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Crypto-Currency Price Prediction using CNN and LSTM Models

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Abstract: ***Growing demand in internet usage has bring up to the revolution in digital economy. From the past decade digital economy is playing major role round the world. The physical assets are converted to digital assets, in which Bitcoin is the major crypto currency for the investors. Bitcoin has the biggest market capital among all other crypto currencies. Bitocoin price prediction and forecast has been one of the tedious tasks for long period. Existing works are attempted to go for accurate prediction and forecast through machine learning models. The forecast can be useful work for the investors to know about the nature of price in future and gives them directions for their investments. In this proposed work, Bitcoin price prediction is proposed through the deep learning models such as Convolutional Neural Networks (CNN) and Long short term memory (LSTM) models. The aim of the work is to give accurate predictions and forecast and bring the daily trend for crypto currency market. Experimental results shows that the proposed system given better accuracy on predictions.***

Keywords: ***Machine learning, Deep learning, Convolutional Neural Networks (CNN), Long short term memory (LSTM), Bitcoin, Crypto-currency.***

I. INTRODUCTION

Bitcoin is the popular crypto currency and has the highest market capital among all other crypto currencies. Thus investors are keen to invest in Bitcoin rather than any other currencies, has attracted for further study on this Bitcoin price predictions. The growing demand in digital economy and the valuations and profit earning ratio of bitcoin is extremely high and the reason its gaining more investor around the world and this is not fixed for any specific country. Traders or investors all over the world can trade and invest in crypto currencies. Bitcoin is simple to trade and there is no much regulations for trading or investing, which attracts many investors all over the world. The digital currency is more secure through the blockchain implementation and decentralized. As it is traded around the world, the price fluctuations are very high and more volatile than compared to stock investing, this is the main reason, that many investors seeks for the better model for price understanding and price projections.

There are many automated model are available for stock price predictions based on mathematical and technical analysis. The same kind of analysis can be applied for cryto currency too. However, the high volatility is one which open doors for the more analysis on deep learning algorithms. The reason for the price fluctuations and high volatility is still not known. It is difficult to predict such uncertainty markets through existing technical analysis. Thus more powerful methods needed for the study.

Bitcoin uses the smart transactions using blockchain technologies, which provides more secure transactions with private keys for every transactions. The transactions once made cannot be edited by anyone as the chain is updated to every holders and decentralized way.

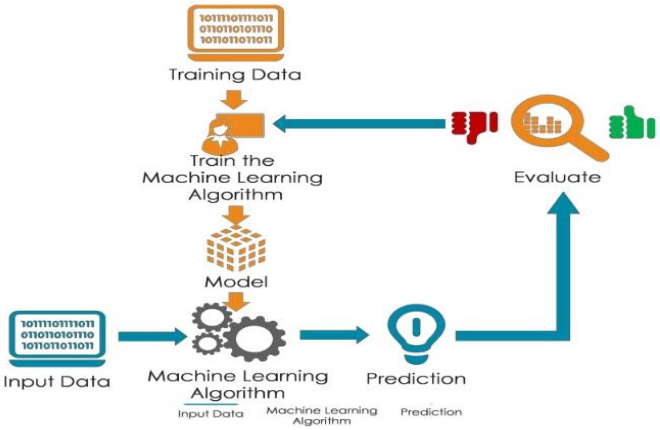

Figure 1: Overview of Machine leaning for Bitcoin

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The above figure shows the machine learning architecture for handling bitcoin price prediction. Here the input data plays vital for every machine learning processes. The data collected in real time will enhance the power of learning and upto date data will add much advantages.

The trained model is tested agians part of dataset and can be evaluated for self analysis and to improve the learning system.

The objective of proposed system is to find more effective model for price prediction and price forecast thorough deep learning models. The main objective is to arrive the price prediction with high accurate values, which can aid the investors on making their decision on investments. Similarly small time frame price projects may helpful for trader trading the crypto currency market.

The remainder of this paper is organized in such a way that chapter 2 discussed about the literature survey and related works carried out for Bitcoin predictions. Chapter 3 discuss about methodology and modules involved in the project. Chapter 4 is the column for results and analysis. chapter 5 is discussing about concluded with future works.

II. RELATED WORK

There are many researchers found Bitcoin is of interesting study and extended their research on it. Some of the are discussed below in brief.

Bitcoin price prediction is handled through machine learning algorithms in [1]. The authors in the work proposed many machine learning models and surveyed more than seven algorithm for the price prediction study. However, the study has give very less accuracy on price predictions, they varies from 52 percentage to 56 percentage. Whereas, Bitcoin is traded all over world needs an accurate and high level price prediction and projects for the investors.

The work [2] discussed Bitcoin price prediction using LSTM methods. The authors evaluated price prediction with varying number of epoch from 10 to 500 and find the optimized results at an epoch level of 500. However, they achieved price predictions, the RMSE (Root Mean Square Error) values is 288, which is considered to be high on error values. Thus more optimized results are needed for predictions. Moreover, the price projects not handled.

The work [3] has analyzed the user reputation for trading in bitcoin market. This work has given score to individual user for handling the trading. The work is carried out with high number of nodes and edges. The rating among the user is done between -10 to 10, where are -10 is considered as least score and 10 is considered as the highest score values. The users from social media is cosnidered for the study by creating DAG (Directed Acyclic Graph). This study recommended the new users for trading suggestions.

Many existing works handled the sentiment as one of much important factor for investing the prices. This type of analysis can be useful for long term price sentiments, whereas traders needed more specific analysis, which is much suitable on price prediction and price forecasts. The work [4] represents, such a sentiment analysis work, where the data fed from crowd sourced data and economic data. The crowd sourced data in terms collected from twitter data. In this work, the author used ARIMA model for learning and predictions. However, price projects not handled.

Another work based on sentiment classification is discussed in [6], where the author used twitter data for sentiment analysis. vectorization model n-gram is used for feature vector extraction from tweets. Classification algorithms and deep learning algorithms were applied on this pre-processed data, their experiments shown that decision tree giving with better output on sentiment classifications.

Bitcoin short term (ST) price prediction is analysed through arima model in [7]. The dataset used in this study from 2013 to 2019 data. For the test dataset, the author used 7 days data for price predictions. ARIMA model has shown better predictions on price. However, the work not studied for more evaluations and price projections.

Similar to the proposed system, LSTM based price prediction was discussed in [8]. The author used LSTM learning for the study and proved that the system achieves less error on price predictions. However, the study not involved any price projections.

III. PROPOSED WORK

The proposed work is implemented for Bitcoin price prediction and Forecast for five days from the dataset extracted real time from quandl.com.

As deep learning models are more power than machine learning models, the proposed work used Convolutional neural Network (CNN) and Long Short Term Memory (LSTM) models for prediction and price forecast.

The below figure shows the overall methodology of proposed approach.

This involves six major modules with real time dataset collection, dataset visualization, data splitting for training and testing, Training the model using CNN and LSTM and finally price forecasts.

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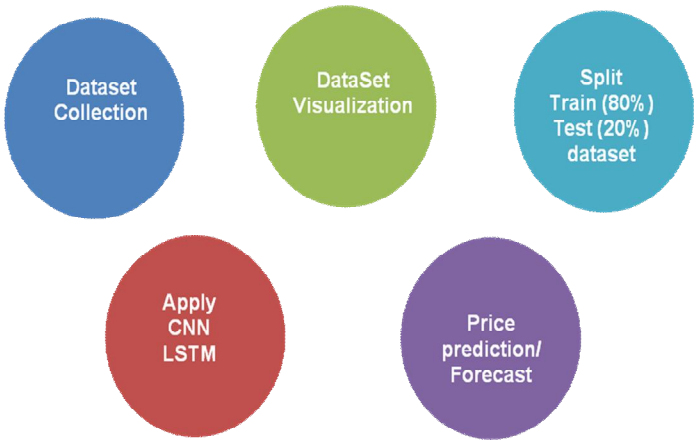

Figure 2: Methodology for proposed work

A. Real time Dataset Collection

Bitcoin is similar stock traded in NSE (national stock exchange) in India. Whereas the nse stock can be traded in India only. The Bitcoin can be traded by all over the world as it is distributed. The crypto currency is more popular from 2011 onwards, the data available is also from 2011 is take for the study.

However, many authorize websites are providing crypto currency dataset, most of them are paid services. Quandl.com provide most of the dataset in no cost and more accurate data available.

The user is registered in Quandl.com, thus the user can able to get the authentication keys to extract the dataset online. As many of the currencies and data are payable, we are downloading the dataset, which is free to download. Quandl.com gets the authentication keys and keyword from the user and using API, the data can be extracted as CSV (Comma separated values) format. To extract the data for this study, the symbol used for data extraction is "BITSTAMPUSD".

The below figure shows the architecture diagram for real time data collection from Quandl.com

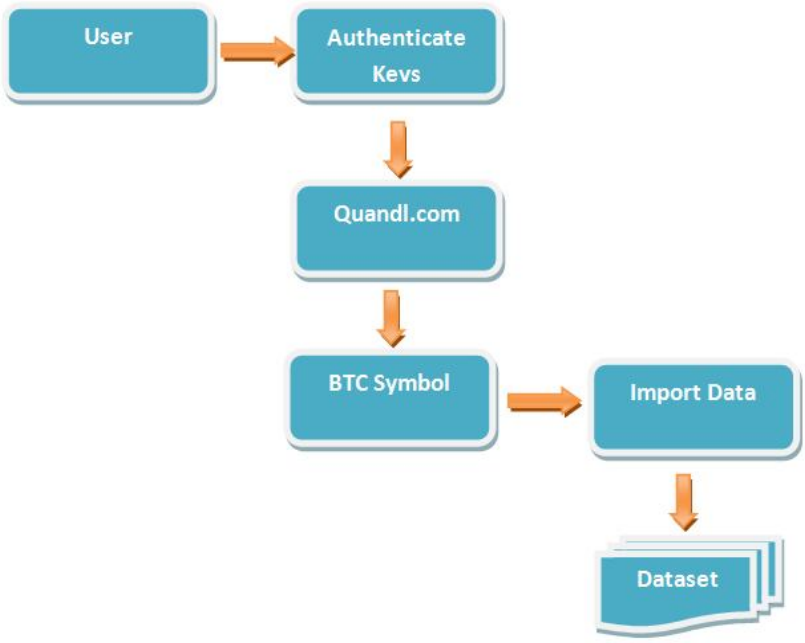

Figure 3: Data Collection in real time for price prediction

Real time data extracted from quandl.com from 2011 to till date is collected with attributes namely date, Open, High, Low, Close, Volume(btc), Volume(currency), Weighted_price. The figure, Figure1, represents the view of extracted dataset sample in comma separated file.

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A	B	C	D	E	F	G	H
Date	Open	High	Low	Close	Volume (BTC)	Volume (Currency)	Weighted Price
9/13/2011	5.8	6	5.65	5.97	58.37138238	346.0973894	5.929230648
9/14/2011	5.58	5.72	5.52	5.53	61.14598362	341.8548132	5.590797514
9/15/2011	5.12	5.24	5	5.13	80.1407952	408.2590022	5.094271914
9/16/2011	4.82	4.87	4.8	4.85	39.9140068	193.7631466	4.854515047
9/17/2011	4.87	4.87	4.87	4.87	0.3	1.461	4.87
9/18/2011	4.87	4.92	4.81	4.92	119.8128	579.8431027	4.839575594
9/19/2011	4.9	4.9	4.9	4.9	20	98	4.9
9/20/2011	4.92	5.66	4.92	5.66	89.28071068	481.0492629	5.388053693
9/21/2011	5.7	5.79	5.66	5.66	17.62932238	100.5942336	5.706074879

Figure 4: Real time data gathered from quandl.com

Details of dataset are give in the below mentioned table

Variable name	Attribute Description
Date	Traded Date
Open	Open price for the date
High	High price for date
Low	Low price for the date
Close	Close price of bitcoin
Volume (BTC)	Traded volume
Volume (Currency)	Traded value
Weighted price	Traded price of coin

Table 1: Data used for the study

B. Dataset Visualization

The large the dataset, the more the accuracy for prediction. Hence the Bitcoin is traded from 2011, we collected from 2011 and to the current date, Figure 2, Visualization of the bitcoin prices with 1000 ticks are shown below.

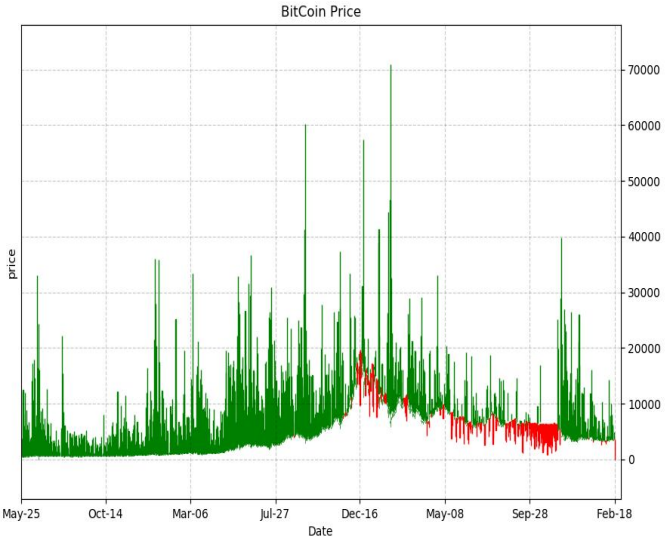

Figure 5: Data Visualization of Bitcoin from 2011 to current date

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The below figure shows the overall architecture of the proposed system.

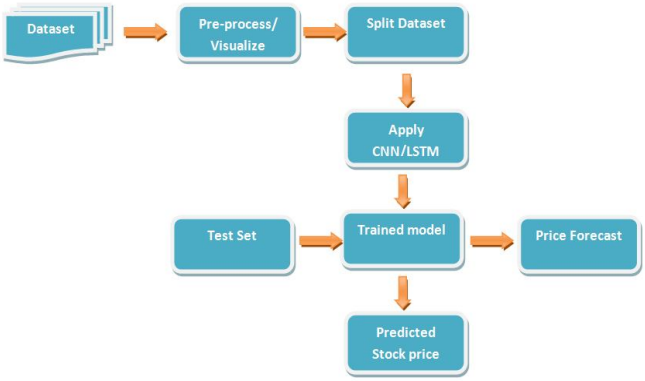

Figure 6: Overall architecture of Proposed Bitcoin prediction and forecast

C. Convolutional Neural Network (CNN)

We used convolutional neural network available in keras for training and testing our model. The model of architecture is Conv1D is used. The proposed model used is Sequential, which is easier to stack the input layers to the output layer. The deep learning algorithms uses neural network architecture like a human brain and which has three layers input, hidden and output layers.

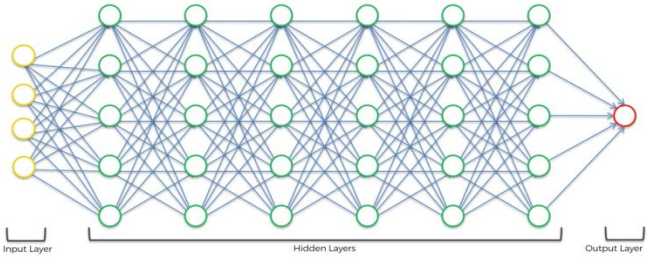

Figure 7: CNN algorithm for Bitcoin dataset

We have created deep learning model with Sequential class model using Keras and Tensor flow. The given dataset is split around 80% as training set and around 20% as test set. The train set is used to train our neural network model, whereas using test set the predictions are done, they are compared with the original values to get accuracy and error metrics. The CNN applied on our dataset is depicted in above figure, Figure 4, in which the input column is considered is Open, High, Low, Close value of dataset.

D. Long Short Term Memory (LSTM)

Long Short-Term Memory network is a recurrent neural network, which can be trained using back propagation model. This model behaves to create a time dependent or attribute/ behaviour dependent model. The back propagation is performed by the feeding back the neural network results at time t and input network at time t+1. Recurrent neural network is the best network for stock price predictions. The below figure shows the LSTM architecture for bitcoin price predictions. Every deep learning models has three layers namely input layer, hidden layer and output layer. Deep learning algorithm is applied such as CNN and LSTM models. Five days forecast price prediction is done using CNN and LSTM models. The values are compared.

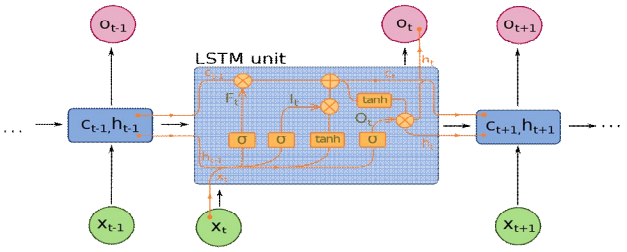

Figure 8: LSTM model

The implementation of deep learning on pre-processed dataset is done, the project price for the five days is plotted. The following figure, Figure 6 shows the application, we designed for bitcoin price prediction. The application is designed using TKInter in python.

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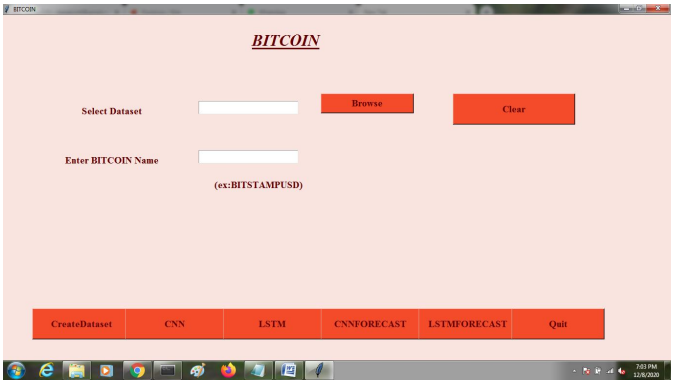

Figure 9: Application for bitcoin price prediction

IV. RESULTS AND DISCUSSIONS

The experimental result done and evaluation metrics are arrived from the above models are discussed here. The proposed work shows CNN algorithm is effective in price prediction. The proposed model outperforms existing in price prediction. The price predicted for testset dataset is plotted for both deep learning models and projected here below.

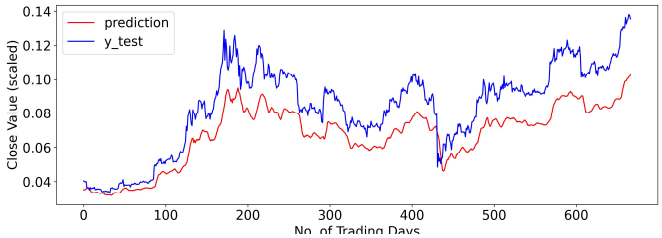

Figure 10: Bitcoin Price prediction through CNN

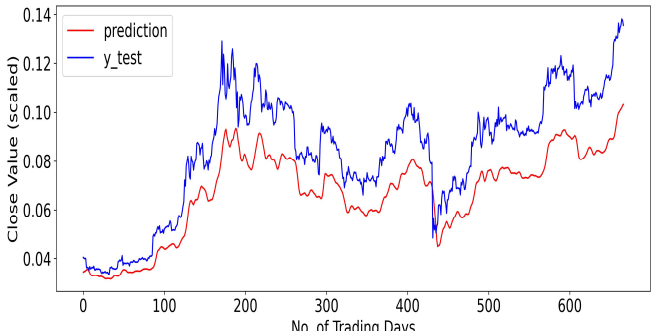

Figure 11: Bitcoin Price prediction through LSTM model

The below figure, Figure 9, shows the MAE (mean absolute error) error values for training and validation sets for CNN algorithm. Similarly, figure 10, represents the loss for training and validation sets for CNN algorithm.

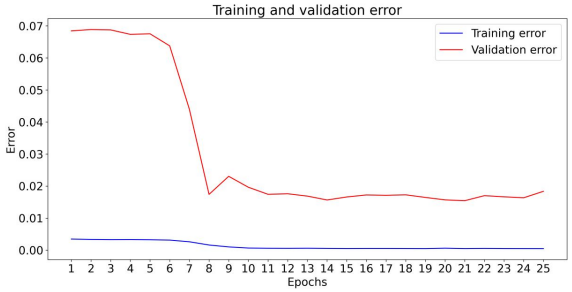

Figure 12: Error value in CNN algorithm

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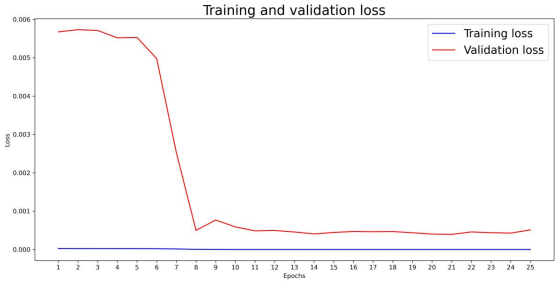

Figure 13: Loss value in CNN algorithm

The below figure, Figure 8, shows the MAE (mean absolute error) error values for training and validation sets for LSTM model. Similarly, figure 9, represents the loss for training and validation sets for LSTM model.

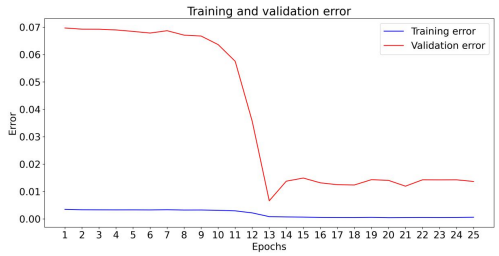

Figure 14: Error value in LSTM algorithm

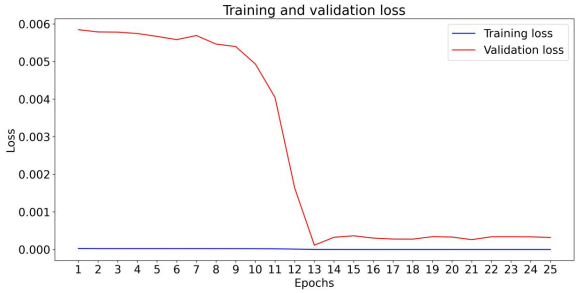

Figure 15: Loss value in LSTM algorithm

Bitcoin Price forecast using CNN model is shown in the below figure. The number of days for price projection can be increased, however to show the optimal results, five days are projected here.

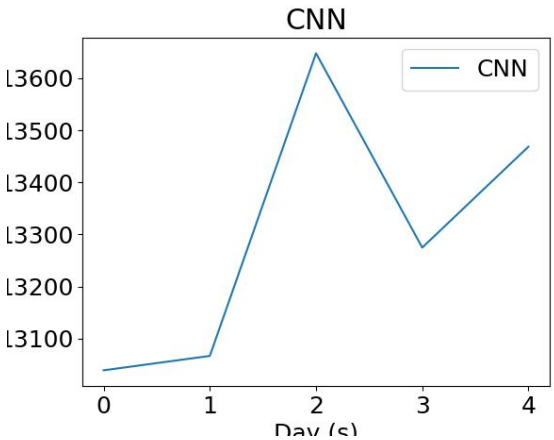

Figure 16: Price Forecast by CNN

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Bitcoin Price forecast using LSTM model is shown in the below figure. The number of days for price projection can be increased, however to show the optimal results, five days are projected here.

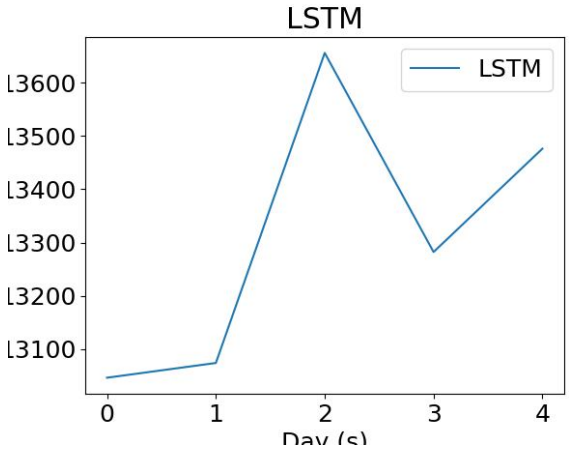

Figure 18: Price Forecast by LSTM

V. CONCLUSIONS

Digital economy growing enormously with high market capital due to the emergence of information technology. Bitcoin, one the major crypto currency, with highest market capital among all other crypto-currencies. Prediction of prices accurately and price projects helps investor and traders, aiming this the proposed work for Bitcoin price prediction with Convolutional neural Network (CNN) and Long Short Term Memory (LSTM) models is done. Price project for five days through Convolutional neural Network (CNN) and Long Short Term Memory (LSTM) models is provided in the work. Experimental results suggests that convolutional Neural Network (CNN) outperforms the other on price prediction.

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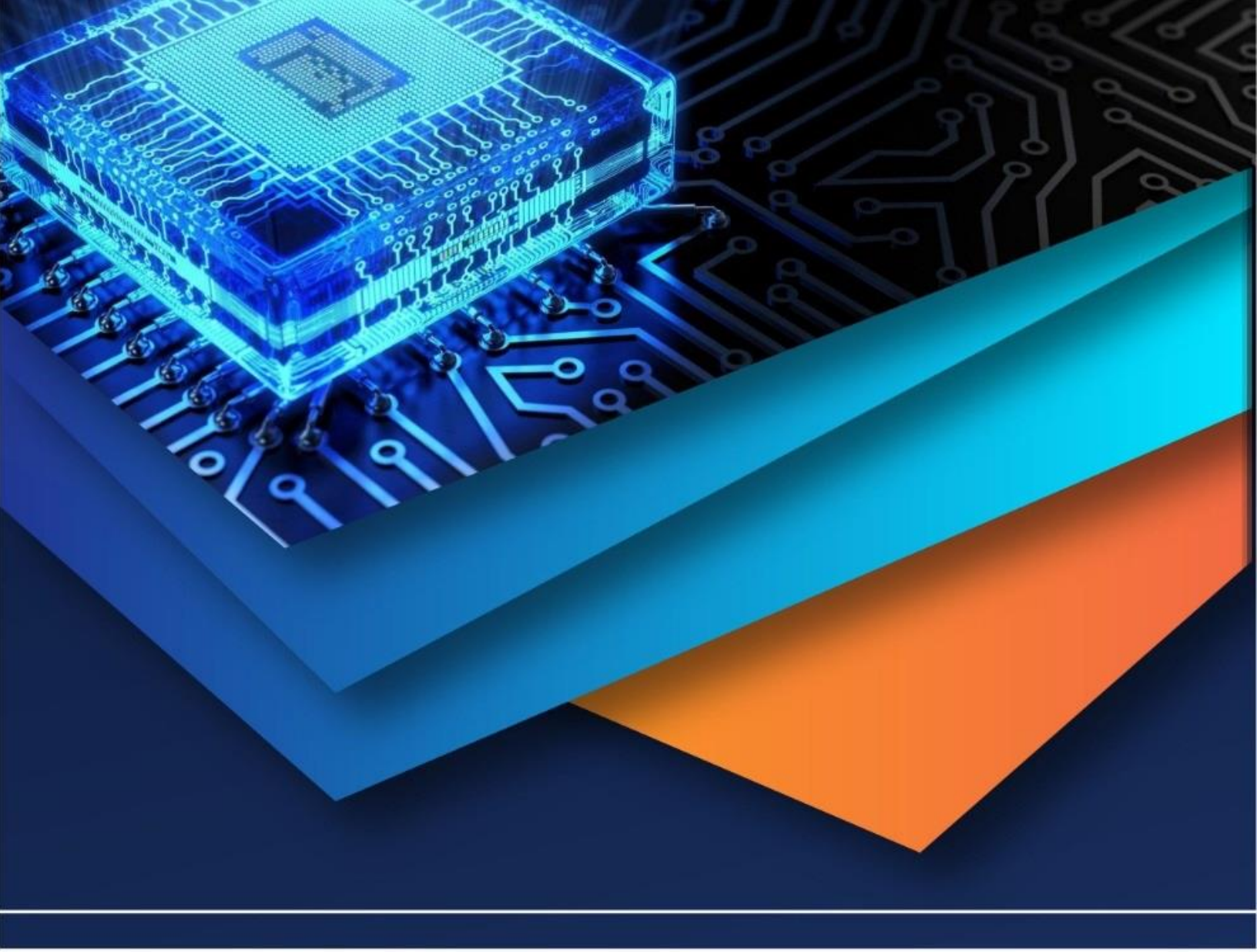

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