A Comparison of Long Short-Term Memory and Recurrent Neural Network for Novel Cryptocurrency Price Prediction with a View to Improving Accuracy

K. Pavanesh[1], John Justin Thangaraj[2]

[1]Research Scholar, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India, Pin code: 602105.

[2*]Project Guide, Corresponding Author, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences Saveetha University, Chennai, Tamil Nadu, India, Pincode:602105.

ABSTRACT

Aim: The aim of this paper is to achieve better accuracy among the pair of bitcoin prices in USD that can be compared and predicted. The price of crypto data is obtained from the source of Bitcoin Price Index. The task is achieved with fluctuating levels of progress through the implementation of a Recurrent Neural Network organization (RNN) also, a Long Short-Term Memory (LSTM) Network. **Materials and Methods:** LSTM with RNN is a widely used neural network algorithm for predicting bitcoin price as it remembers some important data which is received by the input and helps them to predict price of the next output accurately. It is mostly used in sequential data**.** The LSTM algorithm is applied with sample size = 750 and RNN algorithm is computed with sample size = 750, where evaluated many times with the computation for number of iterations N=10 to predict the accuracy percentage. **Results**: LSTM algorithm has better accuracy (85.60%) when compared to RNN accuracy (76.70%). The statistical significant value (two-tailed) is 0.001 ($p<0.01$). Each group consists of a sample size of 10 and the study parameters include alpha value 0.05, beta value 0.2, and the power value 0.8. The sample size was calculated using G Power value as 80%. **Conclusion:** The study proves that Long Short-Term Memory exhibits better accuracy than Recurrent Neural Network in predicting the Cryptocurrency price prediction.

Keywords: Blockchain, Fluctuating, Long Short-Term Memory, Novel Cryptocurrency, Price Prediction, Recurrent Neural Network.

INTRODUCTION

The Novel cryptocurrency or digital currency was invented in the year of 2008 by Satoshi Nakamoto, who is the founder of Bitcoin. The Novel cryptocurrency started working from the year 2009, the implementation was released as open-source software. Bitcoins are created as a reward for a process known as mining (Shen, n.d.)(Kekez and Kubica 2021; Lu et al. 2021; Caporaso, Whitworth, and Fisk 2021; Li and Pan 2021; Thakur et al. 2021; Makond, Wang, and Wang 2021; Shead, Durand, and Thomas 2021; Chuen 2015; Karanovic, Polychronidou, and Karasavvoglou 2021; Zhang et al. 2021; Wu et al. 2021; Hu et al. 2021; Lv et al. 2021; Juneja et al. 2021; Frizzarin et al. 2021; Mahdi et al. 2021; Lebanov and Paull 2021; Guo et al. 2021)(Shen, n.d.). All the transactions involved in bitcoin are secured and they are maintained by a

decentralized system called a blockchain, which is like an online ledger of bitcoin transactions (Márquez-Luna et al. 2021). Virtual banks are used for storing bitcoins fluctuating. A block in a blockchain refers to an individual record and every block in the blockchain is interconnected with the previous block fluctuating and forms the content of the block (Bhanumathy et al. 2021)(Meijer, n.d.). By default, encryption is provided for every one of the information contained inside a blockchain fluctuating. With the introduction of electronic cash systems in the fluctuating network ("Determinants of Cryptocurrency Price Movements" 2019a)(Kekez and Kubica 2021; Lu et al. 2021; Caporaso, Whitworth, and Fisk 2021; Li and Pan 2021; Thakur et al. 2021; Makond, Wang, and Wang 2021; Shead, Durand, and Thomas 2021; Chuen 2015; Karanovic, Polychronidou, and Karasavvoglou 2021; Zhang et al. 2021; Wu et al. 2021; Hu et al. 2021; Lv et al. 2021; Juneja et al. 2021; Frizzarin et al. 2021; Mahdi et al. 2021; Lebanov and Paull 2021; Guo et al. 2021)("Determinants of Cryptocurrency Price Movements" 2019a), any two interested parties can accomplish transactions securely without the involvement of the third party. Each transaction contains a public key of the receiver and the owner validates using his own private key (Shen, n.d.)(Kekez and Kubica 2021; Lu et al. 2021; Caporaso, Whitworth, and Fisk 2021; Li and Pan 2021; Thakur et al. 2021; Makond, Wang, and Wang 2021; Shead, Durand, and Thomas 2021; Chuen 2015; Karanovic, Polychronidou, and Karasavvoglou 2021; Zhang et al. 2021; Wu et al. 2021; Hu et al. 2021; Lv et al. 2021; Juneja et al. 2021; Frizzarin et al. 2021; Mahdi et al. 2021; Lebanov and Paull 2021; Guo et al. 2021)(Shen, n.d.).

This study is referenced in 87 IEEE xplore publications and 92 ScienceDirect articles. In the world there are more than 6500 digital-currencies in practice, among which bitcoin is one of them, which has more than 5.8 million dynamic clients. This has approximately more than 308 exchanges throughout the world. The analysis of the Bitcoin trend in the market is carried out and learning the important highlights used for price prediction is done by (Arai, Kapoor, and Bhatia 2020), for daily price change is predicted by the ("Determinants of Cryptocurrency Price Movements" 2019b; Rashu, n.d.)(Kekez and Kubica 2021; Lu et al. 2021; Caporaso, Whitworth, and Fisk 2021; Li and Pan 2021; Thakur et al. 2021; Makond, Wang, and Wang 2021; Shead, Durand, and Thomas 2021; Chuen 2015; Karanovic, Polychronidou, and Karasavvoglou 2021; Zhang et al. 2021; Wu et al. 2021; Hu et al. 2021; Lv et al. 2021; Juneja et al. 2021; Frizzarin et al. 2021; Mahdi et al. 2021; Lebanov and Paull 2021; Guo et al. 2021)("Determinants of Cryptocurrency Price Movements" 2019b; Rashu, n.d.) neural network models. The dataset is collected from the website named coin-market cap and live streaming data is considered for the experimental work. In order to significantly benefit the current investment decisions, it takes time to

accurately predict the value of this Novel cryptocurrency namely Bitcoin (Hafner 2019). Precisely, this (Ronaghi et al. 2022)1(Dimpfl and Peter, n.d.; Ametrano, n.d.), lies in the time series prediction category. Bitcoin values are not identified with any event or government along these lines; it is necessary to use machine learning to predict the Novel Cryptocurrency.

(Venu and Appavu 2021; Gudipaneni et al. 2020; Sivasamy, Venugopal, and Espinoza-González 2020; Sathish et al. 2020; Reddy et al. 2020; Sathish and Karthick 2020; Benin et al. 2020; Nalini, Selvaraj, and Kumar 2020).The study for Bitcoin in USD taken from the Coin-market cap of Bitcoin Price Index. Rather than focusing on one specific exchange, the average price from five major Bitcoin exchanges namely Binance, Ku-Coin, Coinbase, Kraken and Bitstamp are considered for computations. If one has to implement trades based on the signals it would be beneficial to focus on just one exchange. This latter step allows for additional performance metrics that would be useful to a trader in the fluctuation of a trading strategy depending on classification accuracy, specificity, sensitivity and precision. The dependent variables for this paper come from the Coin-market cap website, and Blockchain.info. In addition to the closing price, the opening price, daily high and daily low are also included as Blockchain data.

MATERIALS AND METHODS

This research work was performed at Cyber Forensic Laboratory, Saveetha School of Engineering, SIMATS (Saveetha Institute of Medical and Technical Sciences). The proposed work contains two groups such as Group 1 is taken as LSTM and Group 2 as RNN (Márquez-Luna et al. 2021). The LSTM algorithm and RNN algorithm were evaluated for 10 iterations with a sample size of 750.

The datasets were collected from the Kaggle dataset. After dataset collection, the not used and not important content which is wrong in the datasets were removed by pre-processing and data cleaning steps. The sample size was calculated using G Power value as 80%. After cleaning and preprocessing the data, it opens the datasets and related accuracy of both LSTM algorithm and RNN algorithm is calculated. The clustering process of LSTM and RNN algorithms are given below.

Long short term memory (LSTM) - Group 1

Long short-term memory(LSTM) is an artificial recurrent neural network (RNN) architecture used in the field of mission learning. LSTM networks are well-suited to classifying and fluctuating, processing and making predictions based on time series data, since there can be a lack of unknown duration between important events in a time series.

Input: Price prediction
Output: Accuracy

Step 1. Import the data from the required library

Step 2. Give directory of the dataset in the csv extension file

Step 3. Data in indexes with price prediction validation
Step 4. Estimate the sample size, fit the training size and testing size.
Step 5. Select the model as MLP model.
Step 6. Perform Classification algorithm.
Step 7. Use LSTM for the importing and Sequential models.
Step 8. Perform training, then perform testing.
Step 9.Then print the accuracy score

In sample preparation group 1, A final LSTM model is used to make predictions on new data. Using a Keras Long Short-Term Memory (LSTM) Model to predict Crypto pices. LSTMs are very powerful in sequence prediction problems because they're able to store past information. This is important in this case because the previous price of a crypto is crucial in predicting its future price (Márquez-Luna et al. 2021). There is no training dataset and test dataset split and no cross-validation folds done by ((Kekez and Kubica 2021; Lu et al. 2021; Caporaso, Whitworth, and Fisk 2021; Li and Pan 2021; Thakur et al. 2021; Makond, Wang, and Wang 2021; Shead, Durand, and Thomas 2021; Chuen 2015; Karanovic, Polychronidou, and Karasavvoglou 2021; Zhang et al. 2021; Wu et al. 2021; Hu et al. 2021; Lv et al. 2021; Juneja et al. 2021; Frizzarin et al. 2021; Mahdi et al. 2021; Lebanov and Paull 2021; Guo et al. 2021). In this paper, all of the data together into one large training dataset and fitting this model for evaluation is computed. Save the model for later or operational use, then load the model and make predictions on new datasets.

Juypter notebook is used as an implementation for this work. The code was developed in that notebook itself. Hardware configuration of the system consists of 8GB RAM and ROM of 1TB HDD+256 SSD with a processor of 11th gen intel(R) core(i5).

Recurrent Neural Network (RNN) - Group 2

In sample preparation group 2, The RNN is best for all types of sequential data analysis. As in forecasting data changes with time, and as RNN can learn changes in time domain, so it could be a better solution for prediction ((Kekez and Kubica 2021; Lu et al. 2021; Caporaso, Whitworth, and Fisk 2021; Li and Pan 2021; Thakur et al. 2021; Makond, Wang, and Wang 2021; Shead, Durand, and Thomas 2021; Chuen 2015; Karanovic, Polychronidou, and Karasavvoglou 2021; Zhang et al. 2021; Wu et al. 2021; Hu et al. 2021; Lv et al. 2021; Juneja et al. 2021; Frizzarin et al. 2021; Mahdi et al. 2021; Lebanov and Paull 2021; Guo et al. 2021)). 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 (Bhanumathy et al. 2021). They have recently gained popularity in Machine learning due to their ability to overcome the limitation of existing neural network architecture.

Input: Price prediction
Output: Accuracy
Step 1. Import the data from the required library
Step 2. Give directory of the dataset in the csv extension file
Step 3. Data in indexes with price prediction validation

Step 4. Estimate the sample size, fit the training size and testing size.
Step 5. Select the model as MLP model.
Step 6. Perform Classification algorithm.
Step 7. Use RNN for the importing and sequential models.
Step 8. Perform training, then perform testing.
Step 9. Then print the accuracy score

The data set is randomly divided into training (80%) and test (20%). Initially, the data set was divided into two parts as the training set and testing set. Then, the algorithm is tested on the training set and test sets. The training set and testing sets are computed for 10 iterations depending on the size of the test set. Table 1 shows the comparison between the accuracy and cross validation of LSTM and RNN for N=10 iterations. The different parameters for the analysis can be calculated as follows:

Accuracy: - It identifies the number of instances that were correctly classified as shown in the following equation 1.

$$Accuracy = \frac{True\ Positive + True\ Negative}{True\ Positive + True\ Negative + False\ Positive + False\ Negative} \quad (1)$$

Cross Validation is used to calculate which part of prediction data is positive using equation 2.

$$\text{Cross Validation} = \frac{TP}{TP+FP} \quad (2)$$

Software specifications are concerned with the resources that must be installed in the target system in order to get an application to work. The minimal software specifications for this model to work are Windows operating system version 10, Python programming language version 3 or above, IDE PyCharm, Jupyter.

Statistical Analysis

Statistical software used in IBM SPSS with version 26.0 to find the standard deviation, mean deviation, level of significance and also plot the graphs etc. The SPSS statistical software was used in the research for statistical analysis ((Kekez and Kubica 2021; Lu et al. 2021; Caporaso, Whitworth, and Fisk 2021; Li and Pan 2021; Thakur et al. 2021; Makond, Wang, and Wang 2021; Shead, Durand, and Thomas 2021; Chuen 2015; Karanovic, Polychronidou, and Karasavvoglou 2021; Zhang et al. 2021; Wu et al. 2021; Hu et al. 2021; Lv et al. 2021; Juneja et al. 2021; Frizzarin et al. 2021; Mahdi et al. 2021; Lebanov and Paull 2021; Guo et al. 2021). Group statistics and independent sample tests were performed on the experimental results and the graph was built for two graphs with two parameters under the study. The dependent variables are transaction cost, financial fluctuations, liquidity and the independent variables are money laundering, tax and risks of losing key due to inheritance of legal heirs.

RESULTS

Table 1, shows Statistical calculation for independent samples tested between LSTM and RNN. The mean of LSTM is 85.60 and RNN is 76.70. T-Test for comparison for LSTM standard error mean is 1.23 and RNN is 1.18. Table 2, visualizes, Statistical independent samples T-test between LSTM, confidence interval as 95%. The significance value is determined as 0.748 ($p>0.001$) for ratio as shown in Fig.1. A simple Bar Graph for Comparison of Accuracy is shown in Fig,1. It is observed that the Mean ratio of Long Short Term Memory (LSTM) is better than Recurrent Neural Network (RNN).

DISCUSSION

In this research work, Long Short Term Memory and Recurrent Neural Network were evaluated for predicting the price of Bitcoin prediction. It was observed that the Long Short Term Memory has better performance than Recurrent Neural Network. The proposed model achieves the price prediction with accuracy of reducing the loss. The dataset from previous five year prices helped in improving the accuracy percentage. The statistical mean precision value obtained by the Long short term memory is 85.60. For Recurrent Neural Network statistical mean precision value is 76.70. The Long short term memory algorithm yields better accuracy and precision when compared with Recurrent Neural Network algorithm. Although different hypotheses and calculations have been produced at the expectation of the cost of bitcoin (Gadey et al. 2020), the vast majority of them have

been demonstrated that they should have been reexamined for price issues of overfitting and mistakes coming about because of high estimated datasets (Satapathy et al. 2020). The worth of bitcoin in the future can be anticipated utilizing the LSTM calculation. In view of the utilization of this calculation, one can save a huge measure of information (Maglogiannis, Iliadis, and Pimenidis 2021). To address this load of restrictions, it is proposed ensemble enabled Long Short-Term Memory (LSTM) neural organization structures that decipher and anticipate momentarily changing Bitcoin cost (Doty 2021). This paper covers work done on bitcoin (BTC) value expectation utilizing various strategies, (Gullapalli 2018) of the need which is an evaluation of intermittent neural organization (RNN) and its framework design. The similar findings of the LSTM algorithm had achieved better performance than the other algorithms(Ametrano, n.d.). The opposite findings of the study proposed that the LSTM gains more percentage in accuracy than the Recurrent Neural Networks ("Determinants of Cryptocurrency Price Movements" 2019b).

Although this proposed system is faster than Long Term Short Memory in price prediction of Novel cryptocurrency, user recommendation approaches that ignore user opinions exploring different recommendations of crypto analysis in order to improve the performance of the recommendation process. Further, this research works the implicit crypto price prediction analysis within the collaborative filtering in Novel Cryptocurrency (Sharma 2020). The future of the cryptocurrency market will be projected more than triple times by 2030, hitting a valuation of nearly $5 billion. The investors, businesses, and brands can't ignore the rising tide of crypto for a long time, and they must adapt to the evaluation of changes.

CONCLUSION

In this research work, prediction of accuracy percentage for user Cryptocurrency price prediction LSTM to have enhanced accuracy (85.60%) when compared to RNN algorithm (76.70%). Cryptocurrency prices which conflict to show the prediction of prices. The results reveal the price of the crypto from high to low from all the observations.

DECLARATIONS

Conflict of Interest

No conflict of interest in this manuscript.

Author Contribution

Author KP was involved in data collection, data analysis, algorithm framing, implementation and manuscript writing. Author CMV was involved in designing the work flow, guidance and review of manuscript.

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TABLES AND FIGURES

Table 1. Statistical calculation for independent samples tested between Long Short Term Memory and Recurrent Neural Network algorithm. The mean of Long Short Term Memory is 85.60 and Recurrent Neural Network is 76.70. T-Test for comparison for Long Short Term Memory standard error mean is 1.231 and Recurrent Neural Network is 1.184

GROUP	N	Mean(%)	Std.Deviation	Std.Error Mean
LSTM	10	85.60	3.893	1.231
RNN	10	76.70	3.743	1.184

Table 2. Statistical independent samples T-test between Long Short Term Memory, confidence interval as 30. The significance value is determined as 0.001 ($p < 0.01$) for 2-tailed test

		Levene's Test for Equality of Variance		T-test for Equality of Means						
	Equal Variance	F	Sig	t	df	Sig(2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Accuracy	**Equal variances Assumed**	0.007	0.748	6.968	18.000	0.001	11.900	1.708	8.312	15.488
	Equal variances Not Assumed			6.968	17.972	0.001	11.900	1.708	8.312	15.488

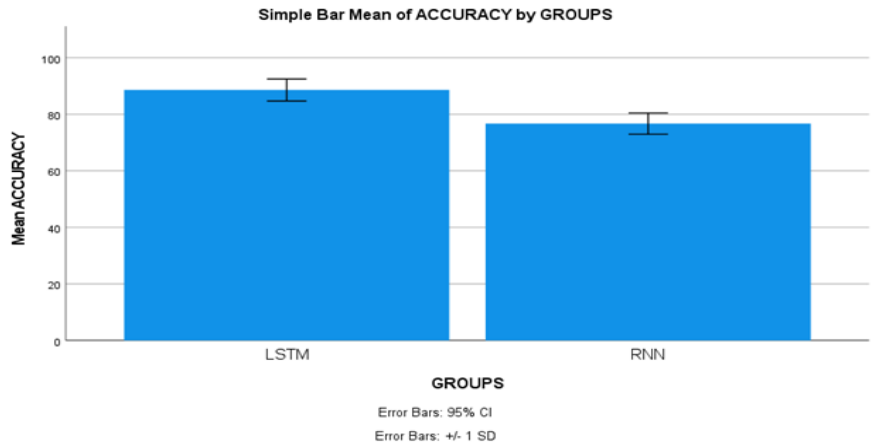

Fig. 1. Bar graph analysis of novel LSTM algorithm and RNN algorithm. Graphical representation shows the mean accuracy of 85.6% and 76.7% for the proposed algorithm LSTM and RNN respectively. X-axis : LSTM , RNN, Y-axis : Mean precision ± 1 SD.