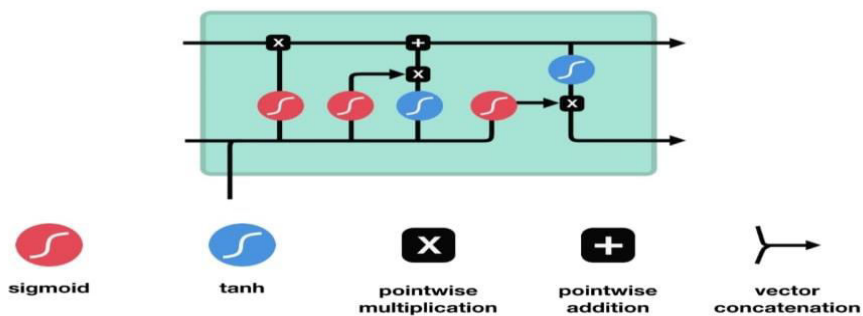


Figure 2:LSTM Architecture

3.1.2 GRU (Gated Recurrent Units)

The GRU is the new generation of recurrent neural networks and is pretty similar to an LSTM. GRU got rid of the cell state and used the hidden state to transfer information. It has also only two gates, a reset gate and update gate as shown in Fig.3.

- **Reset Gate:** The reset gate is another gate that is used to decide how much past information to forget.
- **Update Gate:** The update gate acts similar to the forget and input gate of an LSTM. It decides what information to throw away and what new information to be added.

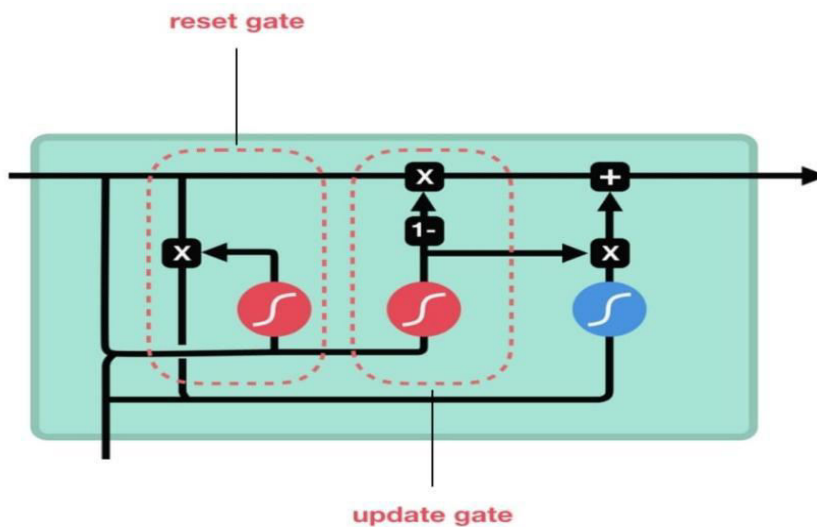


Figure: 3 GRU Architecture

IV. SIMULATION RESULTS AND ANALYSIS

a. Data and Data Set Preparation Method

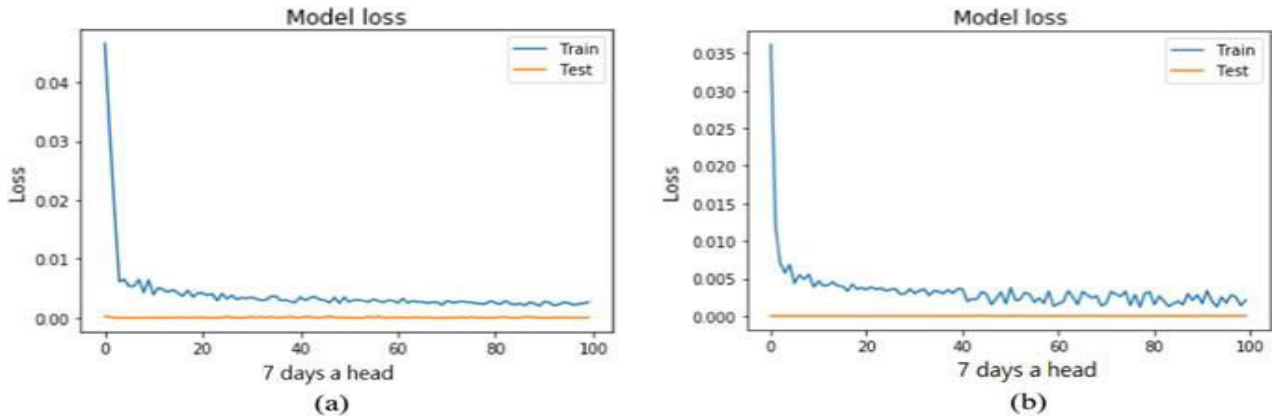
Data preparation is the process of collecting, combining, organizing, and structuring data, and then it can be considered as data visualization, analytics, and data mining with machine learning applications.

Data set preparation is a crucial step in machine learning. The data preparation impacts the accuracy of the predictions. Therefore, in this section, we should explain the details of the data sets. We will expose the methods used to prepare the data in scope of our model.

Table 1 : Comparison of compilation time required by both the deep learning-based models

Model	Compilation time (ms)	Epoch
LSTM	53	100
GRU	5	100

Figure 4: (a)MSE graph obtained using LSTM model (b)MSE graph obtained using GRU model



b. Performance Measures

One of the common ways to compare the time series models is to measure their performance for short- and long-term prediction. To validate the performance of these two models, we have used MAPE (Mean Absolute Percentage Error) and RMSE (Root Mean Square Error) as performance measure. These error values are obtained using LSTM and GRU and listed in Table 2.

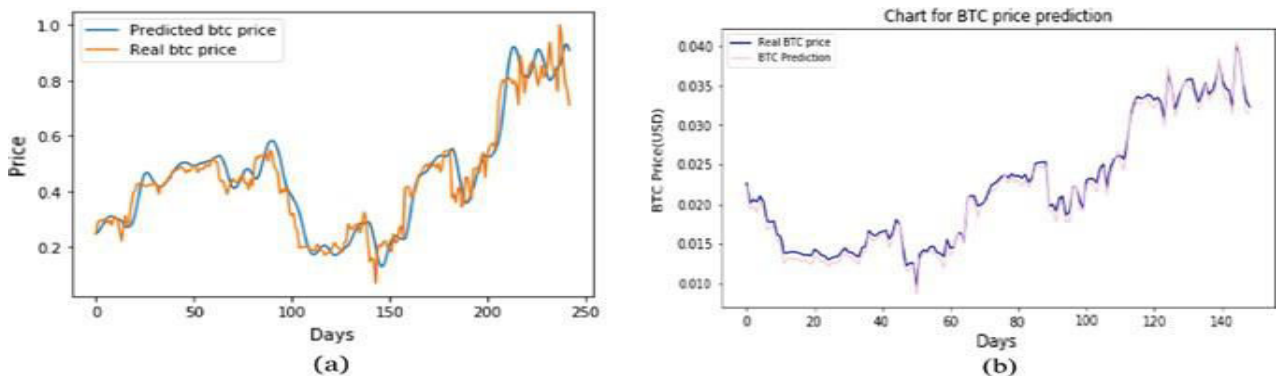


Figure 5:Comparison of actual and predicted bitcoin price during training phase of LSTM (a) and GRU (b)

Table 2 :Comparison of RMSE and MAPE value obtained using LSTM and GRU models

Window size	Number of days ahead	LSTM		GRU	
		RMSE	MAPE	RMSE	MAPE
1	1	0.092	0.068	0.075	0.065
5	3	0.079	0.057	0.065	0.046
7	5	0.081	0.060	0.087	0.062
12	7	0.045	0.030	0.051	0.035
15	15	0.067	0.048	0.067	0.058

From this study, we found that the GRU-based forecasting model is more appropriate in order to forecast time series data of highest price volatility. As we have observed, from Table 2 the prediction accuracy of the LSTM is better at



window size of 12 and days ahead of 7. However, in these window sizes and days ahead, GRU model is more efficient than that of LSTM models and the comparison of actual and predicted bitcoin price obtained.

c. Results

The proposed model of LSTM and GRU price prediction of bitcoin was trained, and also the predictions were carried out for popular cryptocurrency. The accuracy of the projected LSTM as well as GRU model is investigated by finding the root mean sq. error (RMSE) and mean absolute percentage error (MAPE) to determine that model has higher accuracy. We observed from the resultant Table one that LSTM takes more compilation time than GRU model. The MSE value obtained for seven days ahead from each of the models is planned and shown in Fig. 4, and it's clearly observed that GRU is converging faster and steady than the LSTM model. From Fig. 5 a, b, it's discovered that the variation of actual value and predicted price is more in LSTM than the GRU.

V. CONCLUSION AND FUTUREWORK

Bitcoin is the most popular decentralized way of virtual currency which has a great role in the free market economy and avoids the intermediary of another third party between customers. The main objective of our study is to forecast the bitcoin price with the improved efficiency using deep learning models and minimizing the risks for the investors as well as policy-makers. We have implemented two deep learning techniques such as LSTM and GRU as prediction models. The study reveals that the GRU model is the better mechanism for time series crypto currency price prediction and takes lower compilation time. LSTM and GRU models are more capable of recognizing long-term dependencies. In this study, we have only compared to basic deep learning-based models, i.e., LSTM and GRU. However, it needs to investigate further to enhance the accuracy of the deep learning-based prediction models by considering different parameters in addition to the previous one.

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