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(RESEARCH ARTICLE)

A survey on cryptocurrency price prediction

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Abstract

A type of digital currency known as a cryptocurrency allows all transactions to be completed online. There is no hard cash version of this soft currency. We highlight that a decentralized currency differs from a centralized currency in the any user of a virtual currency can purchase services without the need for third parties to get involved. Due to its extreme price volatility, using these cryptocurrencies has an impact on trade and international relations. Moreover, the constantly fluctuating oscillations indicate the urgent need for a more precise method of predicting this price. Deep learning techniques that use effective learning models for training data, including the LSTM, GRU, and Feedback Neural Network, can be used to do this. Benchmark datasets are used to test the suggested strategy. That brings us to the neural network, one of the clever data mining technologies that researchers in many domains have been using for the past ten years.

In the current economy, stock market data is essential. There are two types of forecasting methodologies: nonlinear models (ARCH, GARCH, Neural Network) and linear models (AR, MA, ARIMA, ARMA). To forecast a company's stock price based on past prices, we employed the Box Jenkins Model also known as ARIMA, and Long Short-Term Memory (LSTM), and Feedback Neural Network also known as RNN.

Keywords: Cryptocurrency; Price Prediction; Recurrent Neural Network (RNN); Long Short-Term Memory (LSTM); Time Series Analysis; Historical Data.

1. Introduction

Cryptocurrency is a term for virtual or digital currency in financial systems. Encryption protects it, preventing double-spending and counterfeiting. It can be distinguished from conventional currencies due to its decentralized virtual natural, which can be altered using cryptographic methods, and the fact that neither central bank nor authorities issue it. The other is that it uses a very complicated technology called block chain, which aims to secure store data so that it can't be altered, compromised, or otherwise manipulated. Both Apple's Siri and Google's voice search utilize recurrent neural networks (RNNs), the state-of-the-art method for sequential data. This technique is ideal for machine learning problems requiring sequential data since it uses its internal memory to recollect its input. It's a deep learning algorithm with good performance. In this post, we'll examine how to forecast Bitcoin values using information spanning the previous six years. Essentially, it is a distributed digital ledger of all transactions across the block chain's complete network of computer systems. Each autonomous system (AS) joins the defensive line in a cooperative DDoS defense system based on block chains and multi-domain signaling. Two factors determine how networks affect competition in the emerging cryptocurrency market over time with regard to exchange rates between cryptocurrencies: (1) between various currencies and (2) between exchanges. Even if Bitcoin is the most popular cryptocurrency out of hundreds, well-known since it refuses to compete with its rivals. It has consequently emerged as the leading cryptocurrency. The authors propose that new technology and security innovation, characterizing the competition among cryptocurrencies

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as “healthy competition.” The purpose of this study is to investigate whether Bitcoin’s price may be forecast in a manner akin to that of other stock market tickets. The premise for determining whether or not we can utilize it as a fourth payment mechanism will be this. Block chain records every bitcoin transaction that takes place globally. It is the most secure cryptographic implementation available. In 2017, the market value of cryptocurrencies experienced exponential growth for multiple months in a row, which led to a surge in their popularity. Prices peaked in January 2018 at almost $800 billion. While machine learning has proven effective in forecasting stock market values through the utilization of several time series models, its application in predicting cryptocurrency prices has been restricted. This is understandable given that a wide range of factors, including internal competition, technological difficulties, security concerns, political factors, and so forth, affect bitcoin values. They offer an enormous profit potential because to their extreme volatility, provided that astute inventive strategies are applied. Regretfully, predictions about cryptocurrencies are less accurate than those about the stock market.

2. Literature review

Because digital assets are so erratic, cryptocurrency price prediction has attracted a lot of attention. To predict cryptocurrency pieces, a variety of machine learning approaches have been used, most notably Gated Recurrent Unit (GRU) and Convolutional neural Networks (CNN) networks. The purpose of this review of the literature is to investigate current developments and approaches in this field. We seek to uncover patterns, obstacles, and possible areas for advancement n cryptocurrency price prediction models by reviewing the literature. Determining reliable prediction models that can handle the intricacies of bitcoin markets.

Mohammad J. Hamayel and AmaZni Yosef Owda [1]. The study effectively clarifies how the model maneuvers through the complex sequential patterns seen in bitcoin price data, capturing both short-term market swings and long-term trends. The survey highlights the effectiveness of the model in predicting price movements through carefully carried out tests and comprehensive evaluation utilizing previous bitcoin records. These results highlight its potential application in practical trading and investment situations. The poll also offers incisive criticism on each algorithm’s interpretability and computational efficiency, providing complex viewpoints on the advantages and disadvantages of each.

Sudeep Tanwar, Nisarg P. Patel, Smit N. Patel, Jil R. Patel, Gulshan Sharma, and Innocent E. Davidson [2]. Lead by distinguished researchers Nisarg P. Patel, a Senior Member of IEEE, and including Smit N. Patel, Jil R. Patel, Gulshan Sharma, and another Senior Member of IEEE, Innocent E. Davidson, the study provides and engaging look into the use of deep learning methods in cryptocurrency predictive analytics. Their plan stands out in particular because it acknowledges the interdependence of various cryptocurrency of others. The survey presents a technique that aims to capture these interdependencies and deliver precise price predictions by carefully examining several deep learning architectures. This study is expected to make a substantial contribution to our comprehension of the dynamic for stakeholders and investors navigating the constantly changing world of digital assets.

Patrick Jaquart, David Dann, and Carl Martin [3]. The survey provides a methodical analysis of previous research in this field and a structured synopsis of the methods and strategies used by investigators. The survey provides insight into the wide range of machine learning methods applied to bitcoin price prediction through their examination. Additionally, the survey serves as a guiding resource for additional research in this field by pointing out developing trends and suggesting possible directions for future investigation. All things considered, this examination has helped me better grasp how Bitcoin pricing is determined by machine learning and has motivated me to learn more about this exciting field of research.

J. Risk Financial Manag. [4]. This study provides an extensive analysis of different machine learning techniques used in bitcoin price predictions. It was revised before it was accepted and published on January 13, 2023. The assessment, which was written by an unidentified team, carefully assesses how well machine learning algorithms work and offers a detailed breakdown of both their advantages and disadvantages when it comes to predicting Bitcoin prices. The study provides practitioners and intricacies of cryptocurrency markets by synthesizing empirical evidence. All things considered, this survey provides a thorough overview of the most recent methods for predicting the price of bitcoin and provides insightful advice for further research in this field.

Vijh, M., Chandola, D., Tikkiwal, V.A., & Kumar, A. [5]. This examination examines various machine learning methods that are employed to forecast closing values of stocks and offers a methodical evaluation of their efficiency and applicability. Th survey, which was written by a group of researchers, assesses the effectiveness of machine learning models in this field and provides empirical data. The article provides detailed insight into the opportunities and difficulties involved in stock price prediction using machine learning algorithms by synthesizing empirical evidence. When everything is

taken into account, this survey significantly advances our knowledge of financial forecasting methods and offers sage guidance to investors and stakeholders navigating the complexities of stock markets.

Gurupradeep G, Harrishvaran M, Amsavalli K [6]. The survey explores various machine learning techniques used to forecast bitcoin values and offers a methodical evaluation of their efficacy and performance. The journal article, which was written by a group of researchers, analyzes the predictive power of machine learning models in the context of the ever-changing bitcoin market and offers empirical results. In summary, this research significantly advances our knowledge of bitcoin analysis and provides insightful guidance to investors and stakeholders navigating the volatile realm of digital assets.

Zeinab Shahbazi, Yung-Cheol Byun [7]. The survey investigates how predication models for cryptocurrency markets might be improved through the use of reinforcement learning algorithms. The journal article, written by Shahbazi and Byun, assesses the usefulness of reinforcement learning in this situation and provides empirical data. The survey clarifies the potential of reinforcement learning to optimize prediction tactics and adjust to the fluctuating nature of bitcoin values by combining empirical information. Taken together, our findings add significantly to our knowledge of reinforcement learning applications in bitcoin analysis, with practical ramifications for investors and stakeholders negotiating the complexities of digital asset markets.

Saachin Bhatt, Mustansar Ghaanfar, and Mohammad Hossein Amirhosseini [8]. This survey looks at how to increase the precision of bitcoin price forecasting models by combining machine learning algorithms with traditional historical data and sentiment research from social medial platforms. The journal article, written by Bhatt, Ghazanfar, and Amirhossein, analyzes the effectiveness of machine learning-based prediction models in the setting of cryptocurrency markets and gives empirical findings. The survey provides subtle insights into the efficacy of combining social media sentiment analysis with historical data for bitcoin price prediction by integrating empirical evidence. When all is said and done, this study significantly advances our knowledge of machine learning applications in cryptocurrency analysis and provides insightful guidance for investors and stakeholders navigating the volatile realm of digital assets.

3. Technological Developments

In the screening of Cryptocurrency Price Prediction both RNN and LSTM play significant roles in various stages of the process of Predictions. Some of the algorithms that are developed through the advancement of technology.

3.1. Convolutional Neural Networks (CNN)

- Application: CNNs can be used to predict short-term price movements and identify profitable trading opportunities in cryptocurrency markets.
- Use-Case: The networks ability to extract patterns and features from historical price data represented as images.
- Advantages: CNNs automatically learn relevant features from the input data, reducing the need for manual feature engineering.
- Disadvantages: CNNs are susceptible to overfitting, especially when trained on noisy or non-representative data, which can lead to poor generalization performance on unseen data.

3.2. Recurrent Neural Networks (RNN)

- Application: Predict short-term fluctuations in cryptocurrency prices, such as hourly or daily movements.
- Use-Case: The networks capability to analyze sequential data and capture temporal dependencies within cryptocurrency price sequences.
- Advantages: Adapt to different time-series prediction tasks, including cryptocurrency price forecasting.
- Disadvantages: Vanishing or exploding gradients can hinder the training process and affect prediction performance.

3.3. Support Vector Machines (SVM)

- Application: Predict the direction (upward or downward) of cryptocurrency price trends over short or medium-term intervals.
- Use-Case: Identifying potential buy or sell signals.
- Advantages: Effective in high-dimensional spaces.
- Disadvantages: Sensitivity to choose of kernel function and may struggle with large datasets.

3.4. Random Forests

- Application: Predict Cryptocurrency prices over different time horizons (short-term, medium-term, long-term).
- Use-Case: Predict its future price movements over short-term intervals, such as hourly or daily timeframes.
- Advantages: The wisdom of crowds by combining predictions from multiple decision trees, resulting in more robust and accurate predictions compared to individual trees.
- Disadvantages: Can be prone to overfitting, especially with noisy data.

3.5. Gated Recurrent Units (GRUs):

- Application: To analyze historical price data of cryptocurrencies and predict future price movements.
- Use-Case: Trading signals can be generated to inform buy or sell decisions for cryptocurrency traders.
- Advantages: Less susceptible to Vanishing Gradient Problem and interpretable.
- Disadvantages: Assumes a linear relationship between features and may not capture complex interactions, it may still struggle to capture long-term dependencies in sequences

3.6. Support Vector Regressor (SVR)

- Application: Optimizing cryptocurrency investment portfolios by predicting the future performance of various assets and determining the optimal allocation of funds.
- Use-Case: Predict the prices of alternative cryptocurrencies (altcoins) based on their historical price trends and other relevant factors.
- Advantages: Robustness to Overfitting and Flexibility with kernel functions.
- Disadvantages: Sensitivity to parameters tuning and computationally intensive.

3.7. Deep Neural Networks (DNN)

- Application: Assess and manage risk in cryptocurrency investments by predicting potential price fluctuations and identifying periods of high volatility.
- Use-Case: To optimize their cryptocurrency portfolios by predicting the future performance.
- Advantages: Achieve high predictive accuracy in cryptocurrency price prediction tasks.
- Disadvantages: Require significant computational resources, including high-performance GPUs or TPUs, which can be expensive.

3.8. Long Short-Term Memory (LSTM) Networks

- Application: Capturing patterns and dependencies in sequential data.
- Use-Case: Predict future cryptocurrency prices based on historical price data and potentially other relevant features.
- Advantages: Short term price forecasting, helping traders and investors identify potential buying or selling opportunities over short time horizons.
- Disadvantages: Vulnerable to overfitting, and training large models may require significant computational resources.

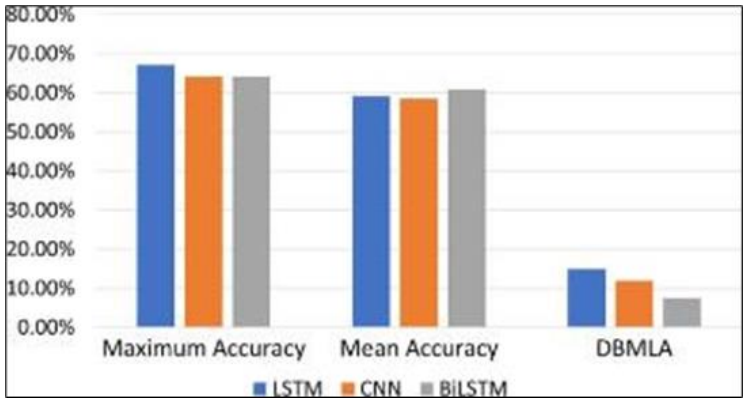

Figure 1 Accuracy comparison between Various models

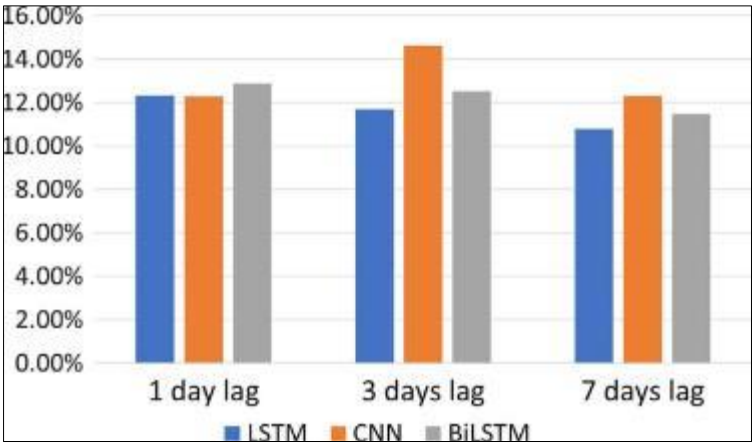

Figure 2 Day lag comparison between Various models

4. Comparative Study

Table 1 Comparison of various Algorithms

Year	Algorithm	Key Developments	Pros	Cons
2020	Machine Learning	Integration of sentiment analysis from social media data with historical data for prediction.	Increased accuracy due to inclusion of sentiment analysis.	Dependency on data quality and reliability.
2021	Reinforcement Learning	Utilization of reinforcement learning algorithms to enhance prediction strategies.	Ability to adapt to changing market conditions	Complexity in model training tuning.
2022	Deep Learning	Adoption of deep learning architectures such as LSTM and GRU for improved prediction accuracy	Ability to capture long-term dependencies inn data.	Increased computational resources required.
2018	Linear Regression	Introduction of basic regression models for price prediction	Simple implement	May struggle with non-linear relationships
2019	Time Series Analysis	Exploration of traditional time series techniques for forecasting	Well-established methods	May struggle with non-linear relationships
2011	Ensemble Learning	Integration of multiple models to improve prediction robustness	Reduction of model bias and variance	Increased complexity in model interpretation.
2024	Hybrid Models	Adoption of ARIMA models for time series forecasting	Well-suited for stationary data.	May struggle with capturing non-linear relationships.
2015	Autoregressive Integrated Moving Average (ARIMA)	Adoption of ARIMA models for time series forecasting	Well-suited for stationary data.	May Struggle with capturing non-linear relationships.
2019	Gated Recurrent Units (GRU)	Adoption of transformer models for sequence-to-sequence tasks in prediction	Simplified Architecture compared to LSTM	May struggle with capturing complex patterns.
2020	Sentiment Analysis	Integration of sentiment analysis from social media with price prediction	Incorporates non-financial data for insights	Vulnerable to noise and manipulation in social media.

5. Conclusion

In conclusion, the implementation of Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) models for cryptocurrency price prediction has showcased promising results, offering valuable insights into market trends and dynamics. Despite the inherent volatility of cryptocurrency markets, these models have demonstrated their ability to capture temporal dependencies and patterns in historical data. Moving forward, the integration of such advanced predictive techniques can empower investors and traders with more accurate forecasts, enabling informed decision-making and contributing to a better understanding of the evolving cryptocurrency landscape.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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