Cryptocurrency Price Predictor: *Crypto* Price Prediction Application with Comparison Of ARIMA, LSTM And SARIMAX Methods

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Abstract

Cryptocurrency telah menjadi inovasi teknologi informasi di bidang keuangan yang paling menarik perhatian investor, peneliti dan masyarakat lain dalam beberapa tahun terakhir di seluruh dunia. Penelitian ini bertujuan untuk mengembangkan aplikasi prediksi harga cryptocurrency dengan hasil perbandingan kinerja tiga metode prediksi yang populer: Autoregressive Integrated Moving Average (ARIMA), Long Short-Term Memory (LSTM), dan Seasonal Autoregressive Integrated Moving Average with Exogenous Factors (SARIMAX). Dalam penelitian ini, dikumpulkan data historis harga cryptocurrency dari sumber terpercaya kemudian melatih dan membangun metode-metode tersebut untuk memprediksi harga cryptocurrency di 2 tahun ke depan. Kinerja masing-masing metode dievaluasi berdasarkan metrik akurasi prediksi Mean Absolute Percentage Error (MAPE) dan Root Mean Squared Error (RMSE) pada LSTM. Hasil penelitian ini menunjukkan metode LSTM lebih unggul dalam menangkap dependensi jangka panjang dan pola non-linear yaitu mendapatkan rata-rata akurasi 5,1%.

Keywords: *Cryptocurrency, Price Prediction, ARIMA, LSTM, SARIMAX*

Abstract

Cryptocurrencies have become innovations in financial information technology in recent years worldwide for investors, researchers, and other communities. This study aims to develop a cryptocurrency price prediction application with the results of a performance comparison of three popular prediction methods: Autoregressive Integrated Moving Average (ARIMA), Long Short-Term Memory (LSTM), and Seasonal Autoregressive Integrated Moving Average with Exogenous Factors (SARIMAX). In this study, historical cryptocurrency price data was collected from trusted sources and then trained and built these methods to predict cryptocurrency prices in the next 2 years. The performance of each method was evaluated based on the prediction accuracy metrics Mean Absolute Percentage Error (MAPE) and Root Mean Squared Error (RMSE) on LSTM. The results of this study indicate that the LSTM method is superior in capturing long-term dependencies and non-linear patterns, with an average accuracy of 5.1%.

Keywords: *Cryptocurrency, Price Prediction, ARIMA, LSTM, SARIMAX*

1. Introduction

In line with the development of technology, people are constantly looking for new ways to achieve success. Therefore, the rapid development of technology has been adopted in various financial mechanisms, including the use of *cryptocurrencies* [13].

The rapid development of technology has made every human activity now highly dependent on technology, including in the financial sector. One example of technological development in finance is the presence of *cryptocurrency*. *Cryptocurrency* is a digital currency that comes from a series of codes or can be called a *blockchain*. The value and popularity of *cryptocurrency* in the eyes of the world has experienced a significant increase. *Cryptocurrency* has become an investment option that attracts the interest of Indonesians because it offers the potential for high returns. According to the Commodity Futures Trading and Supervisory Agency (BAPPEBTI), *cryptocurrency* investors in March 2021 reached 4.45 million investors, an increase of 78% compared to the end of 2020 which only reached 2.5 million investors. This makes it an attractive investment option for investors, traders, financial institutions, and even the public [22].

The first *cryptocurrency* introduced by Satoshi Nakamoto in January 2009 was Bitcoin. Today, Bitcoin has assumed an important role as legal tender for

various types of transactions, ranging from the purchase of gaming services, gaming equipment, to other goods and services. This has led to the increasing popularity of Bitcoin and the emergence of various other *cryptocurrencies* such as *Bitcoin, Ethereum, Binance Coin, Ripple, Dogecoin,* and others. The ability to invest using cryptocurrencies has undergone significant development, making it a highly desirable investment instrument [5]. Therefore, an application that needs that can be used to see predictions of the value of *cryptocurrency* in the future and become a reference in the process of buying and selling *cryptocurrency*. [6].

Predicting *cryptocurrency* price movements is important for investors in this trade or investment. To understand and predict *cryptocurrency* price movements, the most frequently used and promising result is the use of *time series* algorithms. This research will use historical *cryptocurrency* price data for the last 2 years, namely from 2020-2022.

The use of *time series* algorithms in *Bitcoin* price analysis can provide several benefits. The use of this algorithm allows us to identify patterns of price movement in historical data. *Time series* can detect trends, cycles, or short-term fluctuations that may repeat themselves and can be used to make predictions. In addition, the use of *time series* algorithms also allows the development of *cryptocurrency* price prediction applications that can be used by investors and traders. This application will provide information that can be used for decision-making, helping them manage risks and identify future opportunities.

2. Research Methodology

The research methodology describes how to make *crypto* price predictions using the ARIMA, LSTM and SARIMAX methods and then implemented in a website application. The following is a picture of the stages carried out in this study

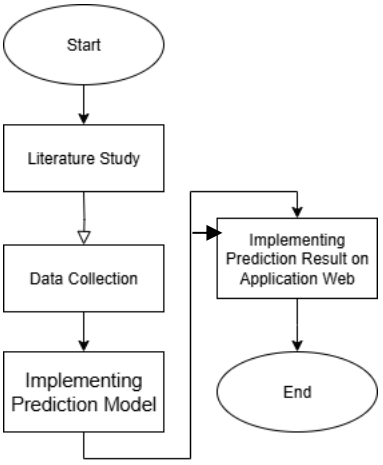


Figure 1 research flow

Figure 1 is the stages of the *cryptocurrency price predictor* research: *crypto* price prediction application with comparison of ARIMA, LSTM and SARIMAX methods. The *flowchart* above starts with a literature study, which is the stage of searching for information through journals and materials related to prediction research using previous time series. The next flow is to collect historical data on *crypto* prices. The historical data used comes from the *yahoo finance website*. Historical data is stored in .csv form and then proceeds to the prediction model implementation stage. The prediction model implementation stage is the stage of doing things starting from EDA to making data visualization. The last stage is implementing the prediction results to the *website* that has been created using the Laravel *framework* in the form of a more attractive graph.

2.1 Overview of Model Implementation Flow

An overview of the implementation flow of the model used to process historical data.
An overview of the model implementation flow is shown in the figure below.

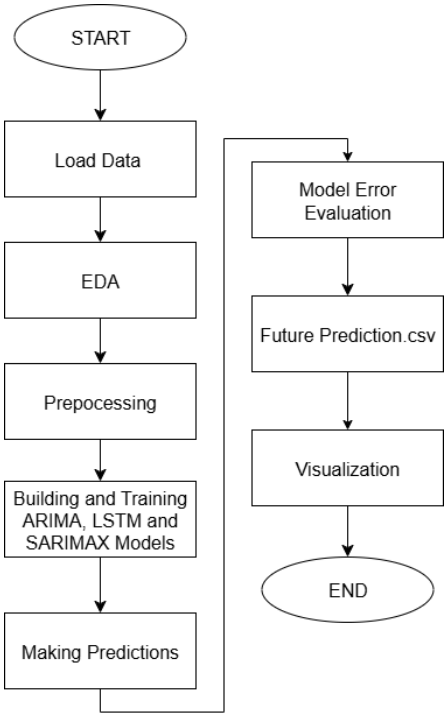


Figure 2 overview of model implementation

Figure 2 is the flow of model implementation used in *forecasting*. After the data used is collected, then load or import the data into the data processing engine used, namely *Google Colab* to carry out the next processing process. The next step is to do *Exploratory Data Analysis* (EDA), which is an important thing to do in the data analysis process used to understand the data. EDA helps to get an overview of the data, including its characteristics, structure, and patterns. After doing EDA is to do data *Pre-Processing*, this step is to check whether the data is generally incomplete, dirty/noise, and inconsistent which will have a big effect on the results of the data mining process. The pre-processing that is done is data *splitting*. Data *splitting* is used to divide the data used into test data and training data. Data division is carried out where it is expected that accuracy can be measured from the model used. Furthermore, building the models used are ARIMA, LSTM and SARIMAX models. The model is trained using the parameters that have been set then tested to build and train the model. Furthermore, after building and training the model using the parameters set, the model makes predictions using test data. Model evaluation is done with two metrics, namely MAPE. Furthermore, the model performs future predictions or predictions of future values to be used as a decision-making aid and visualizes using a line graph to see changes in time series data over time.

2.2 Website Application Overview

The overview of the website application is an overview of the *website* application that will be created. Figure 2 below is an overview of the website application.

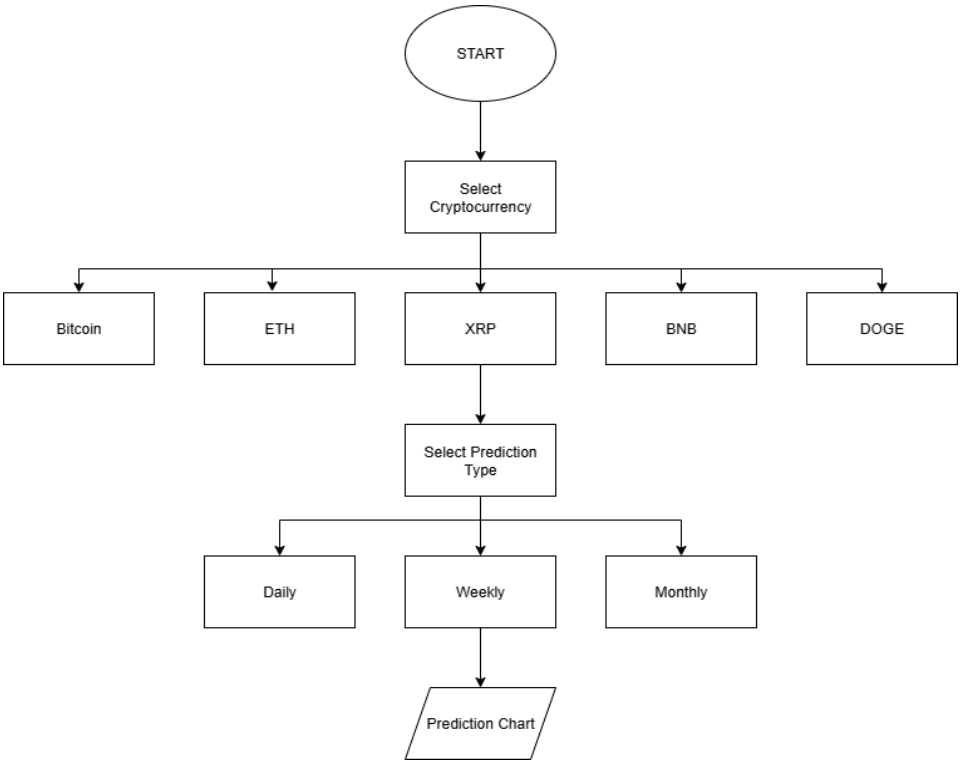


Figure 3 System overview

Figure 3 is an overview of the *website* application created. Judging from the picture, the stage begins when the *user* opens this application the *user* will be given the option to choose the *cryptocurrency* that you want to see the prediction. Then, the user will also be given a choice of the type of prediction he wants to see based on daily, weekly or monthly. Then the application will display a graph according to the *user's* decision.

3. Results and Discussion

The results and discussion describe the results obtained from the research of *cryptocurrency price predictor* crypto price prediction applications with the comparison of ARIMA, LSTM and SARIMAX methods along with forecasting evaluation values that have obtained results. Visualization of data evaluation from the best model is displayed in a line graph.

3.1 Model Results and Evaluation

After the historical *crypto* price data is processed using the ARIMA, LSTM, and SARIMAX methods, the following evaluation results are obtained for each model. The following table shows the results and comparison of each model.

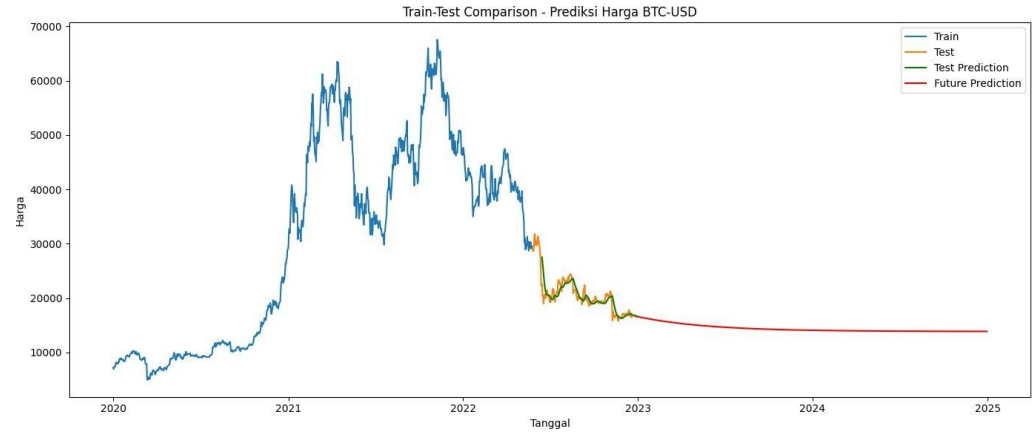
Table 1

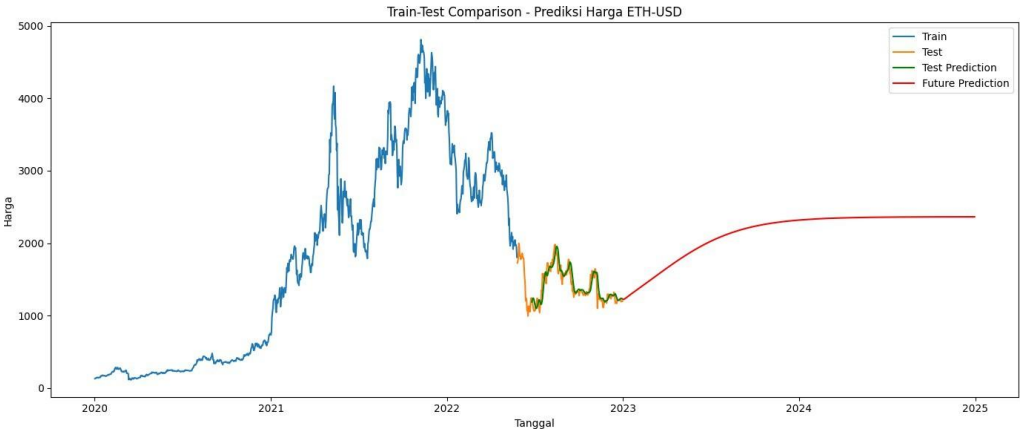
Coin Type	Evaluation Value (MAPE)		
	ARIMA	LSTM	SARIMAX
Bitcoin	20%	5.6%	3%
ETH	24%	4.37%	7%
BNB	14%	2.65%	4%
XRP	32%	6.10%	10%
Doge Coin	23%	6.75%	13%
Average	22.6%	5.1%	7.4%

Based on Table 1. is a table to see a comparison of the evaluation value of each model. To see the performance of the MAPE value model evaluation, it can be seen if the MAPE value produces a value of <10% then the prediction results are declared very good, and the MAPE value> 50% then the prediction results are declared bad. Based on these criteria, the results of the average MAPE of each model used are obtained. At the MAPE value with the average that gets the best results, namely <10% is the LSTM model. This LSTM model produces a stable MAPE value that gets a very good MAPE value on each coin. This is due to LSTM's ability to handle non-stationary data, capture non-linear patterns, utilize data sequences, adapt various features, and learn from large datasets. This makes LSTM more suitable for modeling the complex dynamics and volatility often seen in the *cryptocurrency* market.

3.2 LSTM Visualization

LSTM visualization is a visualization of data that has been processed and produces prediction results using LSTM. LSTM is the result of this model chosen to be displayed in the *website* application created because it gets the best error evaluation results among other models. Visualization of the LSTM model can be seen as follows.





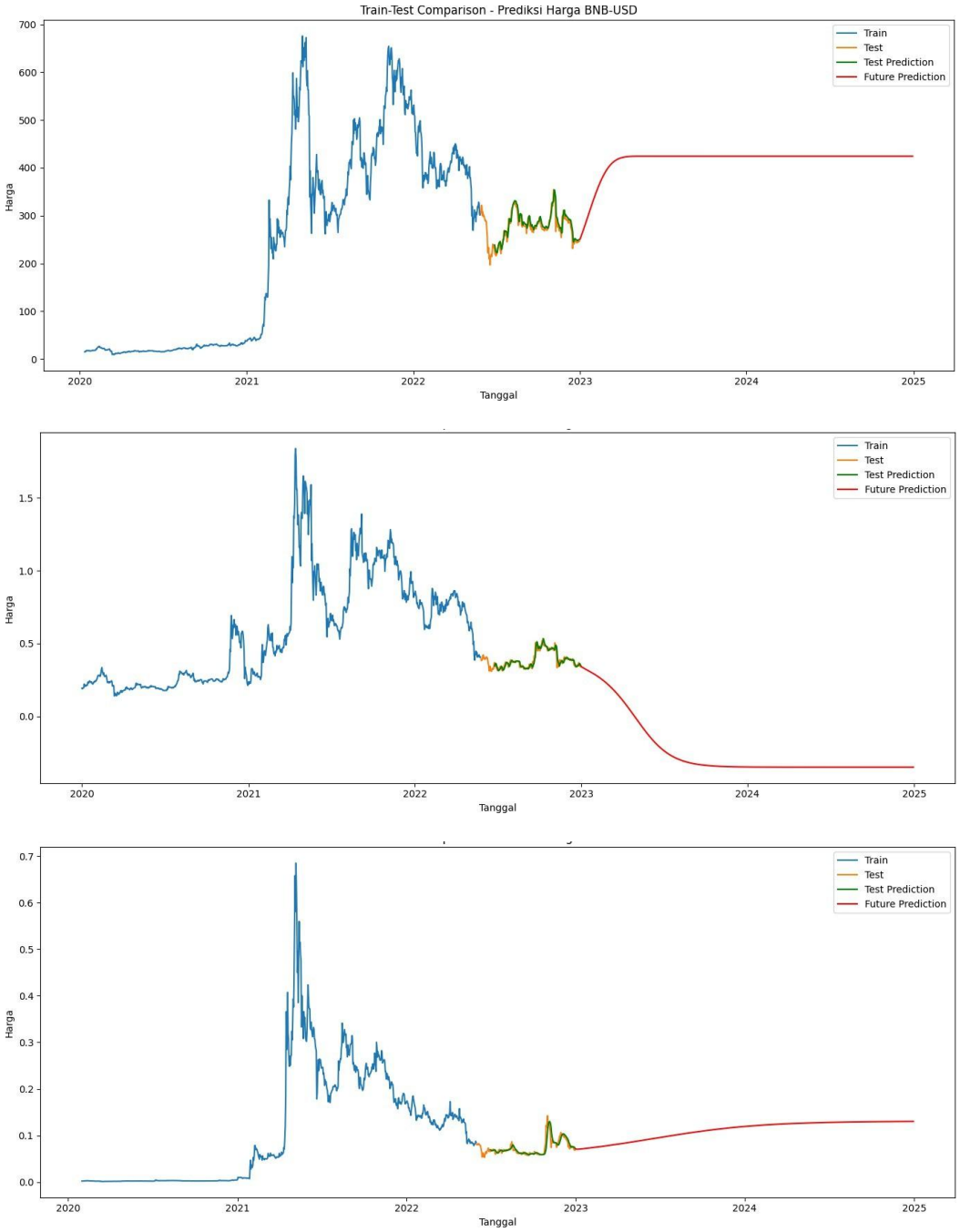


Figure 4 Visualization of LSTM

Figure 4. is a visualization generated from the results of historical price predictions that have been processed using the LSTM method of each coin used. It can be seen that the yellow and green lines are the graph lines of the test data and prediction test data, where the resulting graph lines successfully match the original data. This is because LSTM successfully captures the movement pattern by the LSTM prediction model.

3.3 System Interface Display Results

The interface of the cryptocurrency price predictor system with the comparison of ARIMA, LSTM and SARIMAX methods was successfully created. *cryptocurrency* price predictor crypto price prediction application with the comparison of ARIMA, LSTM and SARIMAX methods was created using the Laravel *framework* using the PHP programming language. Display

The interface of the *cryptocurrency* price predictor *crypto* price prediction application with the comparison of ARIMA, LSTM and SARIMAX methods is shown in Figure 5.



Figure 5 Home Page Display

Figure 5 is the *home page of* the web application when it is first opened. This display contains the name of the *website* application along with a brief description of the application. In addition to the initial appearance on this page also if the user scrolls the page there is a list of predicted coins. Figure 6 is a picture of the coin list display.

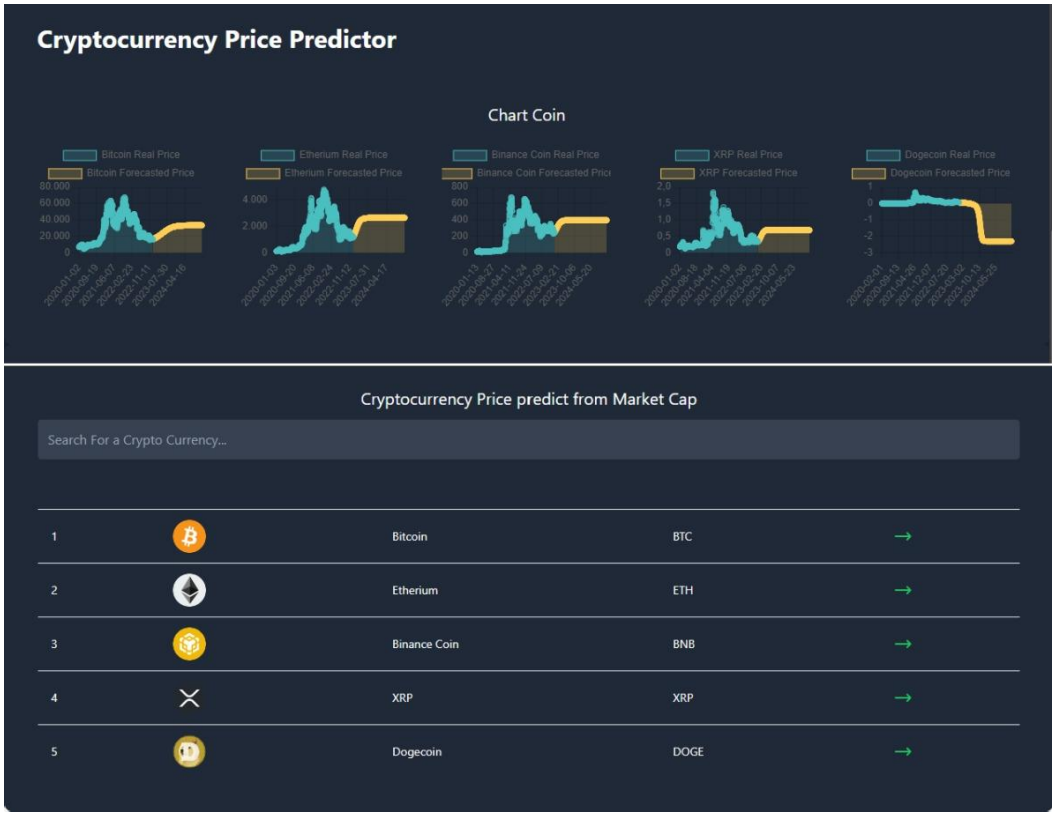


Figure 6 Coin List Display

Figure 6 is a display that contains a list of coins predicted in this study, there are five types of coins as predicted, namely Bitcoin, ETH, XRP, BNB, and Dogecoin. In addition, at the top of the list, there is a search column that can be used by users to search for coins that they want to see predictions, and there is also a display of all coin charts that are expected to make it easier for users to see which coins have good predictions in the next day. Figure 5 is the display if the user selects one of the coins that he wants to see the prediction.

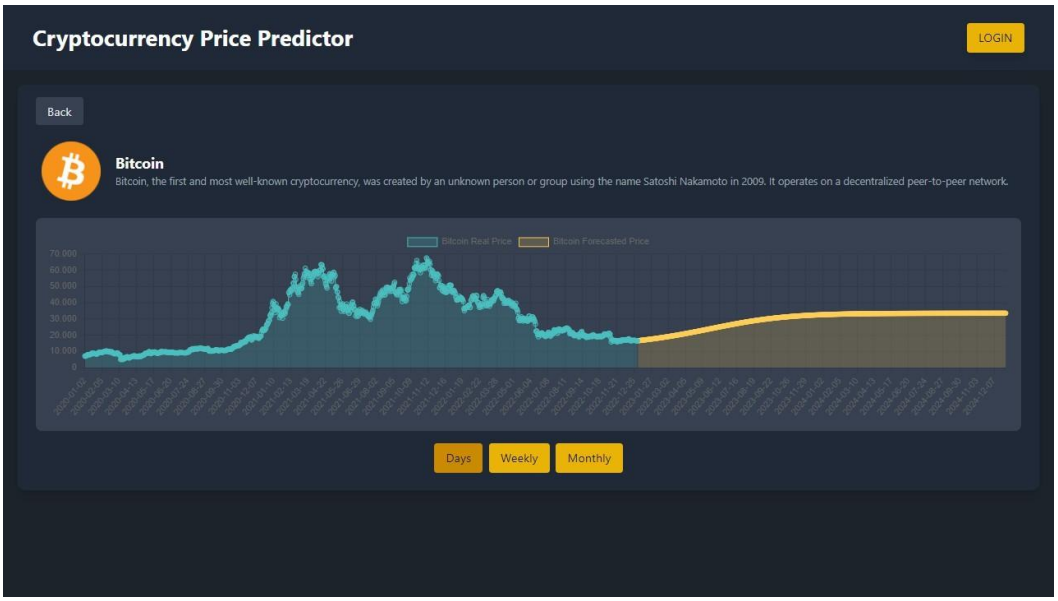


Figure 7 Display when selecting Coin

Figure 7 is a picture of the display when the user selects one of the coins to see its prediction. This page contains the name of the selected coin, a brief description of the coin, and also contains a graph that displays a comparison of the original data and the results of the prediction calculation done before, below the graph also contains options that can be used by users to see the results of prediction calculations based on weekly or monthly.

4. Conclusions and Suggestions

The results of the *cryptocurrency* price predictor research crypto price prediction application with the comparison of ARIMA, LSTM and SARIMAX methods are the evaluation results of the LSTM method are superior in capturing long-term dependencies and *non-linear* patterns because the evaluation results produced by the LSTM model are stable in each coin, namely getting a MAPE value always <10% with an average accuracy of 5.1% which in the MAPE criteria that the MAPE results <10% indicate excellent prediction criteria. So that the prediction results of the LSTM Model will be used to display its visualization in the website application created. Suggestions that can be given for the future are to try to make predictions using other *time series* methods in order to find out if there are methods that are more suitable and good for making *crypto* price predictions besides the LSTM method.

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