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Deep Learning Based Bitcoin Price Forecasing Using LSTM

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Abstract: Bitcoin is one of the most popular and valuable cryptocurrency in the current financial market, attracting traders for investment and thereby opening new research opportunities for researchers. Countless research works have been performed on Bitcoin price prediction with different machine learning prediction algorithms. For the research: relevant features are taken from the dataset having strong correlation with Bitcoin prices and random data chunks are then selected to train and test the model.
The random data which has been selected for model training, may cause unfitting outcomes thus reducing the price prediction accuracy.
Here, a proper method to train a prediction model is being scrutinised. The proposed methodology is then applied to train a simple Long Short Term Memory (LSTM) model to predict the bitcoin price for the upcoming 30 days. When the LSTM model is trained with a suitable data chunk, thus identified, sustainable results are found for the prediction. In the end of this paper, the work culminates with future improvements.
Keywords: Bitcoin, Cryptocurrency, Machine Learning, Price Prediction, Deep Learning, LSTM (Long Short Term Memory)

I. INTRODUCTION

Instead of any direct human investments, generating profit with the help of algorithms is a common practice in the stock market. Many case studies have been performed to reach the conclusion that mathematical models warrant better results than humans. Bitcoins are an eye catching initiative in the fields of cryptography, economics, and computer sciences, as such currencies have a special character which is gained when integrating currency units with cryptographic technology. Due to the fact that cryptocurrency has a minute history, when compared to the stock market, new and unexplored territories are thus being scouted. Structurally, both the stock market and the cryptocurrency price data are having characteristics such as time series data, but high volatility is routinely present in the latter, with heavy wavering in the prices.

A cryptocurrency market differs from a traditional stock market in the respect that the former has a lot of new features. It is required to apply new techniques for prediction suitable for the cryptocurrency market. Fewer studies have been conducted on cryptocurrency price prediction when compared to the stock market. In this paper, we are predicting the Bitcoin price trend using a Long Short-Term Memory (LSTM) model.

Our model is aimed to predict the next thirty days price of Bitcoin.To develop a model which can help us to predict the price of the crypto currency used (in this case: Bitcoin), with low error rate and a high precision of accuracy. The model will not tell the future, but it might forecast the general trend and the direction to expect the prices to move.While using this model, first, the dataset of the crypto currency used needs to be uploaded.

This, usually, contains the various features that the prediction model has to depend on. For e.g. average block size, total number of Bitcoins mined, day high & day low (highest and lowest values of different days), number of transactions, trade volume, etc. Then, secondly, the dataset will be applied on the regression model to obtain the predicted price.What the model proposes to do is that, first the data on Bitcoin Price fluctuations is gathered, of the past couple of years, from the internet. Then, after the process of data acquisition, the database should be organised.

The database is divided into various spreadsheet files, which are then uploaded to the software mainly used for data processing. The necessary calculations, like classification and regression, are then done. And finally the results are evaluated in terms of accuracy, error rates involved.

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II. LITERATURE SURVEY

The literature survey was carried out to find various papers published in international journals related to various Bitcoin price prediction algorithms, and associate the best algorithm for the same.

Ref No.	Author	Title	Methodology	Year
1	Krishna Pal Sharma, ShivamKumar Singh, Ankur Choudhary, Himanshu Goel	"Price Prediction of Bitcoin using Social media activities and past trends"	Analysis of informative trends in social groups, media and extract information to improve prediction accuracy of crypto currency price fluctuations.	2022
2	Muhammad Husaini, Amgad Muneer, Shakirah Mohd Taib	"Crypto currency price prediction using LSTM with Twitter sentiment analysis"	Sentiment analysis of twitter used for listing the earlier price fluctuated data and added to LSTM predicted price inorder to forecast future prices.	2022
3	Soudeh Javadi, Paras M Kathuria, Nisha S Gowda, Talha Ali Khan	"Bitcoin price prediction using LSTM"	Model was implemented using last year data to train and test the data set because of fluctuations of price and resulted with acceptable accuracy using the LSTM with Recurrent neural network.	2022
4	Tamara zuvela, Sara Lazarevic, Sofia Djordjevic, Marko Arsenovic	"Crypto currency price prediction using Deep Learning"	It relied on LSTM to predict value for next N Daysbased on previous days value and then a trained model recieves values for backward and predicts Future desired day and they developed a Front end page application.	2022
5	Chandra Sekhar, M Padmaja, Aditya, Biswajit Sarangi,	"Prediction of Crypto currency using LSTM and XG BOOST"	XG Boost Algorithm used to predict prices of crypto currency better and found a better mean value deviation error tyan LSTM	2022
6	A.Rana, R.Kachchhi, J. Baradia, V. Shelke	"Stock Market Prediction Using Deep Learning"	while implementing a highly accurate LSTM model, have conducted their research on a large scale, thus making their methodology a bit complex.	2021
7	T. Awoke, M. Rout, L. Mohanty, S. C. Satapathy	"Bitcoin Price Prediction and Analysis Using Deep Learning Models"	They have considered basic deep learning models like GRU and LSTM. However, their research lacks further investigation to enhance the model accuracy by considering different parameters.	2021
8	Q. Guo, S. Lei, Q. Ye, Z. Fang	"MRC-LSTM: A Hybrid Approach of Multi-scale Residual CNN and LSTM to Predict Bitcoin Price"	Used a hybrid method consisting of multi-scale residual blocks and an LSTM network to predict Bitcoin price. Although, their work does not include comprehensive metrics which measure the investor's attention to more timely detection of bitcoin market volatility, therefore resulting in a less accurate prediction.	2021
9	Akshay Bhat, Neha Mangla, Ganesh Avarbratha, Narayana Bhat	"Bitcoin Price Prediction Using Machine Learning"	Compared four different price prediction models: Recurrent Neural Networks (RNN), Logistic Regression, Support Vector Machine, and Auto Regressive Integrated Moving Average (ARIMA). Their major findings are that- ARIMA performs poorly for predictions extending beyond the next day. Their RNN model can accurately predict price fluctuations for up to six days. And the logistic regression model can give accurate results only if a separable hyperplane exists.	2019
10	T. Phaladisailoed, T. Numnoda,	"Machine Learning Models Comparison for Bitcoin Price Prediction"	They obtained highly accurate results on implementing their prediction Gated Recurrent Unit (GRU) model. However, their prototype has a large time complexity. Thus, complicating the expected results in this ever-changing environment. Additionally, the selected features aren't enough to predict the Bitcoin prices; as various factors like social media, policies, and laws that each country announces to deal with digital currency.	2018

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III. PROPOSED METHODOLOGY

Firstly, we collect the data set from the online source: Yahoo finance. The data set represents the Bitcoin price in United States Dollars (USD). The dataset includes all the information about bitcoin prices from 23rd October, 2014 to 5th January, 2022.

The second step involves filtering and cleaning the data set. This involves removing all the incomplete data from the rows. It also involves filtering out unnecessary features present in the data collected. For our model, we will only use the columns labelled : Date, Price, Open, High, and Low, as shown in Table below :

Sr. No.	Variable Name	Variable Description	Data Type
1	Time	Date and time of observation	Date
2	Volume	Sum total of trades taking place	Number
3	Open	Opening price on the given day	Number
4	High	Highest price on the given day	Number
5	Low	Lowest price on the given day	Number
6	Close	Closing price on a given day	Number

The next step is training, followed by testing the dataset. We train our model, using the algorithm and the features taken into account to assist our model, to predict the future price of the crypto currency. Moving on to the testing part, we test the data to measure the accuracy of the algorithm that our model is using to predict the price of the Bitcoin.

Finally after the processes of training with the help of the data set features and testing, we evaluate the accuracy of our model. We compare the predicted price of the crypto currency, at a given time period with the real world Bitcoin price at that particular period of time, and evaluate the accuracy and efficiency of our model.

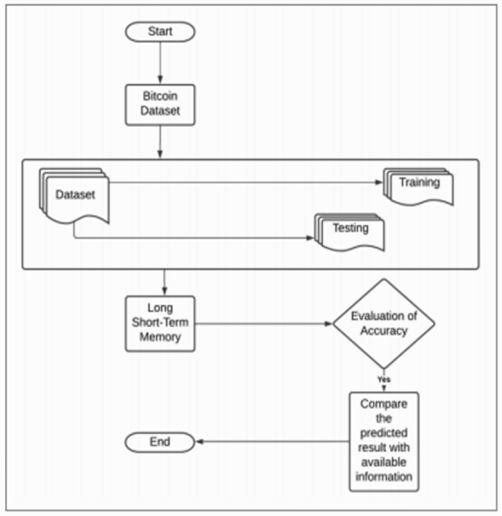

Fig.1 System Architecture

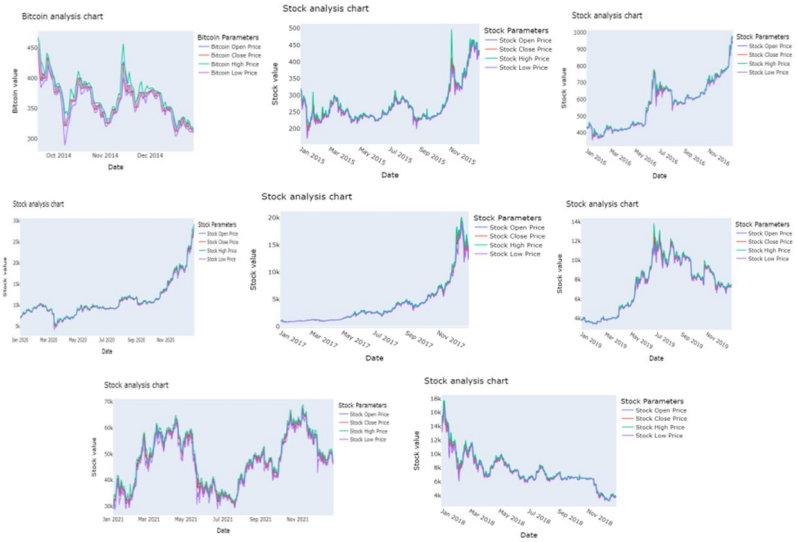

Fig.2 Bitcoin Stock Analysis 2014 - 2021

IV. IMPLEMENTATION

1) *Lag Plots :* After the dataset has been filtered and cleaned, we need to generate a lag plot of the time series data. A lag in a time series data defines how much a data point is falling behind in time from another data point. Lag plots are put into use to analyse and find out whether the time series data follows any pattern
2) *Train-Test Split :* Now, the next step that is needed to be performed is train_x0002_test split. For our model, we will be considering sixty numbers of data samples for implementing the testing, and the rest of the re-sampled data as the training sample.

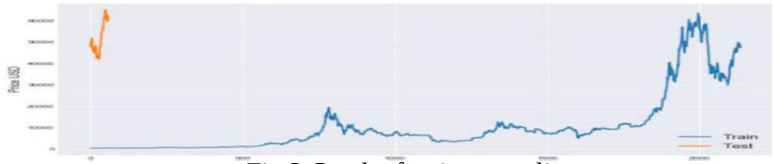

Fig.3 Graph of train-test splits

3) *Scaling :* we are going to scale the data, as we need the training and the test set to be scaled. One important point that needs to be mentioned is that the scaling should be performed after the train-test split has been performed, because scaling before the train-test split would introduce data leakage from the test set to the training set.
4) *Data Generator :* We frame our model, using a "lookback" period to take a window of the last five days of data to predict the data of the current day. A new function is defined, which will split the input sequence into windows of data appropriate for fitting a LSTM model.
5) *Restructuring Input into a shape of 3D Tensor :* For LSTM, we have to reshape the input data into the shape of a three dimensional Tensor of samples, timesteps, and features. Samples are the amount of data points that we are having.Thus, timesteps is equivalent to the number of time steps we are to be running our RNN. Finally, features include the amount of features in every timestep.
6) *Generating the epochs :* From the callback module of the keras library we are importing the callbacks: ModelCheckpoint, and EarlyStopping. These callbacks are used as a best practice to save the model at various checkpoints or after each epoch.
7) *LSTM Prediction using testX and plotting line graph against actual testY :* Due to scaling done earlier with the help of MinMaxScaler, the predicted scale will be between zero and one. We have to transfer this scale to the original data scale. Thus, we are going to use inverse transformation to scale back the data to the original presentation.

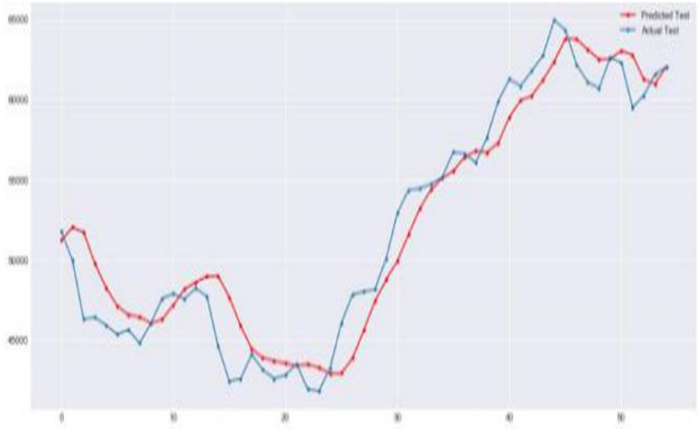

Fig.4 Plot of predicted test and actual test data

8) *LSTM Prediction using trainX and plotting line graph against actual trainY:* This step is similar to the previous step, except the fact that we are performing inverse transformations on the train data.

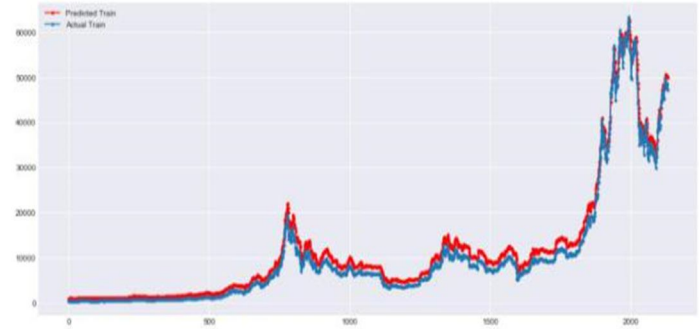

Fig.5 Plot of predicted train and actual train data

9) *Root Mean Square Error:* Finally, we will be generating the root mean square error (RMSE) for both the test and the train data. RMSE is the measure of how well a regression line will fit the data points. The RMSE loss achieved for train data is much lesser compared to the RMSE loss for test data, because the whole training and fit function was run on the training data set.

A. *Results*

Fig.6 Plot of Original vs Predicted Close Price

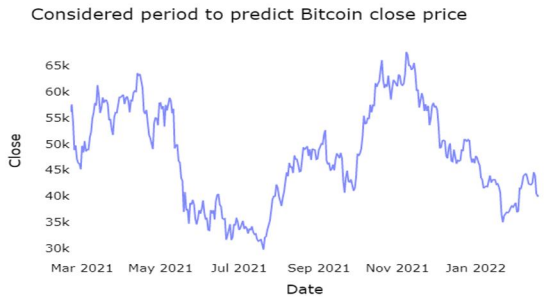

Fig.7 Plot of predicted bitcoin close price

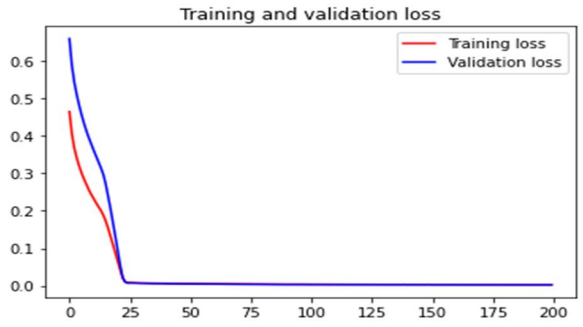

Fig.8 Plot of training and validation loss

Now, we have a trained LSTM model on historical data, we are generating predictions on Bitcoin prices for the future 30 days. From the dataset that we use for the model, the Bitcoin price on 5th January 2022 is the last historical price that we are having. Thus now, we are going beyond that date to predict the Bitcoin prices for the next 30 days.

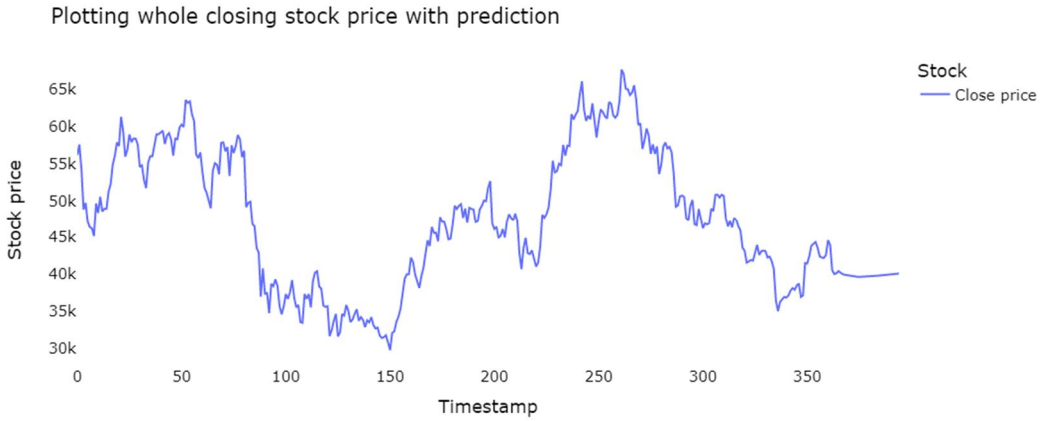

Fig.9 Plot of predicted whole closing stock price

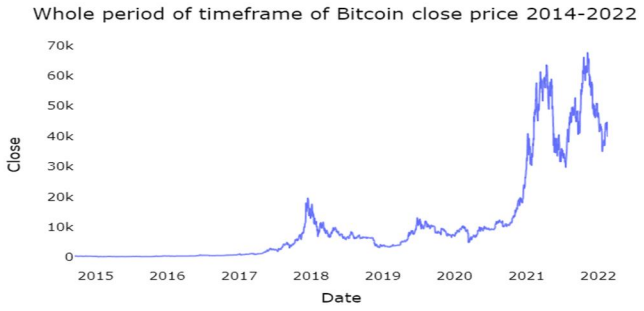

Fig.10 Plot of predicted bitcoin close price 2014 - 2022

Fig.11 Plot of predicted price for future 30 days

B. Merits

The LSTM model helps in:

1) Predicting future values
2) Increased number of timesteps
3) Greater accuracy for forecasting
4) Better Decision making for business

V. CONCLUSION

LSTM based Recurrent neural networks are the most powerful approach for learning from sequential data, whereas the time series are only a special case. The potential of LSTM based models is fully revealed when learning from massive datasets where we can detect complex patterns. The LSTM model, implemented here is a model that takes into consideration the features that affect the Bitcoin price. This model is accurate when predicting the future prices. However, to increase the efficiency of the model, more Bitcoin price features need to be taken into consideration. I recommend using Yahoo Finance for the source of datasets, since information present in this website holds a high degree of authenticity. In my future work, I would include in-depth scrutinisation on the topic of LSTM, and deep learning at large. Such fact-findings would be beneficial for forecasting the prices of cryptocurrencies with the help of LSTM's in the future.

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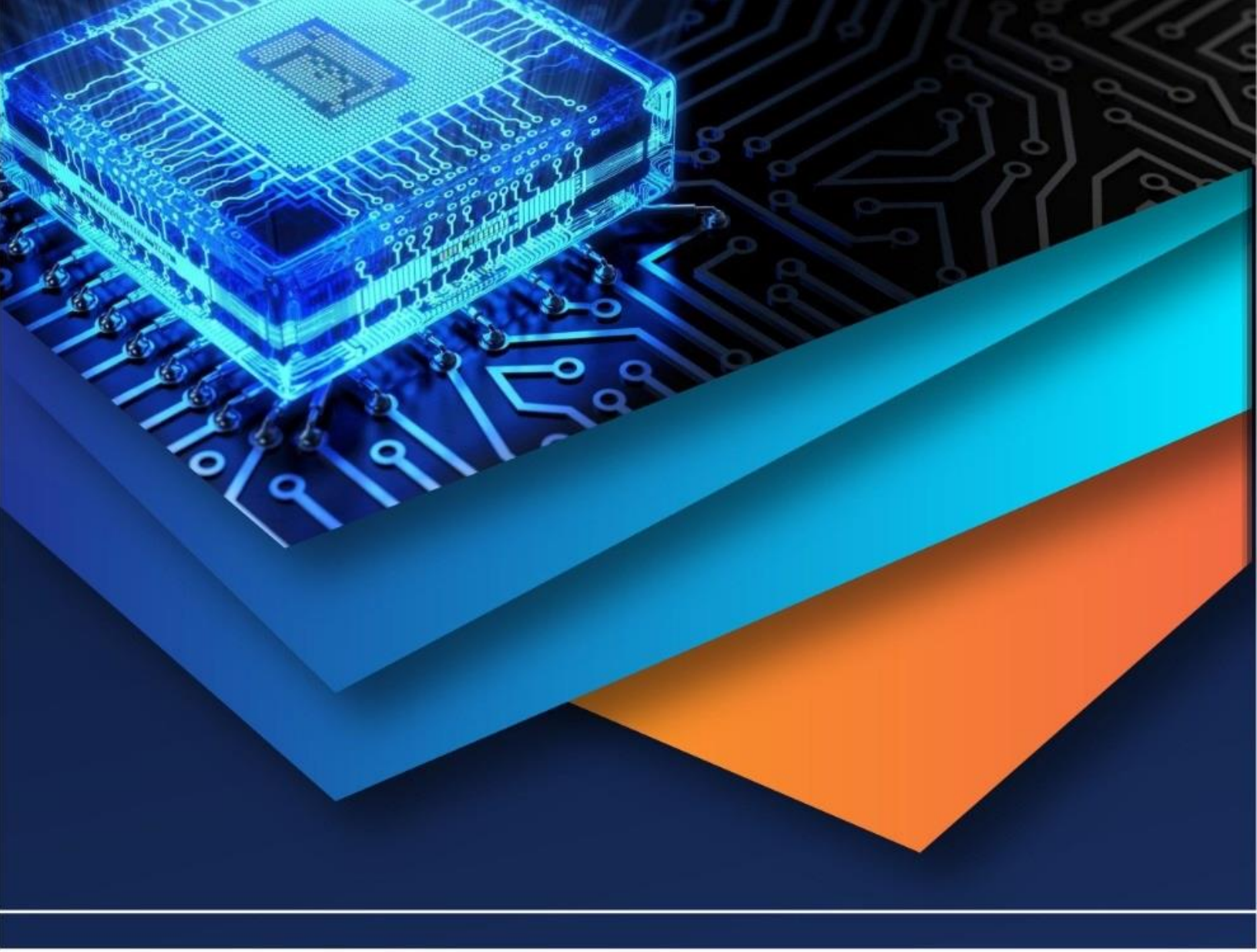

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