Crypto Exchange Model Web App and Bitcoin Price Prediction and Analysis using Deep Learning Model

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CERTIFICATE

This is to certify that the project work entitled "**Crypto Exchange Model Web App and Bitcoin Price Prediction and Analysis using Deep Learning Model**" is a bonafide work carried out by **Basavaprasad S Nagur, Hritesh G Raju, Jaiganasheelan B Sakar, KB Naveen** bearing **USN: 1MS18IS023, 1MS18IS038, 1MS18IS040, 1MS18IS041** in partial fulfillment of requirements of Mini-Project (IS65) of Sixth Semester B.E. It is certified that all corrections/suggestions indicated for internal assessment has been incorporated in the report. The project has been approved as it satisfies the academic requirements in respect of project work prescribed by the above said course.

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Abstract

Cryptocurrencies are a digital way of money in which all transactions are held electronically. It is a soft currency which doesn't exist in the form of hard notes physically. Here, we are emphasizing the difference of fiat currency which is decentralized that without any third-party intervention all virtual currency users can get the services. However, getting services of these cryptocurrencies impacts on international relations and trade, due to its high price volatility. There are several virtual currencies such as bitcoin, ripple, Ethereum, Ethereum classic, lite coin, etc. In our study, we especially focused on a popular cryptocurrency, i.e., bitcoin. From many types of virtual currencies, bitcoin has a great acceptance by different bodies such as investors, researchers, traders, and policy-makers. To the best of our knowledge, 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 price volatility of bitcoin and to obtain high accuracy. Our study involves comparing these two time series deep learning techniques and proved the efficacy in forecasting the price of bitcoin.

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Chapter 1

Introduction

Motivation: Creating wealth is the top most priority of every individual. Once when this thought stumbled across me and my teammates mind, we thought of a way to do it. And one of the methods chosen was through investments in crypto market. Entering the crypto market is easy, but taking profit from the market is an art. Hence, we decided to master the strategy of profit making from the crypto market and ventured into the field of Algorithmic trading. We used the deep learning approach using RNN and LSTM techniques and trained the algorithm in such a way that we started to reap consistent profits from the market.

Bitcoin is a worldwide and most popular cryptocurrency, first introduced in 2008 and exploited as open source in 2009 by a person called Satoshi Nakamoto, but it became highly popular in 2017. Bitcoin functions as a decentralized moderate of electronic cash, with transactions proved and transcribed in a public distributed ledger (blockchain) without any third-party intervention. Transaction blocks consist of secure shell algorithm which is used to connect each other, and blocks are served as a non-editable data which is recorded when the transaction is being held. Then any virtual currency especially bitcoin has been adopted by the people, and the virtual currency market trend has been growing up.

The popularity of bitcoin is increased within a short period of time. Different technologies and business companies are joined with bitcoin. As different researchers assured that after 2015 around 100,000 technology and business companies have started the bitcoin market. Some of the popular companies which are joined with bitcoin are Amazon, Microsoft, Overstock, Dell, and others. Many works have been done to predict time series, as well

as BTC value. However, any deep learning models have not been much used yet to predict the BTC price value. Knowing the deep learning models become state-of-the-art neural network architecture that improves prediction accuracy in various domains including time series, we consider applications of deep learning to predict the BTC price value. In coming sections, we will explore previous works done on BTC price prediction, discuss deep learning models to predict the time series, and focus on three main articles which will serve as foundation of our work.

Primarily, the main challenge of bitcoin exchange rate is its high rate of price fluctuation. High price volatility implies a certain measure should be taken to predict the price of bitcoin accurately. Knowing the forecasting activity is necessary to tell about the future price of bitcoin and build trust as well as acceptance throughout the world. Influenced by a variety of factors, such as political system, public relations, and market policy of a country, can determine economical role of bitcoin and international relation of countries on different market strategies. Lastly, doesn't have an official road map: few key challenges and developments coming up for bitcoin prediction

Scope: Bitcoin is a worldwide and most popular cryptocurrency, first introduced in 2008 and exploited as open source in 2009 by a person called Satoshi Nakamoto, but it became highly popular in 2017. Bitcoin functions as a decentralized moderate of electronic cash, with transactions proved and transcribed in a public distributed ledger (blockchain) without any third-party intervention. Transaction blocks consist of secure shell algorithm which is used to connect each other, and blocks are served as a non-editable data which is recorded when the transaction is being held. Then any virtual currency especially bitcoin has been adopted by the people, and the virtual currency market trend has been growing up.
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Our prediction apart from paper trading platform, we used it in real world environment and earned a decent reward. Here is a screen shot.

Fig. 0: Portfolio Screen shot

Objectives: Our objective is clear as crystal. Predicting bitcoin prices and **EARNING PROFITS** 💸.

Proposed Model: The proposed methodology considers two different deep learning-based prediction models to forecast daily price of bitcoin by identifying and evaluating relevant features by the model itself. After applying both the models for bitcoin prediction, we can determine which model is much more accurate for the future fulfilment of our target and select appropriate parameters to obtain a better performance. In this work, we have proposed deep learning mechanisms such as LSTM and GRU which are the latest and efficient techniques for the forecasting of bitcoin price. As bitcoin is the most popular cryptocurrency, the price volatility issue should be handled within a short period of time. The process of prediction starting from collecting data till the forecasting of bitcoin price is depicted in Fig 1.

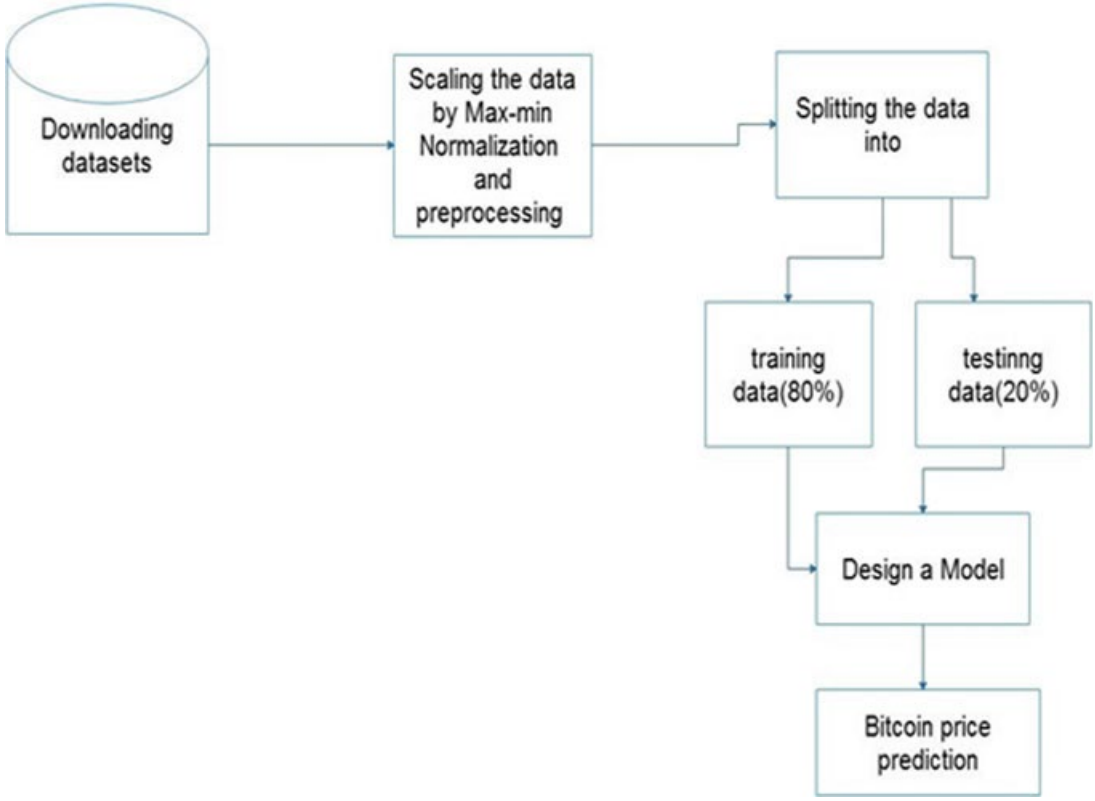

Fig. 1 Block diagram of proposed workflow

RNN

RNN is 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 information along time series data. They have recently gained popularity in deep learning due to their ability to overcome the limitation of existing neural network architecture where it comes to learn over long sequences. Two common RNN networks are LSTM and GRU and presented in the subsequent sections.

LSTM

LSTMs are explicitly designed to avoid the long-term dependency problem. Remembering information for long periods of time is practically their default behaviour, not something they struggle to learn. All recurrent neural networks have the form of a chain of repeating modules of neural network. In standard RNNs, this repeating module will have a very simple structure, such as a single *tan h* layer. The deep learning LSTM neural networks overcome the problems with RNN related to vanishing gradients, by replacing nodes in the RNN with memory cells and gating mechanism. In this regard, it is an attractive deep learning neural architecture mostly on the account of its efficacy in memorizing long- and short-term temporal information simultaneously, and it can be viewed the same in LSTM architecture depicted in Fig. 2.

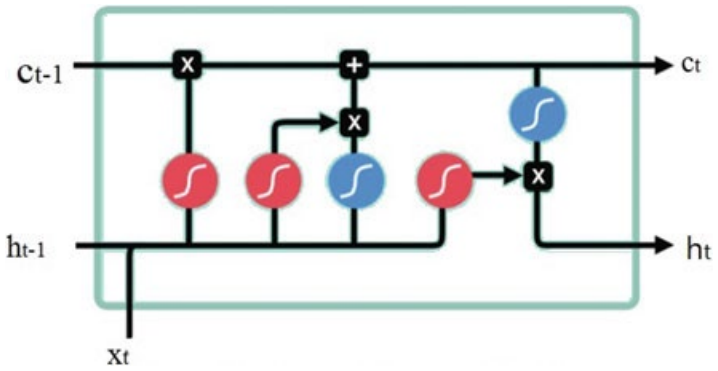

Fig. 2 LSTM architecture

3.1.2 GRU

The GRU is the newer 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.

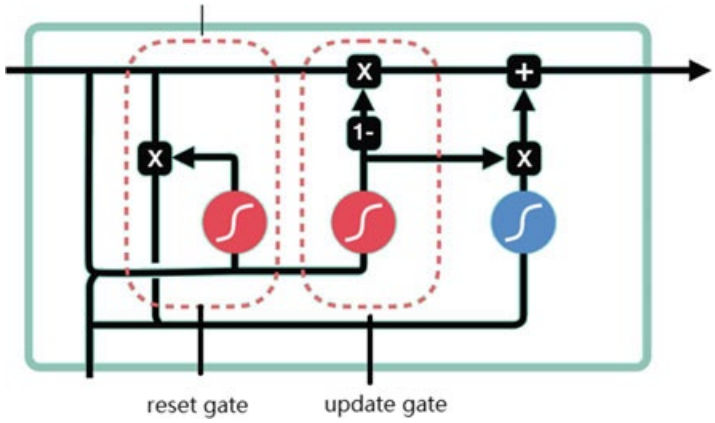

Fig. 3 GRU architecture

Chapter 2

Literature Review

Sean McNally: This paper is concerned with predicting the price of Bitcoin and it achieves this using an implementation of a Bayesian optimized recurrent neural network (RNN) and Long Short Term Memory (LSTM) network and also compared with ARIMA which is a popular time series furcating model but as expected the deep learning model outperforms ARIMA with an accuracy of 52% and an RSME of 8% [2]. Isaac Madan, Shaurya Saluja and Aojia Zhao: The paper is divided into two phases, in the first phase all the models and algorithms are applied to the Bitcoin data to see which of them would perform efficiently and would have fewer errors while classifying. The Binomial Generalized Linear Model (GLM) performs with precision although the Random Forest Model is more accurate it is less precise. SVM increased the rate of errors because of which binomial GLM and Random Forest were selected for the second phase. In the second phase, the GLM and Random Forest time series models are used to find the pros and cons of having a big or a small window to determine which would be more efficient to implement in the automation. The big window would be more efficient to implement because the only drawback is missing a short-term hike or burst in price but the overall gain is much more in a larger window. And the paper also concludes with an observation that the Random Forest model gives higher accuracy when compared to GLM because Random forests use nonparametric trees hence outliers and linear separability of data are not involved [3]. Brandon Ly, Divendra Timaul et al.: This paper is concerned with creating a deep learning model that predicts the price of Bitcoin. The paper uses trial and error method in creating the algorithm. It creates different models all with a different combination of optimizers and activation function to find a combination that would result in a deep learning model that would predict the price of bitcoin. The resulting model produced results that aren't perfectly

accurate but still, the model has predictive capabilities [4]. Fedor Lisovskiy: this paper uses LSTM networks to predict cryptocurrency prices. In this paper, they train two LSTM networks one solely using cryptocurrency price data and the other using both the cryptocurrency price data and sentiment features. After 1000 epochs of training the network trained just with price data had an accuracy of 49.2% and the network with price data and sentiment features had an accuracy of 52% [5]. Bruno Spilak: this paper introduces a Neural Network framework that provides a deep machine learning solution to the price prediction problem. The framework is built with three instances a Multilayer Perceptron (MLP), a simple RNN and an LSTM. This paper also shows how LSTM is useful for trend prediction as it achieved a high prediction accuracy on cryptocurrency data [6]. Matthew Chen, Neha Narwal and Mila Schultz: This paper talks about price prediction in Ethereum and to reach the goal of predicting a number of methods and models were assessed and out of them ARIMA outperformed Random Forest, SVM, Naïve Bayes and RNN this is mainly because the data used was time series data and unstructured with price features that are not likely to repeat.

Chapter 3

System Analysis and Design

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. It is critical to feed accurate data for the problem we want to solve. Data set preparation is a crucial step in machine learning. As we mentioned before, 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. The dataset used for this research consists of daily price value collected from Kaggle website https://www.kaggle.com. The overall data collection period is from January 1, 2014 to February 20, 2018. In this dataset, there are seven attributes such as opening price, high price, low price, and closing prices and also the market cap of publicly traded outstanding shares.

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

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

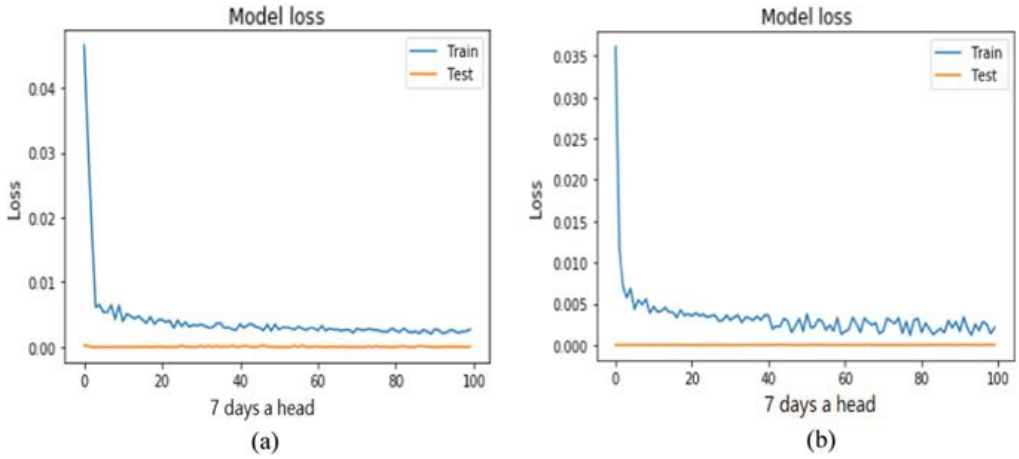

Fig. 4 a MSE graph obtained using LSTM model **b** MSE graph obtained using GRU model

Chapter 4

Modelling and Implementation

As bitcoin is the most popular cryptocurrency, the price volatility issue should be handled within a short period of time. The process of prediction starting from collecting data till the forecasting of bitcoin price is depicted in Fig. 1.

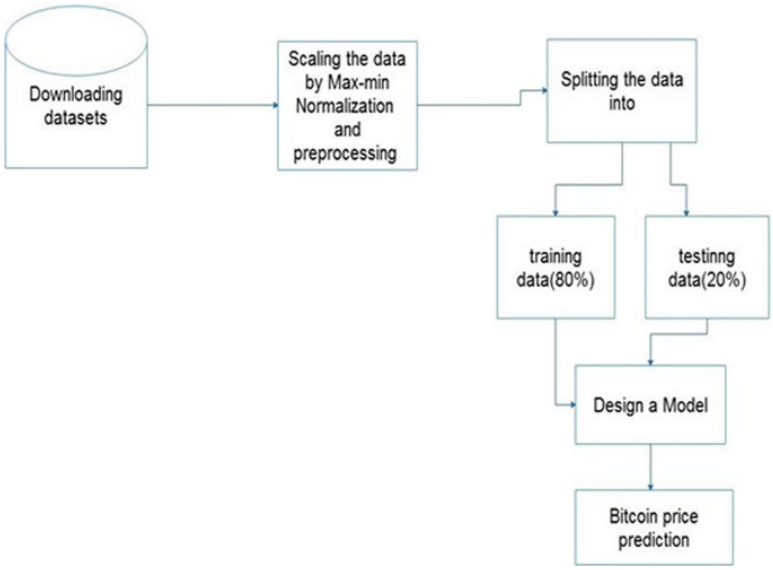

Fig. 1 Block diagram of proposed workflow

Chapter 5

Testing, Result and Discussion

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

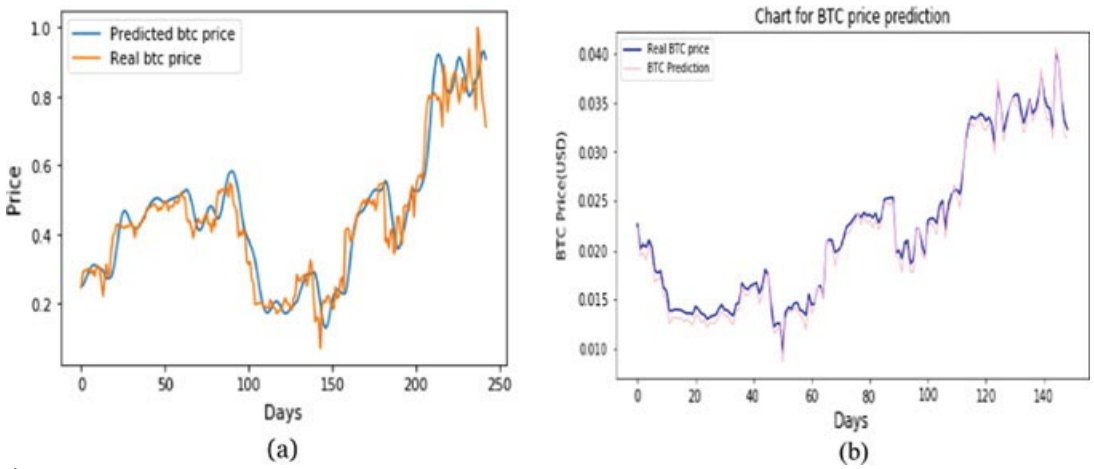

Fig. 5 Comparison of actual and predicted bitcoin price during training phase of LSTM (**a**) and GRU (**b**)

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

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

The proposed model of LSTM and GRU price prediction of bitcoin was trained, and the predictions were carried out for popular cryptocurrency. The accuracy of the proposed LSTM as well as GRU model is investigated by finding the root mean square error (RMSE) and mean absolute percentage error (MAPE) to determine which

model has better accuracy. We observed from the resultant Table 1 that LSTM takes greater compilation time than GRU model.
The MSE value obtained for 7 days ahead from both the models is plotted and shown in Fig. 4, and it is clearly observed that GRU is converging faster and steady than the LSTM model. From Fig. 5a, b, it is discovered that the variation of actual price and predicted price is more in LSTM than the GRU.

Chapter 6

Conclusion and Future work

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 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 cryptocurrency price prediction.

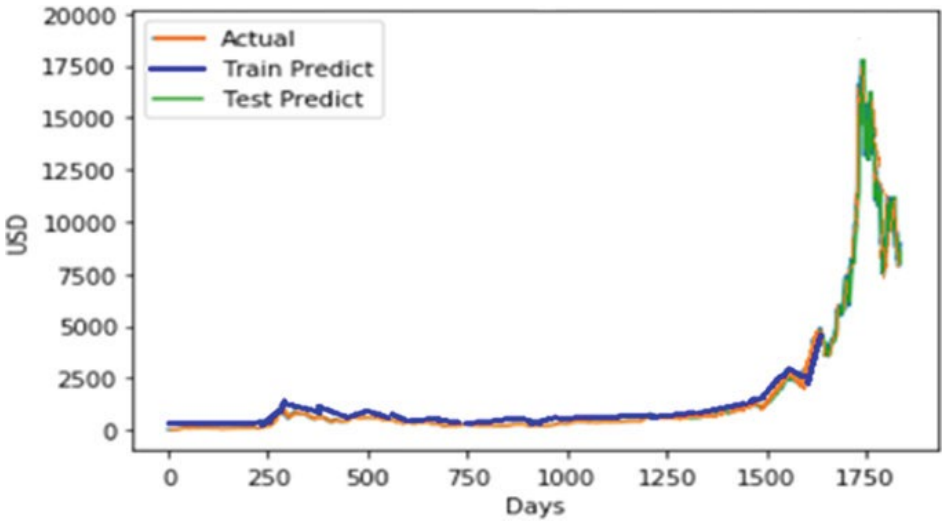

Fig. 6 Actual and predicted bitcoin price in terms of USD obtained using LSTM model

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. Features such as political system, public relations, and market policy of a country can affect and determine the price volatility of cryptocurrency. In our study, we have not considered other cryptocurrencies such as ripple, Ethereum, lite coin, and others. We will enhance the model by applying on these cryptocurrencies so the model becomes a stable one. Fuzzification can also be incorporated at the input layer by considering the degree of participation of each of the features in the prediction.

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