

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Innovations in blockchain and cryptocurrency technology have successfully transformed financial perceptions among the global community, while also creating new opportunities. One of the most notable outcomes of blockchain technology is Bitcoin a digital currency that has garnered significant attention. Transactions are conducted online and transferred directly from one party to another without involving financial institutions, leveraging the peer-to-peer concept of blockchain technology[1] Thanks to decentralized system unregulated by any financial institution Bitcoin has become a popular investment instrument.

However, behind the popularity and freedom of this decentralized system, the lack of regulation is a doubled-edged sword. Bitcoin can also be a high-risk asset if used as a store of value. The price of Bitcoin itself is highly volatile, so its value can undergo drastic changes in a short period and potentially yield disproportionate returns especially when compared to other investment instrument such as stocks and bonds. According to data Bitcoin's market capitalization reached USD 128.10 billion on May 30 2018 and continued to rise reaching USD1,156.48 billion on March 1 2021[2]. After a continuous to rise through 2021, Bitcoin's market capitalization stood at USD380.56 billion as of June 1 2022. This condition often points to a skewed distribution that does not follow a normal or non-Gaussian distribution and is more prone to extremely volatile price changes both increases and decreases all of which can occur within a short period[3].

Behind its volatile and uncertain market movements Bitcoin's underlying technology is actually designed to ensure secure and transparent transactions without relying on legislation [4]. Bitcoin itself features a sophisticated security infrastructure such as the Blockchain as every transaction is public and must be validated by network nodes [5]Every new Bitcoin transaction that is successfully verified within the Bitcoin network is added to the Blockchain in the form of a

called “block” a unit for data storage that is permanent and cannot alter the data record through the use of hashing functions[3]. Although the system used by Bitcoin is highly secure and decentralized investor attention often drives misguided momentum due to erroneous high expectations regarding Bitcoin’s future price. For example, research conducted by Brauneis et al show that increases in transaction costs and on-chain transaction volume are associated with increased liquidity[6]. Based on these research findings analysis of the Bitcoin market can be expanded to include factors such as the Blockchain the number of active wallets, transaction costs, and on-chain transactions volume all of which play distinct roles in influencing price movements and the stability of the Bitcoin market[7].

Based on the points explained above the idea arose to predict Bitcoin prices using on-chain data which can help minimize losses and of course increase investors’ profits when investing in Bitcoin. This is particularly important because Bitcoin price movements are influenced by various complex factors that are difficult to predict in advance. Prediction or forecasting is the process of estimating the value of data for a time period. The prediction process can occur if the patterns present in the training dataset are successfully identified and the processed using algorithms capable of handling time series data. Deep Learning is one application of the technology used to predict Bitcoin prices using input from on-chain data making it a viable option for predicting Bitcoin prices which are highly volatile.

One of the many effective and suitable Deep Learning algorithms for modelling Bitcoin prices and time-series data is the LSTM (Long Short-Term Memory) model which is well-suited for predicting Bitcoin prices. LSTM is also an evolution of the Recurrent Neural Network (RNN) algorithm used to predict Bitcoin prices it is a neural network designed to handle historical data and possesses the ability to retain long-term information[8]. LSTM addresses the vanishing gradient problem inherent in RNNs by retaining long-term information and identifying trend patterns in time series data [9]. The LSTM model is used to capture temporal dependencies making it more effective for modelling non-Gaussian time series a characteristic of Bitcoin [3].

LSTM itself has a limitation in that it only processes data in one direction, leading to the development of Bidirectional LSTM (BiLSTM), which consists of two LSTM networks: the first uses a forward layer to understand and process data information from the forward direction, and a backward layer to understand and process data information from the opposite direction.[10]. The fluctuating and unpredictable patterns of Bitcoin prices, when viewed from a single direction of the data sequence, can be better and more accurately recognized by BiLSTM by simultaneously utilizing information from both the left and right sides. Bitcoin itself is known for its high price volatility, and these price movements are also influenced by several factors, including on-chain factors such as transaction volume, tx_count, active_spending_addresses, and fee_btc.

Various previous studies have been conducted on similar topics. In 2023, Dian Islamiaty Puteri predicted the prices of three sharia-compliant stocks; ANTM.JK, UNVR.JK, and INDF.JK for the 2018–2023 period using a BiLSTM model, which processes data bidirectionally to capture patterns more effectively. The results showed that the BiLSTM model delivered the best results with MAPE values of 2.59%, 1.77%, and 1.05%, respectively, which fall into the category of highly accurate predictions[11]. Subsequently, in 2022, Mo Yang and Jing Wang conducted a study aimed at addressing the issue of low prediction accuracy in non-linear and volatile time series data. The dataset used consisted of closing price data for China's CSI 300 index. The method employed was BiLSTM, which processes data bidirectionally, yielding the best results with RMSE and MAPE values of 0.46 and 0.79, respectively, indicating the model's ability to generate accurate and stable predictions [12]

Therefore, the BiLSTM algorithm can be used as a hypothesis for predicting Bitcoin prices; this model is capable of handling the volatility and nonlinear data found in the Bitcoin market. By using BiLSTM, Bitcoin price predictions can be made using on-chain data as the model's input and the closing price as the target, resulting in more accurate predictions that can capture long-term price movement patterns

1.2 Problem Formulation

Based on the background of the study described above, the problem formulation for this study is as follows:

1. How is the BiLSTM architecture built?
2. How to use metric MAE, RMSE, and MAPE as a model evaluation?
3. How to deploy the model to website application?

1.3 Objective of the Research

Objective of the research as follow:

1. To predict the price of Bitcoin using on-chain data and the BiLSTM model.
2. To implement the resulting algorithmic model into a website application.

1.4 Significance of the Study

The benefits of the research as follow:

1. Academic Benefits:

This research hopes to make a significant contribution to the development of science and technology regarding Bitcoin price prediction using an on-chain data approach and the BiLSTM algorithmic model. The results of this research aim to serve as a reference for further development in the field of cryptocurrency market analysis, specifically in utilizing on-chain data to predict Bitcoin price movements.

2. Pratical Benefits:

This research is expected to provide direct benefits to investors, market analysts, and cryptocurrency industry players. By predicting Bitcoin price movements more accurately using data for risk management, it will benefit investors in making better decisions regarding buying or selling Bitcoin. Other results from this study can be utilized by financial application developers or cryptocurrency platforms to enhance their services by providing more accurate and data-driven predictive analysis.

3. Technological Benefits:

This research also contributes to the technological field by integrating the BiLSTM prediction model with a web application, which will subsequently allow users to access the Bitcoin price prediction model. This can serve as a solution for users who wish to track Bitcoin price movements easily and accurately by leveraging the BiLSTM model, while simultaneously applying artificial intelligence to process large-scale time series data.

1.5 Scope and Limitations

To maintain the focus and scope of this research, the limitations of this study are as follows:

1. The data used in this research is obtained from the BigQuery platform, which provides on-chain transaction data. The dataset utilized consists of on-chain data comprising (spent_volume_btc, active_addresses_spending, volume_btc, tx_count, and others).
2. This research does not discuss external factors such as government regulations related to Bitcoin, or the sentiments of prominent figures that can influence the price of Bitcoin. This research solely focuses on the analysis of on-chain data recorded in the Blockchain and its impact on Bitcoin price movements.