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# A Survey on Bitcoin Price Prediction using Deep Learning Algorithms

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**ABSTRACT:** Cryptocurrency is a new type of asset that has come about because of the development of financial technology. It has given researchers a lot of room to work. Cryptocurrency price forecasting is hard because of how quickly prices change and how quickly they change. There are a lot of different types of cryptocurrencies that people use all over the world. In the last few weeks, the media and the public have paid a lot of attention to Bitcoin because of its rise and fall in price. According to this, many people have looked into the factors that affect the Bitcoin price and the patterns behind its changes, especially with the help of machine learning methods. In this paper, we looked at a lot of other papers that used Deep Learning algorithms to predict the price of bitcoin.

**KEYWORDS:** Cryptography, blockchain, Bitcoin, Deep learning algorithms.

## I. INTRODUCTION

As a virtual or digital money, cryptocurrencies are widely employed in financial systems. Using encryption, it cannot be forged or double-spent, making it hard to counterfeit. Decentralized virtual currencies that may be exchanged using cryptographic protocols are different from regular currencies since they are not issued by a central authority or central banks.

Nakamoto, a mysterious figure who first appeared on the scene in 2008, is the one credited with creating the Bitcoin digital currency. Peer-to-peer transactions are protected by encryption thanks to blockchain technology. The short-term predictability of the bitcoin market is examined in this research. This is why we use an array of machine learning techniques and examine a wide range of possible market-predictive characteristics. The field of financial economics includes empirical asset pricing as a prominent topic.

Given their capacity to choose from among a potentially enormous number of characteristics while also learning complicated, high-dimensional correlations between them, machine learning approaches have seen increased use in this field. There has been a significant amount of study on the pricing of shares and bonds, but less attention has been dedicated to the innovative topic of bitcoin pricing. In addition, most research have only focused on technical aspects and not on the relevance of the machine learning models deployed.

Rather of relying on a single bank or administration, the peer-to-peer Bitcoin network allows users to transfer digital money directly amongst themselves. Its increasing acceptance in more than 40 countries (including Germany, Canada, and Croatia) has led to the birth of new alternative coins.

Most people use Bitcoin since it is the most valuable cryptocurrency. Speculators predicted that it might fundamentally alter the nature of trade in the future. However, predicting the price of Bitcoin is a challenging undertaking, and investors face a complicated decision-making process. The Bitcoin price's nonlinearity is to blame for this. Therefore, a more accurate forecasting system is needed to reduce the danger of making decisions based on inaccurate information.



## II. EXISTING SYSTEMS AND DRAWBACKS

The existing system makes use of different machine learning and artificial neural network algorithms and methods.

(i) Faghih et al. 2020, made use of Grey System Theory to predict the changes in bitcoin price. In this case, the Grey Model of the first order is appropriate. The trend of time series is modelled using a first-order differential equation, and the template is updated when fresh data becomes available. Accumulative Generation Operator (AGO) is used to align the data's unpredictability [1].

Drawback:

- Choosing inappropriate time frame will not give accurate results.
  - Investment asset management is difficult.
- (ii) Velankar et al. 2018, consider various parameters that affect the bitcoin price. The data collected contains price and payment network of 5 years. This model is used to predict daily price change. They made use of Bayesian regression and general linear model (GLM) [2].

Drawback:

- It can take data for a maximum of 10 minute interval.
  - Investment asset management is difficult.
  - Not preferable for long term data.
- (iii) To predict bitcoin transactions, Wenqi and colleagues in 2020 developed DLForecast, a model. Deep neural networks are used to learn the representations of the data. Prediction models are combined using the MMU ensemble, which is based on historical data [3].

Drawback:

- Accuracy is low - 60%.
  - Only some types of activity may be represented by dynamic graphs.
- (iv) Bitcoin market predictability is examined by Patrick et al. in 2021, with horizons ranging from one minute to 60 minutes. Technical, blockchain-based, sentiment-/interest-based, and asset based capabilities are all included in the entire feature set of this product. For the majority of techniques, technical aspects are the most important, followed by blockchain-based and interest-based features [4].

Drawback:

- Due to the very short holding periods, this strategy has negative returns if transaction costs are taken into account.
  - Gradient boosting classifiers is most suitable for Short term prediction.
- (v) For each model, Engchuen et al. 2020 used the projected outcome to compare three neural networks: Feedforward Neural Network (FNN), Nonlinear Autoregressive with Exogenous Input (NARX) Neural Network and Nonlinear Autoregressive. The best model is determined by comparing each model's performance measurement. In terms of predicting Bitcoin's price, NARX has been shown to be an effective neural network [5].

Drawback:

- The results revealed that NARX outperformed FNN and NAR in terms of its performance.
  - Forecasting the price of Bitcoin cannot be done using standard approaches.
- (vi) Using the linear regression and Long Short-Term Memory model, Alvin et al. 2021, show how to anticipate the value of a Bitcoin. Compared to other Machine Learning models, linear regression has an accuracy rating of 99.87 percent, making it one of the most accurate models available [6].

Drawback:

- It has scalability issues.
- Forecast based on human emotion is not suitable.



### III. PROBLEM STATEMENT

To build a method that accurately predicts the Bitcoin Cryptocurrency price.

#### OBJECTIVES

- The primary goal of this research is to develop an efficient and accurate algorithm for predicting the long-term price of Bitcoin.
- It saves the man power and time of the analyst.
- Provide business strategy on investment.
- Real time analysis and graphical representation of data.

### IV. LITERATURE SURVEY

To better anticipate Bitcoin's price, a team led by Suhwan Ji et al. [7] examined and analysed many cutting-edge deep learning approaches, including DNNs, LSTMs, convolutional neural networks, and deep residual networks. For Bitcoin price prediction, LSTM-based prediction models beat the other prediction models (regression) somewhat, while DNN-based models did the best for predicting Bitcoin's rises and falls (classification). The use of classification models rather than regression models in algorithmic trading was also shown to be more profitable in a basic investigation. Overall, the suggested deep learning-based prediction models performed similarly to each other in terms of accuracy.

By studying the attitude on Twitter, Dibakar Raj Pant and his colleagues suggested a study that aims to anticipate the volatility of Bitcoin's price by finding a correlation between the two. The feelings expressed in the Bitcoin tweets gathered from various news accounts are categorised into favourable and negative. For the RNN model to forecast future prices, the proportion of positive and negative tweets is fed in together with the previous price data. 81.39 percent of positive and negative tweets are correctly classified as positive or negative, while RNN's total price prediction accuracy is 77.62 percent.

Machine learning algorithms were used to forecast Bitcoin values by T. Phaladisailoed [9] and Numnonda [9] in an experiment. Regression models utilising scikitlearn and Keras libraries were tested using 1-minute interval trade data on the Bitstamp Bitcoin exchange website from January 1, 2012 to January 8, 2018. The MSE was as low as 0.00002 and the R-Square (R<sup>2</sup>) as high as 99.2 percent in the top results.

It was suggested by Anupriya and Shruti Garg [10] that an ARIMA model be used to forecast the closing price of Bitcoin. Using the ARIMA model to forecast bitcoin prices makes sense since this model is used to forecast time series data. Based on the pricing data's seasonality and trend, a projection of future values is produced. The R programming language is used to create visualisations. A percent mean error is derived after comparing the estimated findings to real prices. For the majority of the data, the current mean error is less than 6%.

A study by Huisu Jang and Jaewook Lee [11] examined the time series of the Bitcoin process to determine the impact of Bayesian neural networks (BNNs). Blockchain data that is directly related to Bitcoin's supply and demand may also be used to train models that can increase the accuracy of the newest Bitcoin pricing process. The empirical research that compares the Bayesian neural network with other linear and non-linear benchmark models on modelling and forecasting the Bitcoin process is carried out by our team. Our empirical tests reveal that BNN is a good predictor of Bitcoin price time series and a good explanation for the recent volatility in the Bitcoin value.

Analysis of several characteristics impacting bitcoin price prediction using Root Mean Square Error (RMSE) is carried out by Apoorva Aggarwal et al. [12] utilising various deep learning models, such as Convolutional Neural Network (CNN), Long Short Term Memory (LSTM) and Gated Recurrent Units (GRUs) (GRU). The price of gold has been examined in relation to the price of bitcoin.

The LSTM neural network approach was utilised to forecast stock data under various stationary settings, and statistical analysis was done on many experimental data sets by Fei Qian and Xianfu Chen [13]. Another algorithm to compare with the LSTM is the ARIMA algorithm. The LSTM neural network prediction method provides improved prediction accuracy and is less susceptible to the stability response, according to a large number of experiments.



Researchers Neha Mangla et al. [14] set out to accurately forecast the Bitcoin price by taking into account a wide range of variables.

At the same time as gathering knowledge on the most relevant aspects surrounding Bitcoin's price, we sought a deeper understanding and identification of daily market fluctuations in the cryptocurrency. We'll be as accurate as possible in our daily price change predictions. A whopping \$230 billion is being exchanged at the moment on the public cryptocurrency market. Predictability of Bitcoin's price has been extensively analysed, making it the most valued cryptocurrency. The basic features of Bitcoin, as discussed in full in the aforementioned articles, are outlined in the next sections.

[15] Salim Lahmiri and Stelios Bekiros [15] used deep learning approaches to predict Bitcoin, Digital Cash, and Ripple prices. As far as we know, this is the first time deep learning has been used in bitcoin prediction. Non-linearity was tested, and the findings showed that fractal dynamics, extended memory, and self-similar behaviour may be seen in every digital currency timeseries tested. Long-short-term memory neural network topologies (LSTM) are much more predictable than the generalised regression neural architecture, which serves as our benchmark system. This is because they are built on Gaussian kernels, which are only ideal for local approximation of non-stationary signals, not global nonlinear hidden patterns. Deep learning was proven to be very effective at predicting the intrinsic chaotic dynamics of cryptocurrency markets, despite the increased computing overhead of the LSTM model compared to brute force in nonlinear pattern recognition.

Predicted daily closing price series of Bitcoin, Litecoin, and Ethereum coins, using data from previous days' values. It is still possible for academics and economists to identify parallels and contrasts between the price behaviour of cryptocurrencies and the price behaviour of traditional financial instruments. With this in mind, we evaluated our results against various benchmarks, including a recent work on Bitcoin price forecasting that follows different approaches, a well-known paper that uses Intel NASDAQ closing prices for three years, and another, more recent paper that provides quantitative results on stock market index predictions. For uni-variate series forecast, we used the Simple Linear Regression model, which uses just closing prices, and the Multiple Linear Regression (MLR) model, which uses both closing price and volume data for multivariate series prediction. Multilayer Perceptron (MLP) and Long short-term memory were also utilised in our research (LSTM). A random walk could not be distinguished from the complete time series, but dividing it into shorter sequences that reflect various price "regimes" allowed for more accurate forecasting, as measured by the Mean Absolute Percentage Error (MAPE) and the relative Root Mean Square Error (RMSE) (relativeRMSE). With more than one preceding price, the best results are achieved, proving the existence of temporal regimes other than random walks. As a consequence, our models outperform those in the benchmark studies in terms of overall performance and time complexity, further advancing the state of the art.

Bitcoin price predictions are made using the most powerful and widely used deep learning algorithm, as described by K. Mahar et al. [17]. It's a real-time dataset based on the current date's Bitcoin value (Open, Close, Low, High, Volume). The goal of this research is to accurately determine the current Bitcoin price using the LSTM algorithm. It's clear from these findings that LSTM is a viable option for dealing with this issue.

Yan Li and Wei Dai [18] have presented a hybrid neural network model based on convolutional neural networks (CNN) and long short-term memory networks (LSTM) to address the issue of Bitcoin's price volatility and difficulty in forecasting. Additionally, external factors like macroeconomic indicators and investor interest are taken into consideration while constructing a model. Feature extraction is the first step in using CNN. Training and short-term price predictions are done using the feature vectors supplied into LSTM. Compared to a single structure neural network, the CNN-LSTM hybrid neural network can greatly increase the accuracy of value and direction prediction. What this means for academics and investors in the cryptocurrency sector is significant.

Machine learning algorithms were used to determine the best ones that could predict Bitcoin's price based on three other well-known currencies, according to a study by Negar Malekia et al [19]. A new way of estimating Bitcoin's value is also being developed, and it takes into account the values of other cryptocurrencies as well (Ethereum, Zcash, and Litecoin). Results showed that Zcash, out of these three cryptocurrencies, had the greatest performance in projecting Bitcoin's price without any data on Bitcoin's price changes.

Researchers Kartik Gautam [20] and his colleagues investigated several forms of cryptocurrencies and their features, as well as answering many inquiries about their history or market worth. What is cryptocurrency, and how does it differ from other forms of digital currency? When comparing the various cryptocurrencies, we've already spoken about their unique qualities. Among these characteristics are the currency's short form, current value in market, currency



capitalization, programming language of implementation, the year of release of cryptocurrency, the founder of cryptocurrency, block time, all-time high and all-time low, market rank, and the type of proof and algorithm utilised in currency. These characteristics are quite useful in deciding whether or not to use or invest in the cryptocurrency. Many cryptocurrencies are presently available on the market, making it difficult to pick one. There are a number of cryptocurrencies that we believe have a good chance of success in the future. To help the reader understand what he or she is reading, we have also explained each word used in the comparison.

In MohilMaheshkumar Patel et al. [21], an LSTM and GRU-based hybrid cryptocurrency prediction technique is suggested, which solely considers Litecoin and Monero as the two cryptocurrencies of interest in the research. With these data, it is clear that the suggested method successfully forecasts the values of several cryptocurrencies with high accuracy.

With this new technique to Bitcoin transaction forecasting by using deep neural networks and Bitcoin transaction network representations, Wenqi Wei published DLForecast [3]. DLForecast contributes three new ideas. This study begins by looking at the topological connection pattern, quantity patterns, and dynamics of Bitcoin transactions as they relate to one another. After creating a time-decaying reachability and a time-decaying transaction pattern graph, we are hoping to capture a variety of spatial-temporal Bitcoin transactions. After that, we create a Bitcoin transaction forecasting engine based on past transactions with a built-in time-decaying component on both graphs. The multiplicative model update (MMU) ensemble is used to integrate prediction models constructed on multiple transaction attributes derived from each associated Bitcoin transaction graph in order to maintain an effective transaction forecasting performance. In a comparison with a forecasting model based on a static graph baseline, we find that our spatial-temporal forecasting model has a predicting accuracy of over 60% and a runtime efficiency of 50% when evaluated on real-world Bitcoin transaction data.

To examine the projected results of three distinct neural networks, researchers E ChuenLoh and Shuhaida Ismail [5] presented a study comparing Feedforward Neural Networks (FNN), Nonlinear Autoregressive with Exogenous Input (NARX) Neural Networks, and Nonlinear Autoregressive (NAR) Neural Networks. The best model is determined by comparing each model's performance measurement. The best model is then utilised to anticipate 30 days in the future. The results indicated that NARX outperformed both FNN and NAR in terms of performance. It has been shown that NARX is the best neural network for predicting the price of bitcoin. For investors and economists alike, the model's fresh insights into Bitcoin forecasting utilising NARX mean less chance of making an incorrect investment choice.

It was hypothesised by S Tanwar et al. [22] that a deep-learning-based hybrid model (including GRUs and LSTMs) could forecast the price of Litecoin and Zcash with interdependency of the parent currency. In real-time applications, the suggested model is well-trained and tested using standard data sets. The results show that the suggested model accurately predicts prices compared to other models.

In order to test and train the ML and AI model, Alvin Ho et al. [6] suggested Bitcoin data sets. The data filtration was completed with the aid of python libraries. Data analysis and visualisation are made a lot easier using Python's built-in features. After gaining a grasp of the data, we employ the features or properties that are most relevant to the model to cut down on unnecessary data. The model has been implemented and the results have been recorded. The linear regression model's accuracy rate was determined to be 99.87 percent accurate when compared to other Machine Learning models from comparable research. However, the LSTM model has a very low error rate of 0.08 percent, compared to the other models. Thus, the neural network model is shown to be more efficient than the machine learning approach. When a user inputs the coin's high, low, and open features values, a little GUI is formed that will anticipate its future value based on those inputted numbers. A machine learning model and an artificial neural network model are compared in this study. We selected linear regression to compare the LSTM model since it had the best accuracy among the other machine learning models.

The predictability of the bitcoin market was examined by Patrick Jaquart et al. [23] at timescales spanning from one minute to sixty minutes. As a result, we put a variety of machine learning models to the test and discover that, although all models beat a random classifier, recurrent neural networks and gradient boosting classifiers are particularly well-suited for the predicted tasks under consideration. A wide range of features are available to us, including technical, blockchain-based, sentiment-/interest-based, and asset-based options. For the most part, our findings reveal that technical aspects are the most important for most techniques, followed by a few blockchain-based and interest-based elements. Longer prediction horizons are associated with better predictability. This quantitative long/short trading



technique may provide monthly profits of up to 39% before transaction costs, but the very short holding periods result in a net loss after transaction expenses.

## V. CONCLUSION

Deep learning-based Bitcoin price prediction models were constructed and compared in this research utilising Bitcoin blockchain information. Deep neural networks (DNN), long-term memory (LSTM) models, convolutional neural networks (CNN), deep residual networks (ResNet), and their combinations were tried. The future Bitcoin price is predicted via regression, whereas the direction of that price change is predicted by a classification issue.

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