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DESIGN AND IMPLEMENTATION OF CRYPTOCURRENCY PREDICTION MODEL USING GRU ALGORITHM

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ABSTRACT

Blockchain System, also known as Distributed Ledger Technology (DLT), is a technology used for the secure storage and transfer of information. Cryptocurrency is the most widely used blockchain application. Cryptocurrencies are decentralized electronic money that may be used to conduct anonymous and secure transactions over the internet. Cryptocurrency is extremely volatile, uncertain, and unpredictable. The extreme volatility of cryptocurrency values necessitates the development of an accurate model to forecast its value. Bitcoin is the most widely used cryptocurrency. So, we study and compare different approaches for bitcoin price prediction using Mean Square error (MSE) and Root Mean Square Error (RMSE). Experimental results show that the gated recurring unit (GRU) model performs better than popular existing traditional and machine learning models.

Keywords: Blockchain, cyptocurrency, Bitcoin, Predictive model, Neural networks, Gated Recurrent Unit.

INTRODUCTION

Blockchain System, also known as Distributed Ledger Technology (DLT), is a technology used for the secure storage and transfer of information. Cryptocurrencies are gaining popularity in recent years. A cryptocurrency is a digital or virtual money used for digital asset exchange and transfer. It makes use of encryption to safely transfer assets, control, and regulate the addition of cryptocurrencies, and secure transactions. When compared to traditional currencies, which rely on central banking institutions, cryptocurrencies are built on the notion of decentralized control. As a result, a cryptocurrency is used to send money electronically without the involvement of a central authority, such as a bank. Due to its uncontrollable and untraceable character, the cryptocurrency market has grown enormously in a short period of time. Digital currencies are increasingly being used for financial transactions around the world. Cryptocurrencies have grown in popularity since 2017, thanks to their quick market capitalization increase, culminating in revenue of more than $700 billion in 2018. The digital currency market is varied, with a large range of goods available to investors. The first and most well-known cryptocurrency is bitcoin, which was created anonymously by Satoshi Nakamoto and offered it to the public as open-source code in January 2009[1]. Bitcoin has a very high return, but it is also very volatile and has a low correlation to traditional assets. Bitcoin's significant volatility is well-documented. Bitcoin volatility has been predicted using traditional statistical and machine learning methods[2].

The reminder of this paper is as follows. Section 2 describes the basic models used for implementation of bitcoin price prediction, Section 3 shows the design and implementation of bitcoin price prediction using GRU, Section 4 gives the evaluation of the implementation; and, finally, we give concluding remarks and future works in Section 5.

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BASIC MODELS

Examples of traditional time series prediction methods includes univariate auto regressive(AR), univariate moving average(MA) and autoregressive integrated moving average (ARIMA)[3]. Machine-learning prediction techniques for bitcoin price includes linear regression, logistic regression, support vector machine [4], artificial neural network [5], deep learning, reinforcement learning and gradient boosting [6].

The methods presented in [7] are linear regression, random forest and gradient descent. Data from 2016-17 are taken and implemented in the methods, gives the results shown in table 1. The results include Mean Absolute Error Value (MAE), Root Mean Square Error(RMSE) and Accuracy.

TABLE.1 RESULTS OF THE THREE METHODS USED IN [7]

Method	Accuracy	RMSE	MAE
Linear Regression	0.9944	0.0113	0.0060
Random Forest	0.9272	0.0407	0.0115
Gradient Descent	0.9401	0.0369	0.0113

IMPLEMENTATION OF GATED RECURRENT UNIT (GRU)

Gated Recurrent Units (GRUs) are a gating method in Recurrent Neural Networks, first proposed by Kyunghyun Cho et al. in 2014. GRUs are improved version of LSTM Networks, but they are so special and effective than the LSTM Networks. The goal of the GRU is to solve the vanishing gradient problem that is encountered by a standard Recurrent Neural Network. GRU uses 2 gates to solve the vanishing gradient problem, they are Update gate and Reset gate. Basically, these are two vectors which decide what information should be passed to the output. The special thing about them is that they can be trained to keep information from long ago, without washing it through time or remove information which is irrelevant to the prediction.

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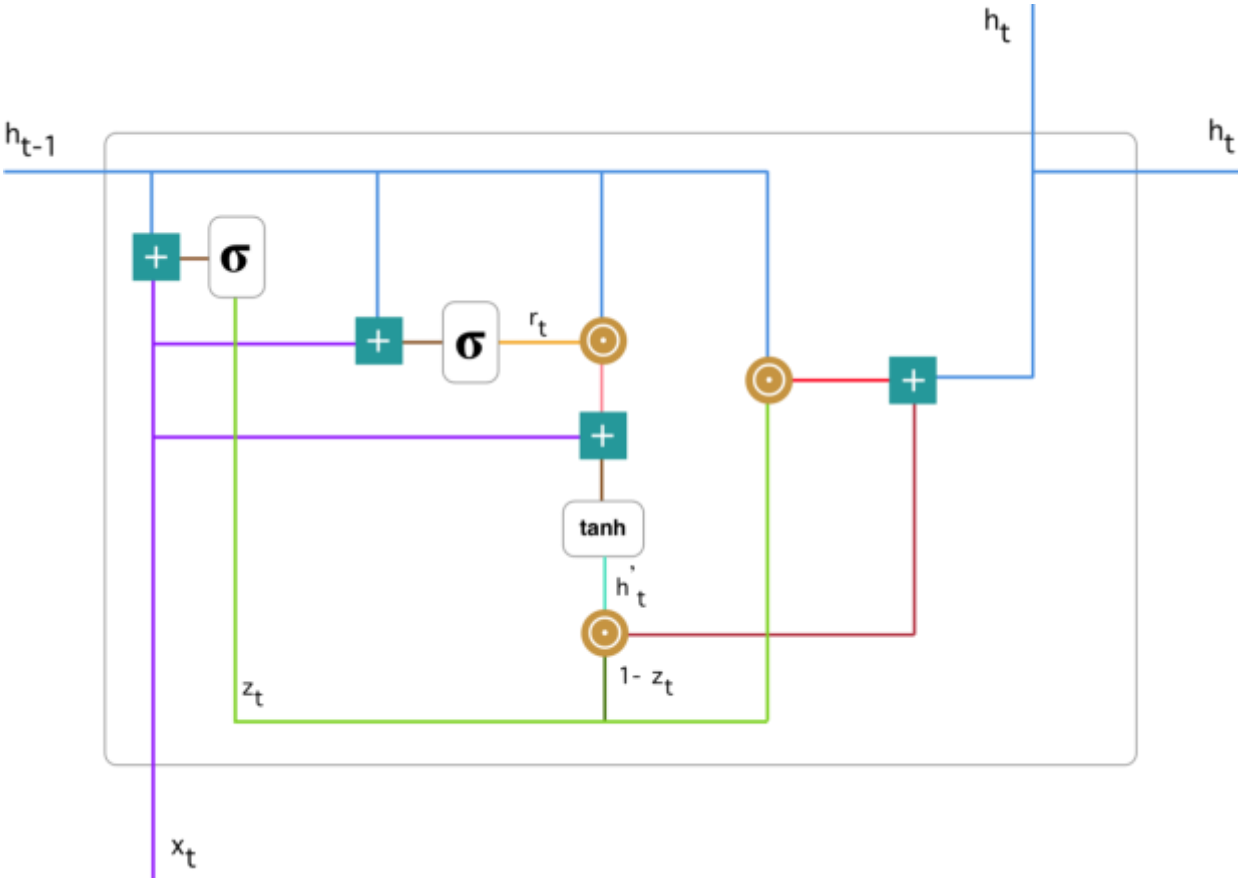

Figure .1 Architecture of Gated Recurrent Unit(GRU)

The mathematical equations of z_t, r_t, h_t' and h_t are given as

$$z_t = \sigma(W^{(z)}x_t + U^{(z)}h_{t-1})$$

$$r_t = \sigma(W^{(r)}x_t + U^{(r)}h_{t-1})$$

$$h_t^{'} = \tanh(Wx_t + r_t \odot Uh_{t-1})$$

$$h_t = z_t \odot h_{t-1} + (1 - z_t) \odot h_t^{'}$$

In this system, the data set is taken from yahoo finance. The data set taken as70 to 30 ratio for training and testing ratio. The data set contains Close, open, date, volume. The dataset having dates of interval a day i.e., day by day. It also performs well in multi-class prediction. By using this model, the accuracy and performance of prediction of Bitcoin price are increased.

MODEL IMPLEMENTATION AND RESULTS

The Data set is taken from yahoo finance, and it contains 7 columns namely date, close, open, low, high, adj close and volume. Where open and close are opening and closing price of the bitcoin and the prices are in dollars. The values are taken per day. The data values are normalized and divided into training set and test set.

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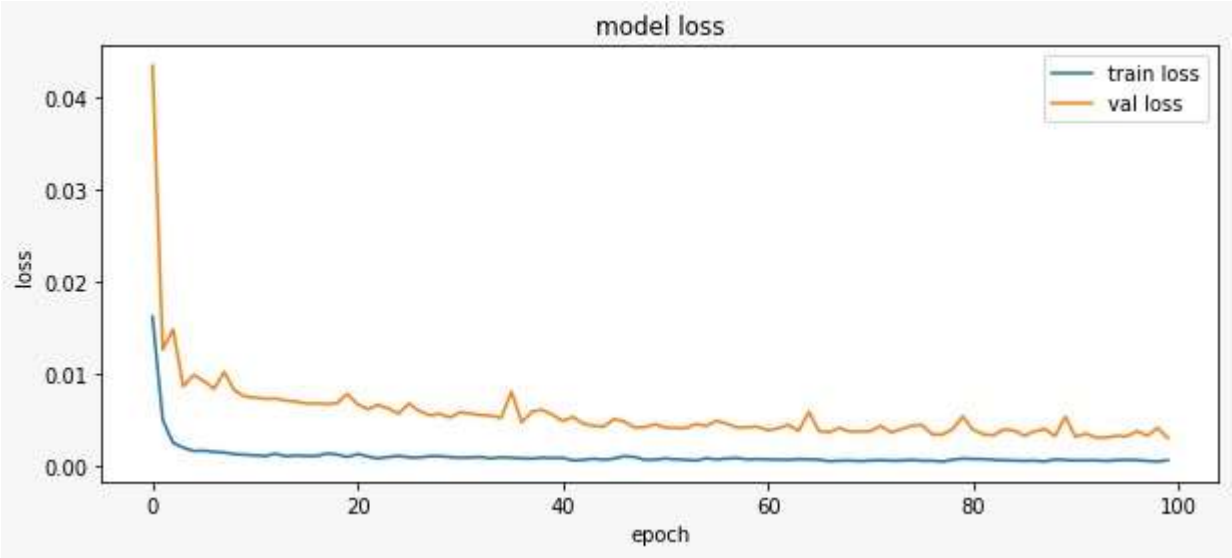
The actual and predicted values of the two models LSTM and GRU are shown in table.2 The MAE and RMSE of the two models are shown in Table.3 . Figure 2 shows the GRU model with recurrent dropout predicted Bitcoin price in the test data, as compared to the original data. The model predicted price is close to the original price compared with LSTM.

Date	Actual Bitcoin Price	Bitcoin price predicted using LSTM	Bitcoin price predicted using GRU
01-02-2022	38743	34747	37897
02-02-2022	36953	34747	37897
03-02-2022	37155	35193	37858
04-02-2022	41501	36084	41884
05-02-2022	41441	39181	42580

Table2. Actual and Predicted values of LSTM and GRU

Parameter	LSTM Model	GRU Model
MAE	2489	1703
RMSE	3125	2221

Table.3 MAE and RMSE of LSTM and GRU



(a)

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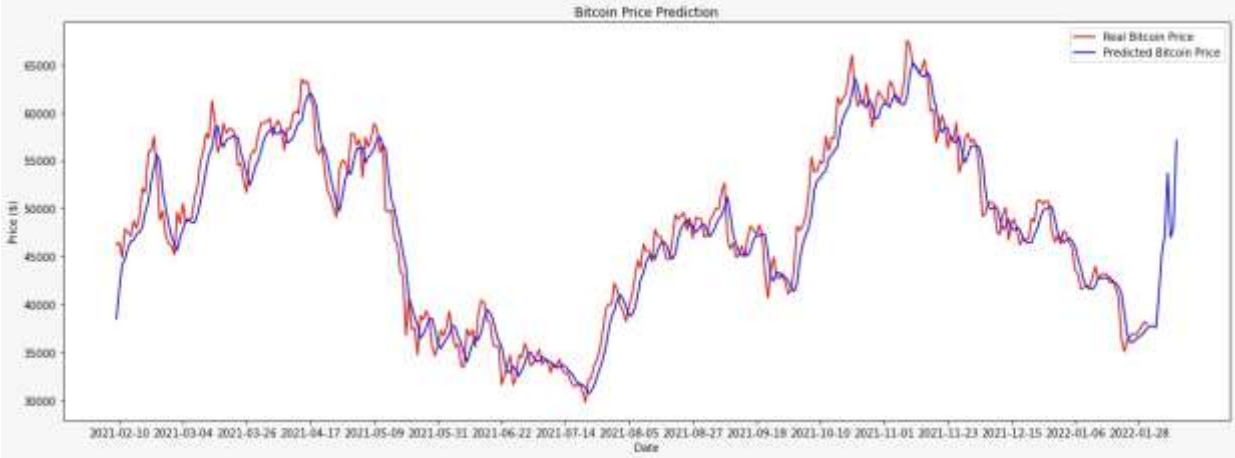
(b)



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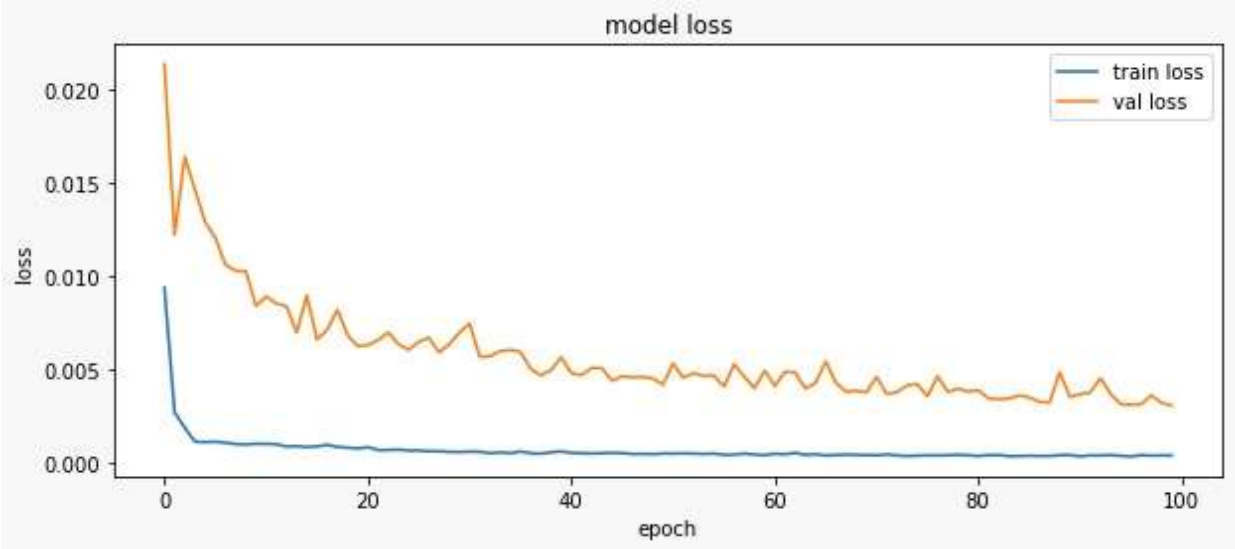

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(e)

(f)

Figure.2 (a) Training and Validation loss of GRU model (b) Comparison of actual and predicted Bitcoin price using GRU Model(c) Bitcoin price predicted by GRU model (d) Training and Validation loss of LSTM model (e) Comparison of actual and predicted Bitcoin price using LSTM model(f) Bitcoin price predicted by LSTM model

CONCLUSION

The performance of the model will increase when compared to previous individual models. We find that the RNNs models provide more accurate predictions for the bitcoin market compared to the other models. As GRU uses less memory, the training and execution will be faster. The RMSE losses (Root Mean Squared Error) are reduced when compared to the individual models. The MAE losses (Mean Absolute Error) are reduced when compared to the individual models.

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