ETHEREUM CRYPTOCURRENCY PRICE MOVEMENT PREDICTION SYSTEM USING TRIPLE EXPONENTIAL SMOOTHING METHOD

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Abstract

An innovation that was sparked is an alternative currency to replace conventional currency, namely digital currency that is secured using a cryptographic method called Cryptocurrency. However, cryptocurrency prices cannot be controlled, causing massive fluctuations. Cryptocurrency price changes are very stable due to several factors such as speculation from users and the nature of the follow-up from new to one of the causes. The cause of this bandwagon is due to extreme price increases in a short time, even within a day the price of Crypto can experience a difference of millions of rupiah for each increase and decrease. To answer this question, we need a software that can predict the Rupiah exchange rate. By using the Triple Exponential Smoothing prediction method. In implementing Triple Exponential Smoothing, historical data is needed which will later be processed to produce prediction results, for that we need parameters that can be used as historical data counters, in this study used parameters 0.40 as parameters Xt and S't and 0.60 as Beta parameters. In the process, starting from calculating the first to third smoothing, ensuring Constants, Slopes, and Parabolics, to completing the process by producing Forecasting, the results of the measurement of the margin error level with a margin of error of 0.94638% using data for the final 2021 period, which is between November - December on the Triple Exponential implementation simulation and on the implementation into the system that has been developed is 3.7249% using data from May 2022 to June 2022.

Keywords: Ethereum, Crypto, Triple Exponential Smoothing, Prediction, Price

1. INTRODUCTION

The ease of internet access and the development of information technology, which from year to year is getting more advanced and rapidly growing every year, makes the growth of online commerce (e-commerce) grow so rapidly. The public has gained convenience in transacting with various convenience features offered in every process, from sales, delivery, to receipt of goods and services. This is also supported by the consumerism behavior of the community due to the increasingly diverse needs of the community. These developments have made the circulation of currency in cyberspace more and more, but in the financial system, especially currency, it is considered still limited due to regulations from the government, banking companies and Central Banks which have limitations such as privacy issues, inflation, transaction fees, and so on. not to mention the intervention of financial brokers who take profits unilaterally which harms the community.

To answer this problem, an innovation was initiated, namely an alternative currency to replace conventional currency, namely digital currency which is observed using the cryptographic method. In a journal written by Joey Conway that the concept of Cryptocurrency is introduced in general, Joey Coway sparked a concept of a currency that uses the concept of cryptography to maintain the privacy of the owner's confidentiality, which is named DigiCash. This concept was given the name Cryptocurrency in the future. Cryptocurrency answers the problems of the conventional financial system that relies heavily on third parties such as banks and financial institutions or companies such as Paypal, Visa and Mastercard. However, due to several obstacles in its development. It was only in 2008 that the first cryptocurrency was created under the name Bitcoin by Satoshi Nakamoto whose real identity is unknown. The whereabouts of Satoshi Nakamoto is an unsolved mystery. (Ferry Mulyanto dan M Titra Mulia 2015)

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One of the digital transactions used to record transactions made with cryptocurrencies such as ethereum, bitcoin and others is the blockchain. (Macedo, 2018). Cryptocurrency prices cannot be controlled, causing massive fluctuations. Cryptocurrency price changes are very unstable due to several factors such as a lot of speculation from its users and the follow-up nature of new users being one of the causes. The cause of this bandwagon is due to extreme price increases in a short period of time, even within a day the price of Bitcoin can experience a difference of millions of rupiah for each increase and decrease. Many factors affect cryptocurrency prices ranging from speculation, economic conditions, government regulations or policies, central bank decisions, and others.

To answer these problems, we need a software that can predict the exchange rate of CryptocurrencyEthereum against Rupiah. The software uses a mathematical method that can predict the movement of the Ethereum-Rupiah Cryptocurrency exchange rate in the future.

2. LITERATURE REVIEW
Research flowchart
The research flow chart is a description of the research steps, starting from needs analysis, data collection, system design, system creation, and system testing.
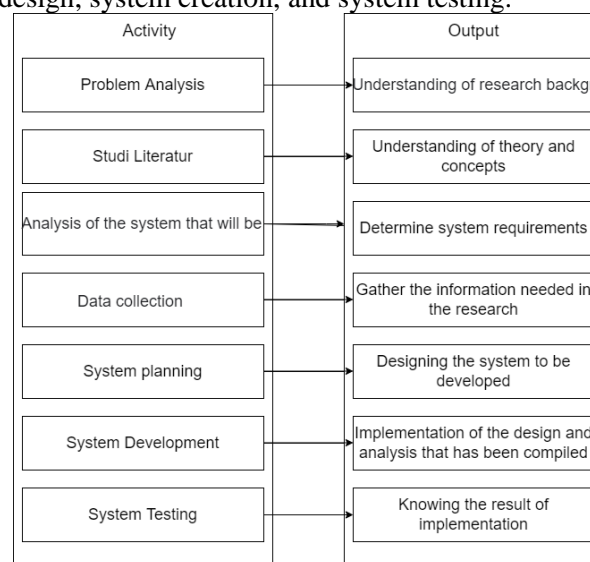
Image 1. Research Design Diagram

System planning
In the process of developing a system, system design is very important which describes the results of the analysis that has been carried out into visual depictions such as using flowcharts or flowcharts or data diagrams such as DFD (Data Flow Diagrams) and Context Diagrams. That way the flow of the system to be built will be easier to understand in the development process as shown in image 1 :
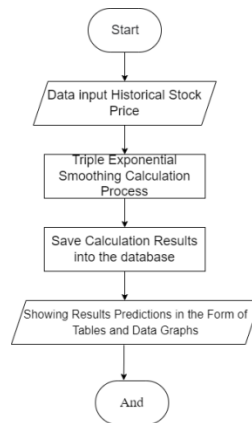
Image 2. Flowchart Of the System Built

Context diagram

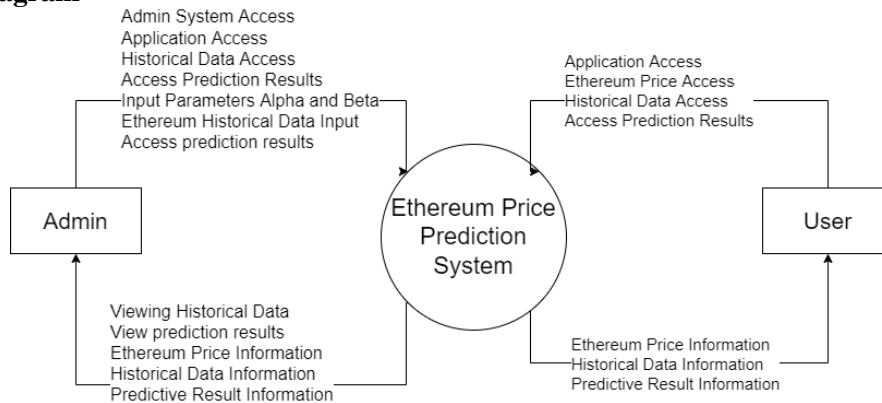**Image 3. Context diagram**

In image 3 there is a context diagram made to describe the whole of the system being built. Describe the context of the system by describing the input, process and output of the system.
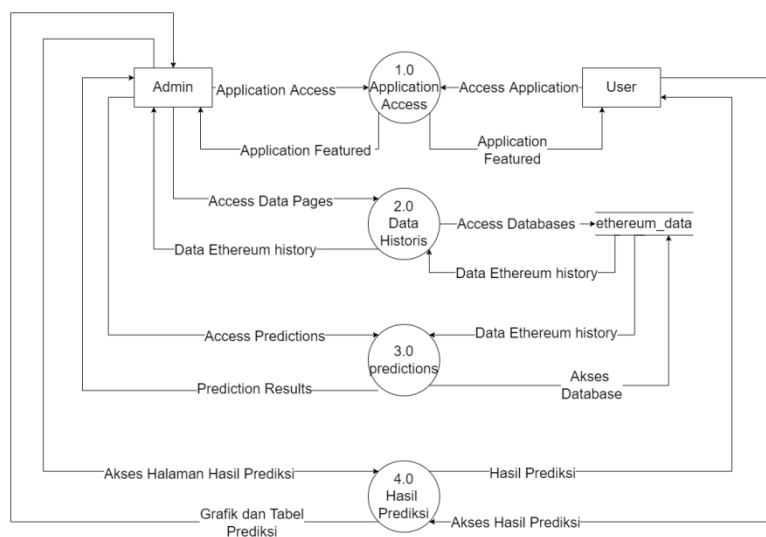
DFD level 1

Image 4. DFD level 1

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Historical data table

Table 2.1 Historical data tabel

Field	Type	Width	Description
Id	INT	11	Primary Key
Date	Varchar	50	
Open	Varchar	50	
Close	Varchar	50	
High	Varchar	50	
Low	Varchar	50	

Table 2.2 Historical data tabel

Field	Type	Width	Description
Id	INT	11	Primary Key
Parameter	Varchar	50	
API_KEY	Varchar	50	

3. IMPLEMENTATION METHOD

Triple Exponential Smoothing Implementation for Ethereum Cryptocurrency Price Prediction

The implementation of Triple Exponential Smoothing on Ethereum price predictions is carried out in various ways, from historical data preparation to visualization of the final results of Ethereum predictions and market prices using graphs and data tables. The historical data used starts from the end of 2021 which will later be processed with Triple Exponential Smoothing. In this chapter only the last 50 data will be used. As in the flowchart below.
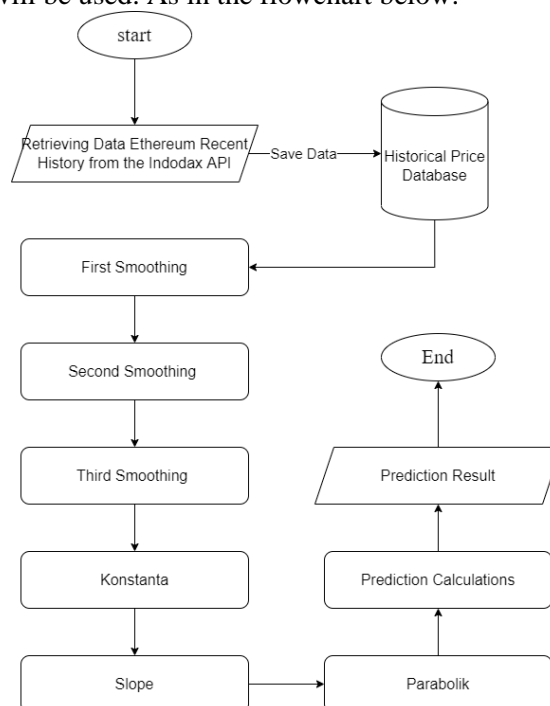

Image 5. Triple Exponential Smoothing Implementation Flow

Historical data used

Table 3 is the historical data used in this study which has been adjusted to the needs. Obtained from the indodax data server.

Table 3.1 Historical Ethereum Price Historical Data Table – IDR 50 last days

No	Date	Price			
		Close	Open	High	Low
1	1/1/2022	Rp. 54,029,000	Rp. 53,119,000	Rp. 54,084,000	Rp. 52,934,000
2	31/12/2021	Rp. 53,119,000	Rp. 53,453,000	Rp. 54,639,000	Rp. 52,500,000
3	30/12/2021	Rp. 53,453,000	Rp. 52,360,000	Rp. 54,182,000	Rp. 52,001,000
4	29/12/2021	Rp. 52,360,000	Rp. 54,653,000	Rp. 55,090,000	Rp. 52,180,000
5	28/12/2021	Rp. 54,721,000	Rp. 57,521,000	Rp. 57,521,000	Rp. 54,380,000
6	27/12/2021	Rp. 57,521,000	Rp. 57,650,000	Rp. 58,508,000	Rp. 57,500,000
7	26/12/2021	Rp. 57,650,000	Rp. 58,145,000	Rp. 58,205,000	Rp. 57,080,000
8	25/12/2021	Rp. 58,146,000	Rp. 57,360,000	Rp. 58,502,000	Rp. 57,290,000
9	24/12/2021	Rp. 57,360,000	Rp. 58,160,000	Rp. 58,500,000	Rp. 57,273,000
10	23/12/2021	Rp. 58,149,000	Rp. 56,900,000	Rp. 58,675,000	Rp. 55,719,000
11	22/12/2021	Rp. 56,900,000	Rp. 57,533,000	Rp. 57,980,000	Rp. 56,505,000
12	21/12/2021	Rp. 57,533,000	Rp. 56,763,000	Rp. 58,000,000	Rp. 56,355,000
13	20/12/2021	Rp. 56,759,000	Rp. 56,500,000	Rp. 57,192,000	Rp. 54,500,000
14	19/12/2021	Rp. 56,516,000	Rp. 57,067,000	Rp. 57,680,000	Rp. 56,128,000
15	18/12/2021	Rp. 57,029,000	Rp. 56,137,000	Rp. 57,417,000	Rp. 54,745,000
16	17/12/2021	Rp. 56,137,000	Rp. 57,001,000	Rp. 57,351,000	Rp. 53,700,000
17	16/12/2021	Rp. 57,001,000	Rp. 57,578,000	Rp. 58,999,000	Rp. 57,000,000
18	15/12/2021	Rp. 57,578,000	Rp. 55,636,000	Rp. 58,580,000	Rp. 52,958,000
19	14/12/2021	Rp. 55,638,000	Rp. 55,222,000	Rp. 55,854,000	Rp. 53,558,000
20	13/12/2021	Rp. 55,222,000	Rp. 59,500,000	Rp. 59,633,000	Rp. 53,500,000
21	12/12/2021	Rp. 59,571,000	Rp. 58,889,000	Rp. 60,000,000	Rp. 57,800,000
22	11/12/2021	Rp. 58,889,000	Rp. 56,900,000	Rp. 59,000,000	Rp. 56,123,000
23	10/12/2021	Rp. 56,901,000	Rp. 59,554,000	Rp. 60,816,000	Rp. 56,800,000

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24	9/12/2021	Rp. 59,592,000	Rp. 63,624,000	Rp. 64,182,000	Rp. 59,150,000
25	8/12/2021	Rp. 63,624,000	Rp. 61,957,000	Rp. 63,800,000	Rp. 61,285,000
26	7/12/2021	Rp. 61,957,000	Rp. 62,825,000	Rp. 63,738,000	Rp. 61,346,000
27	6/12/2021	Rp. 62,825,000	Rp. 61,278,000	Rp. 63,147,000	Rp. 57,746,000
28	5/12/2021	Rp. 61,278,000	Rp. 60,886,000	Rp. 62,000,000	Rp. 59,225,000
29	4/12/2021	Rp. 60,886,000	Rp. 61,744,000	Rp. 61,744,000	Rp. 56,500,000
30	3/12/2021	Rp. 61,744,000	Rp. 65,075,000	Rp. 66,832,000	Rp. 60,000,000
31	2/12/2021	Rp. 65,052,000	Rp. 66,026,000	Rp. 66,685,000	Rp. 64,200,000
32	1/12/2021	Rp. 66,026,000	Rp. 66,528,000	Rp. 68,628,000	Rp. 65,421,000
33	30/11/2021	Rp. 66,528,000	Rp. 63,525,000	Rp. 67,897,000	Rp. 62,010,000
34	29/11/2021	Rp. 63,468,000	Rp. 61,688,000	Rp. 63,777,000	Rp. 61,485,000
35	28/11/2021	Rp. 61,688,000	Rp. 59,304,000	Rp. 61,716,000	Rp. 57,792,000
36	27/11/2021	Rp. 59,304,000	Rp. 58,600,000	Rp. 60,523,000	Rp. 58,513,000
37	26/11/2021	Rp. 58,621,000	Rp. 64,514,000	Rp. 64,898,000	Rp. 57,501,000
38	25/11/2021	Rp. 64,514,000	Rp. 61,174,000	Rp. 64,900,000	Rp. 60,900,000
39	24/11/2021	Rp. 61,174,000	Rp. 62,003,000	Rp. 62,474,000	Rp. 59,917,000
40	23/11/2021	Rp. 62,003,000	Rp. 58,775,000	Rp. 62,523,000	Rp. 58,377,000
41	22/11/2021	Rp. 58,775,000	Rp. 61,054,000	Rp. 61,585,000	Rp. 58,000,000
42	21/11/2021	Rp. 61,054,000	Rp. 62,954,000	Rp. 63,020,000	Rp. 60,927,000
43	20/11/2021	Rp. 62,954,000	Rp. 61,502,000	Rp. 63,180,000	Rp. 60,309,000
44	19/11/2021	Rp. 61,501,000	Rp. 57,492,000	Rp. 61,600,000	Rp. 57,269,000
45	18/11/2021	Rp. 57,492,000	Rp. 61,496,000	Rp. 62,200,000	Rp. 57,001,000
46	17/11/2021	Rp. 61,496,000	Rp. 60,696,000	Rp. 61,500,000	Rp. 58,900,000
47	16/11/2021	Rp. 60,733,000	Rp. 65,500,000	Rp. 65,500,000	Rp. 59,764,000
48	15/11/202	Rp.	Rp.	Rp.	Rp.

		1	65,500,000	66,061,000	67,693,000	65,050,000
49	14/11/202 1	Rp. 66,062,000	Rp. 66,321,000	Rp. 66,857,000	Rp. 64,800,000
50	13/11/202 1	Rp. 66,353,000	Rp. 66,750,000	Rp. 67,181,000	Rp. 65,600,000

The above data will be used in the prediction process using Triple Exponential Smoothing to find out future prices.

Triple Exponential Smoothing

The next step is to make predictions using triple exponential smoothing, where the prediction calculation phase will be carried out using pre-determined parameters. Using predefined historical data.

Table 3.2 Simulation Data

No	Date	Price			
		Close	Open	High	Low
1	1/1/2022	Rp. 54,029,000	Rp. 53,119,000	Rp. 54,084,000	Rp. 52,934,000

1. First Smoothing

$$S't = aXt + (1 - a)S't - 1 \dots\dots\dots (4.1)$$
$S'1 = Rp\ 54,029,000$
$S'2 = (0.4)\ Rp.53,119,000 + (0.6)Rp\ 54,029,000 - 1 = Rp.53,664,999$
$S'3 = (0.4)\ Rp.54,084,000 + (0.6)\ Rp.53,664,999 - 1 = Rp.53,832,598$
$S'4 = (0.4)\ Rp.52,934,000 + (0.6)Rp.53,832,598 - 1 = Rp.53,473,158$

2. Second Smoothing

$$S''t = aS't + (1 - a)S''t - 1 \dots\dots\dots (4.2)$$
$S''1 = Rp\ 54,029,000$
$S''2 = (0.4)\ Rp.53,664,999 + (0.6)Rp\ 54,029,000 - 1 = Rp.53,883,399$
$S'3 = (0.4)\ Rp.53,832,598 + (0.6)\ Rp.53,883,399 - 1 = Rp.53,863,078$
$S'4 = (0.4)\ Rp.53,473,158 + (0.6)\ Rp.53,863,078 - 1 = Rp53,707,109$

3. Third Smoothing

$$S'''t = aS''t + (1 - a)S'''t - 1 \dots\dots\dots(4.3)$$
$S''1 = Rp\ 54,029,000$
$S''2 = (0.4)\ Rp.53,883,399 + (0.6)Rp\ 54,029,000 - 1 = Rp.53,970,758$
$S'3 = (0.4)\ Rp.53,863,078 + (0.6)\ Rp.53,970,758 - 1 = Rp53,927,685$
$S'4 = (0.4)\ Rp53,707,109 + (0.6)\ Rp53,927,685 - 1 = Rp53,839,454$

4. Constanta

$$at = 3 * S't - 3 * S''t + S'''t \dots\dots\dots (4.4)$$
$a1 = 3 * Rp54,029,000 - 3 * Rp54,029,000 + Rp54,029,000 = Rp54,029,000$
$a2 = 3 * Rp.53,664,999 - 3 * Rp53,883,399 + Rp53,970,758 = Rp53,315,560$
$a3 = 3 * Rp53,832,598 - 3 * Rp53,863,078 + Rp53,927,685 = Rp53,836,248$
$a4 = 3 * Rp53,473,158 - 3 * Rp53,707,109 + Rp53,927,685 = Rp53,137,601.$

5. Slope

$$bt = \frac{a}{2(1-a)^2}[(6 - 5a)\ S't - (10 - 8a)\ S''t + (4 - 3a)S'''t] \dots\dots\dots(4.5)$$
$b1 = \frac{0.4}{2(0.6)^2}[(6 - (5 * 0.4) * 0.6)\ Rp54,029,000 - (10 - (8 * 0.4) *$
$0.6)\ Rp54,029,000 + (4 - (3 * 0.4) * 0.6)\ Rp54,029,000] = 0$

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$$b2 = \frac{0.4}{2(0.6)^2} \; [(6 - (5*0.4)*0.6) \; Rp.53{,}664{,}999$$
$$- (10 - (8*0.4)*0.6) \; Rp53{,}883{,}399$$
$$+ (4 - (3*0.4)*0.6) \; Rp53{,}970{,}758 \;] = -Rp349{,}439$$

$$b3 = \frac{0.4}{2(0.6)^2} \; [(6 - (5*0.4)*0.6) \; Rp53{,}832{,}598$$
$$- (10 - (8*0.4)*0.6) \; Rp53{,}863{,}078$$
$$+ (4 - (3*0.4)*0.6) \; Rp53{,}927{,}685 \;] = Rp32{,}769$$

$$b4 = \frac{0.4}{2(0.6)^2} \; [(6 - (5*0.4)*0.6) Rp53{,}473{,}158$$
$$- (10 - (8*0.4)*0.6) \; Rp53{,}707{,}109$$
$$+ (4 - (3*0.4)*0.6) \; Rp53{,}927{,}685 \;] = -Rp314{,}021$$

6. Seasonal Trends (Parabolic)

$$ct = \frac{a^2}{(1-a)^2}(S't - 2S''t + S'''t) \quad\text{................(4.5)}$$

$$c1 = \frac{0.4^2}{(0.6)^2}(Rp54{,}029{,}000 - 2*Rp54{,}029{,}000 + Rp54{,}029{,}000) = 0$$

$$c2 = \frac{0.4^2}{(0.6)^2}(Rp.53{,}664{,}999 - 2*Rp53{,}883{,}399 + Rp53{,}970{,}758) = -Rp58{,}240$$

$$c3 = \frac{0.4^2}{(0.6)^2}(Rp53{,}832{,}598 - 2*Rp53{,}863{,}078 + Rp53{,}927{,}685)$$
$$= -Rp297{,}717$$

$$c4 = \frac{0.4^2}{(0.6)^2}(Rp.53{,}473{,}158 - 2*Rp.53{,}707{,}109 + Rp.53{,}839{,}454)$$
$$= -Rp413{,}543$$

7. Forecasting

$$Ft = at + bt + \frac{1}{2}ct \quad\text{................(4.6)}$$

$$F1 = Rp54{,}029{,}000 + 0 + \frac{1}{2}(0) = Rp54{,}029{,}000$$

$$F2 = Rp53{,}315{,}560 + -Rp349{,}439 + \frac{1}{2}(-Rp58{,}240) = Rp52{,}937{,}000$$

$$F3 = Rp53{,}836{,}248 + Rp32{,}769 + \frac{1}{2}(-Rp297{,}717) = Rp53{,}720{,}159$$

$$F4 = Rp53{,}137{,}601 + -Rp314{,}021 + \frac{1}{2}(-Rp413{,}543) = Rp52{,}616{,}809$$

Then the result obtained is

Table 3.3 Results

Close	Open	High	Low
Rp54,029,000	*Rp52,937,000*	*Rp53,720,159*	*Rp52,616,809*

Comparison of Predicted Results with Real Data

The next step is to do a comparison process between the predicted results and the real price by determining the difference and the percentage of the difference with the formula:
Difference:

$$Difference = Prediction\ Results - Real\ Prices$$

Persentase

$$Persentase = \frac{difference}{prediction\ results} * 100\%$$

Then the result obtained is:

Close

$$Difference = \text{Rp54,029,000} - \text{Rp54,029,000} = 0$$

Open

$$Difference = \text{Rp52,937,000} - \text{Rp. 53,119,000} = -\text{Rp182,000}$$

High

$$Difference = \text{Rp. 54,084,000} - \text{Rp53,720,159} = -\text{Rp363,841}$$

Low

$$Difference = \text{Rp52,616,809} - \text{Rp. 52,934,000} = -\text{Rp317,191}$$

The percentage results are as follows:

Close :

$$Persentase = \frac{(\text{Rp54,029,000} - \text{Rp54,029,000})}{\text{Rp54,029,000}} * 100\% = 0$$

Open :

$$Persentase = \frac{(\text{Rp52,937,000} - \text{Rp. 53,119,000})}{\text{Rp52,937,000}} * 100\% = 0.34380\%$$

High :

$$Persentase = \frac{(\text{Rp. 54,084,000} - \text{Rp53,720,159})}{\text{Rp. 54,084,000}} * 100\% = 0.67729\%$$

Low :

$$Persentase = \frac{(\text{Rp52,616,809} - \text{Rp. 52,934,000})}{\text{Rp52,616,809}} * 100\% = 0.60283\%$$

Then the results of the comparison between the prediction results with real prices are as follows:

Table 3.4 Comparison Results

Data	Close	Open	High	Low
Data Real	Rp. 54,029,000	Rp. 53,119,000	Rp. 54,084,000	Rp. 52,934,000
Prediction	*Rp54,029,000*	*Rp52,937,000*	*Rp53,720,159*	*Rp52,616,809*
Difference	Rp -	-Rp182,000	-Rp363,841	-Rp317,191
Persentase	0%	0.34380%	0.67729%	0.60283%

Prediction Results Sample data

The next step is to perform the same calculations as above using the same method for all previously stored data, which will later be calculated for 50 historical data. In this discussion, the Close price will be used because it is the closing price of Ethereum. Here are the results of the calculation:

Table 3.5. Sample data prediction results

No	Date	Close		Prediction		Diffrence		Persentase
1	1/1/2022	Rp	54,029,000	Rp	52,616,809	-Rp	317,191	0.60283%
2	31/12/2021	Rp	53,119,000	Rp	52,614,670	Rp	114,670	0.21794%
3	30/12/2021	Rp	53,453,000	Rp	51,740,319	-Rp	260,681	0.50382%
4	29/12/2021	Rp	52,360,000	Rp	52,560,899	Rp	380,899	0.72468%
5	28/12/2021	Rp	54,721,000	Rp	54,655,761	Rp	275,761	0.50454%
6	27/12/2021	Rp	57,521,000	Rp	57,737,102	Rp	237,102	0.41066%

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7	26/12/2021	Rp	57,650,000	Rp	56,940,705	-Rp	139,295	0.24463%
8	25/12/2021	Rp	58,146,000	Rp	57,133,390	-Rp	156,610	0.27411%
9	24/12/2021	Rp	57,360,000	Rp	57,445,721	Rp	172,721	0.30067%
10	23/12/2021	Rp	58,149,000	Rp	55,031,748	-Rp	687,252	1.24883%
11	22/12/2021	Rp	56,900,000	Rp	56,558,187	Rp	53,187	0.09404%
12	21/12/2021	Rp	57,533,000	Rp	56,097,025	-Rp	257,975	0.45987%
13	20/12/2021	Rp	56,759,000	Rp	53,740,964	-Rp	759,036	1.41240%
14	19/12/2021	Rp	56,516,000	Rp	56,215,740	Rp	87,740	0.15608%
15	18/12/2021	Rp	57,029,000	Rp	54,038,019	-Rp	706,981	1.30830%
16	17/12/2021	Rp	56,137,000	Rp	52,944,782	-Rp	755,218	1.42643%
17	16/12/2021	Rp	57,001,000	Rp	57,459,679	Rp	459,679	0.80000%
18	15/12/2021	Rp	57,578,000	Rp	51,601,355	-Rp 1,356,645		2.62909%
19	14/12/2021	Rp	55,638,000	Rp	52,831,614	-Rp	726,386	1.37491%
20	13/12/2021	Rp	55,222,000	Rp	53,476,035	-Rp	23,965	0.04482%
21	12/12/2021	Rp	59,571,000	Rp	57,284,515	-Rp	515,485	0.89987%
22	11/12/2021	Rp	58,889,000	Rp	55,278,220	-Rp	844,780	1.52823%
23	10/12/2021	Rp	56,901,000	Rp	57,483,291	Rp	683,291	1.18868%
24	9/12/2021	Rp	59,592,000	Rp	59,714,023	Rp	564,023	0.94454%
25	8/12/2021	Rp	63,624,000	Rp	60,590,571	-Rp	694,429	1.14610%
26	7/12/2021	Rp	61,957,000	Rp	61,470,403	Rp	124,403	0.20238%
27	6/12/2021	Rp	62,825,000	Rp	55,980,099	-Rp 1,765,901		3.15452%
28	5/12/2021	Rp	61,278,000	Rp	58,640,195	-Rp	584,805	0.99728%
29	4/12/2021	Rp	60,886,000	Rp	54,871,899	-Rp 1,628,101		2.96710%
30	3/12/2021	Rp	61,744,000	Rp	60,256,572	Rp	256,572	0.42580%
31	2/12/2021	Rp	65,052,000	Rp	64,176,550	-Rp	23,450	0.03654%
32	1/12/2021	Rp	66,026,000	Rp	65,807,295	Rp	386,295	0.58701%
33	30/11/2021	Rp	66,528,000	Rp	60,914,967	-Rp 1,095,033		1.79764%
34	29/11/2021	Rp	63,468,000	Rp	60,981,281	-Rp	503,719	0.82602%
35	28/11/2021	Rp	61,688,000	Rp	56,519,444	-Rp 1,272,556		2.25154%
36	27/11/2021	Rp	59,304,000	Rp	58,600,644	Rp	87,644	0.14956%
37	26/11/2021	Rp	58,621,000	Rp	58,021,827	Rp	520,827	0.89764%
38	25/11/2021	Rp	64,514,000	Rp	59,946,417	-Rp	953,583	1.59073%
39	24/11/2021	Rp	61,174,000	Rp	59,660,574	-Rp	256,426	0.42981%
40	23/11/2021	Rp	62,003,000	Rp	57,440,911	-Rp	936,089	1.62965%
41	22/11/2021	Rp	58,775,000	Rp	58,165,654	Rp	165,654	0.28480%
42	21/11/2021	Rp	61,054,000	Rp	61,173,305	Rp	246,305	0.40263%
43	20/11/2021	Rp	62,954,000	Rp	59,480,259	-Rp	828,741	1.39330%
44	19/11/2021	Rp	61,501,000	Rp	56,070,588	-Rp 1,198,412		2.13733%
45	18/11/2021	Rp	57,492,000	Rp	57,579,846	Rp	578,846	1.00529%

46	17/11/2021	Rp	61,496,000	Rp	57,956,097	-Rp	943,903	1.62865%
47	16/11/2021	Rp	60,733,000	Rp	60,078,103	Rp	314,103	0.52283%
48	15/11/2021	Rp	65,500,000	Rp	65,383,428	Rp	333,428	0.50996%
49	14/11/2021	Rp	66,062,000	Rp	64,474,830	-Rp	325,170	0.50434%
50	13/11/2021	Rp	66,353,000	Rp	65,471,023	-Rp	128,977	0.19700%

The results of the predictions above will be carried out in the data visualization process using line graphs or line charts. Where a comparison will be made between the original price and the prediction, the results are as follows:
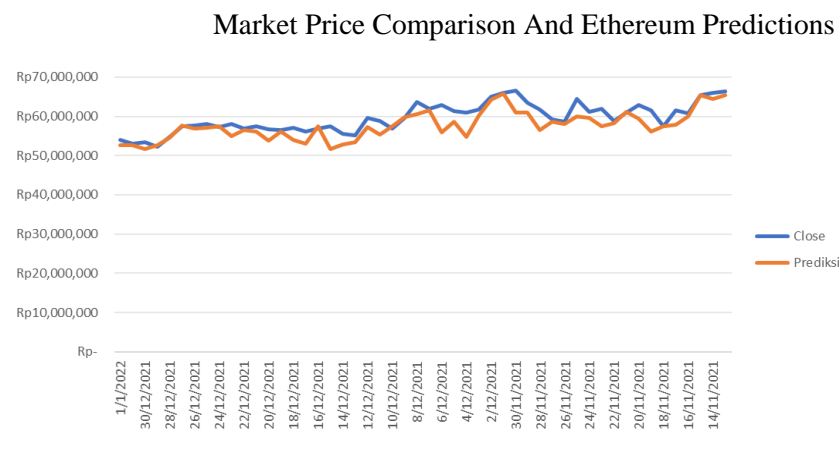

Image 6 Real and predicted price comparison chart

Based on the graph above, it can be seen that the prediction results and real prices have various differences that are not so significant. However, the chart pattern can be seen to have a similar movement to the real price pattern.

Measurement of Prediction Accuracy using MAPE (Mean Absolute Percentage Error)

After seeing the difference between the real price and the prediction, we can measure the accuracy by using the MAPE (Mean Absolute Percentage Error) method which looks for the average value of the difference in accuracy between the prediction results and the Real Tomorrow Data. Which is where this pin makes predictions on a daily basis or in the next 1 day level. With MAPE Formula:

$$Difference:$$
$$Difference = Prediction\ Result - Real\ Price\ Tomorrow$$

$$Persentase$$
$$Persentase = \frac{Difference}{Prediction\ Results} * 100\%$$

Then the result obtained is:

Table 3.6 Prediction Results

No	Date	Close	Prediction	Diffrence	Persentase
1	13/11/2021	Rp66,353,000	Rp 65,471,023	-Rp 590,977	0.19700%
2	14/11/2021	Rp66,062,000	Rp 64,474,830	-Rp 1,025,170	0.50434%
3	15/11/2021	Rp65,500,000	Rp 65,383,428	Rp 4,650,428	0.50996%
4	16/11/2021	Rp60,733,000	Rp 60,078,103	-Rp 1,417,897	0.52283%

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5	17/11/2021	Rp61,496,000	Rp 57,956,097	Rp 464,097	1.62865%
6	18/11/2021	Rp57,492,000	Rp 57,579,846	-Rp 3,921,154	1.00529%
7	19/11/2021	Rp61,501,000	Rp 56,070,588	-Rp 6,883,412	2.13733%
8	20/11/2021	Rp62,954,000	Rp 59,480,259	-Rp 1,573,741	1.39330%
9	21/11/2021	Rp61,054,000	Rp 61,173,305	Rp 2,398,305	0.40263%
10	22/11/2021	Rp58,775,000	Rp 58,165,654	-Rp 3,837,346	0.28480%
11	23/11/2021	Rp62,003,000	Rp 57,440,911	-Rp 3,733,089	1.62965%
12	24/11/2021	Rp61,174,000	Rp 59,660,574	-Rp 4,853,426	0.42981%
13	25/11/2021	Rp64,514,000	Rp 59,946,417	Rp 1,325,417	1.59073%
14	26/11/2021	Rp58,621,000	Rp 58,021,827	-Rp 1,282,173	0.89764%
15	27/11/2021	Rp59,304,000	Rp 58,600,644	-Rp 3,087,356	0.14956%
16	28/11/2021	Rp61,688,000	Rp 56,519,444	-Rp 6,948,556	2.25154%
17	29/11/2021	Rp63,468,000	Rp 60,981,281	-Rp 5,546,719	0.82602%
18	30/11/2021	Rp66,528,000	Rp 60,914,967	-Rp 5,111,033	1.79764%
19	1/12/2021	Rp66,026,000	Rp 65,807,295	Rp 755,295	0.58701%
20	2/12/2021	Rp65,052,000	Rp 64,176,550	Rp 2,432,550	0.03654%
21	3/12/2021	Rp61,744,000	Rp 60,256,572	-Rp 629,428	0.42580%
22	4/12/2021	Rp60,886,000	Rp 54,871,899	-Rp 6,406,101	2.96710%
23	5/12/2021	Rp61,278,000	Rp 58,640,195	-Rp 4,184,805	0.99728%
24	6/12/2021	Rp62,825,000	Rp 55,980,099	-Rp 5,976,901	3.15452%
25	7/12/2021	Rp61,957,000	Rp 61,470,403	-Rp 2,153,597	0.20238%
26	8/12/2021	Rp63,624,000	Rp 60,590,571	Rp 998,571	1.14610%
27	9/12/2021	Rp59,592,000	Rp 59,714,023	Rp 2,813,023	0.94454%
28	10/12/2021	Rp56,901,000	Rp 57,483,291	-Rp 1,405,709	1.18868%
29	11/12/2021	Rp58,889,000	Rp 55,278,220	-Rp 4,292,780	1.52823%
30	12/12/2021	Rp59,571,000	Rp 57,284,515	Rp 2,062,515	0.89987%
31	13/12/2021	Rp55,222,000	Rp 53,476,035	-Rp 2,161,965	0.04482%
32	14/12/2021	Rp55,638,000	Rp 52,831,614	-Rp 4,746,386	1.37491%
33	15/12/2021	Rp57,578,000	Rp 51,601,355	-Rp 5,399,645	2.62909%
34	16/12/2021	Rp57,001,000	Rp 57,459,679	Rp 1,322,679	0.80000%
35	17/12/2021	Rp56,137,000	Rp 52,944,782	-Rp 4,084,218	1.42643%
36	18/12/2021	Rp57,029,000	Rp 54,038,019	-Rp 2,477,981	1.30830%
37	19/12/2021	Rp56,516,000	Rp 56,215,740	-Rp 543,260	0.15608%
38	20/12/2021	Rp56,759,000	Rp 53,740,964	-Rp 3,792,036	1.41240%
39	21/12/2021	Rp57,533,000	Rp 56,097,025	-Rp 802,975	0.45987%
40	22/12/2021	Rp56,900,000	Rp 56,558,187	-Rp 1,590,813	0.09404%
41	23/12/2021	Rp58,149,000	Rp 55,031,748	-Rp 2,328,252	1.24883%
42	24/12/2021	Rp57,360,000	Rp 57,445,721	-Rp 700,279	0.30067%
43	25/12/2021	Rp58,146,000	Rp 57,133,390	-Rp 516,610	0.27411%

44	26/12/2021	Rp57,650,000	Rp 56,940,705	-Rp 580,295	0.24463%
45	27/12/2021	Rp57,521,000	Rp 57,737,102	Rp 3,016,102	0.41066%
46	28/12/2021	Rp54,721,000	Rp 54,655,761	Rp 2,295,761	0.50454%
47	29/12/2021	Rp52,360,000	Rp 52,560,899	-Rp 892,101	0.72468%
48	30/12/2021	Rp53,453,000	Rp 51,740,319	-Rp 1,378,681	0.50382%
49	31/12/2021	Rp53,119,000	Rp 52,614,670	-Rp 1,414,330	0.21794%
50	1/1/2022	Rp54,029,000	Rp 52,616,809	-	-
MAPE					**0.94638%**

System Implementation

System implementation is the process of implementing the Triple Exponential Smoothing method into a system that uses a programming language, in this study, the HTML5, CSS, PHP and JavaScript Web programming languages were used.

Setting Up Latest Ethereum Data

At this stage, the latest data will be used to be input into the system that has been made so that the prediction results can be known. Then the data used are:

1. Setting Up Latest Ethereum Data

At this stage, the latest data will be used to be input into the system that has been made so that the prediction results can be known. Then the data used are:

Table 3.7. Data used in data testing

No	Date	Close	Open	High	Low
1	13/06/2022	19.704.000	21.050.000	21.333.000	19.667.000
2	12/06/2022	21.050.000	22.411.000	22.577.000	21.003.000
3	11/06/2022	22.412.000	24.424.000	24.656.000	22.020.000
4	10/06/2022	24.424.000	26.030.000	26.169.000	24.350.000
5	09/06/2022	26.030.000	26.006.000	26.569.000	25.800.000
6	08/06/2022	26.006.000	26.249.000	26.490.000	25.645.000
7	07/06/2022	26.249.000	26.879.000	27.010.000	25.152.000
8	06/06/2022	26.879.000	26.174.000	27.613.000	26.162.000
9	05/06/2022	26.174.000	26.150.000	26.425.000	25.820.000
10	04/06/2022	26.150.000	25.774.000	26.230.000	25.500.000
11	03/06/2022	25.777.000	26.700.000	26.737.000	25.400.000
12	02/06/2022	26.700.000	26.879.000	27.002.000	26.100.000
13	01/06/2022	27.041.000	28.355.000	28.596.000	26.829.000
14	31/05/2022	28.355.000	29.010.000	29.175.000	28.196.000
15	30/05/2022	29.010.000	26.416.000	29.124.000	26.328.000
16	29/05/2022	26.416.000	26.190.000	26.497.000	25.831.000
17	28/05/2022	26.190.000	25.278.000	26.391.000	25.278.000
18	27/05/2022	25.275.000	26.384.000	26.638.000	25.106.000

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19	26/05/2022	26.384.000	28.560.000	28.788.000	25.810.000
20	25/05/2022	28.559.000	29.069.000	29.562.000	28.513.000
21	24/05/2022	29.069.000	29.010.000	29.273.000	28.329.000
22	23/05/2022	29.010.000	29.933.000	30.468.000	28.900.000
23	22/05/2022	29.933.000	29.031.000	29.999.000	28.900.000
24	21/05/2022	29.031.000	28.905.000	29.150.000	28.640.000
25	20/05/2022	28.905.000	29.694.000	30.144.000	28.350.000
26	19/05/2022	29.694.000	28.326.000	29.870.000	28.187.000
27	18/05/2022	28.326.000	30.701.000	30.837.000	28.296.000
28	17/05/2022	30.701.000	29.886.000	31.000.000	29.650.000
29	16/05/2022	29.902.000	31.426.000	31.426.000	29.000.000
30	15/05/2022	31.426.000	30.285.000	31.603.000	29.568.000
31	14/05/2022	30.285.000	29.697.000	30.538.000	29.000.000
32	13/05/2022	29.697.000	28.725.000	31.497.000	28.699.000

2. The calculation results

By using the same stages, the results obtained are as follows, where the following results are the results of implementing the algorithm into applications using the PHP, HTML, and Java Script programming languages.

Table 3.8. Data Implementation Results

No	Date	Price (Close)	Prediksi	Diffrence	Percent (%)
1	13/06/2022	Rp. 19,704,000.00	Rp. 19,925,044.22	Rp. 221,044.22	1.1094%
2	12/06/2022	Rp. 21,050,000.00	Rp. 21,228,364.22	Rp. 178,364.22	0.8402%
3	11/06/2022	Rp. 22,412,000.00	Rp. 22,220,615.42	-Rp. 191,384.58	-0.8613%
4	10/06/2022	Rp. 24,424,000.00	Rp. 24,593,500.22	Rp. 169,500.22	0.6892%
5	09/06/2022	Rp. 26,030,000.00	Rp. 25,853,100.22	-Rp. 176,899.78	-0.6842%
6	08/06/2022	Rp. 26,006,000.00	Rp. 25,599,994.62	-Rp. 406,005.38	-1.5860%
7	07/06/2022	Rp. 26,249,000.00	Rp. 24,840,521.02	-Rp. 1,408,478.98	-5.6701%
8	06/06/2022	Rp. 26,879,000.00	Rp. 26,151,321.02	-Rp. 727,678.98	-2.7826%
9	05/06/2022	Rp. 26,174,000.00	Rp. 25,747,468.22	-Rp. 426,531.78	-1.6566%
10	04/06/2022	Rp. 26,150,000.00	Rp. 25,305,037.82	-Rp. 844,962.18	-3.3391%
11	03/06/2022	Rp. 25,777,000.00	Rp. 25,394,834.62	-Rp. 382,165.38	-1.5049%
12	02/06/2022	Rp. 26,700,000.00	Rp. 25,918,821.82	-Rp. 781,178.18	-3.0139%
13	01/06/2022	Rp. 27,041,000.00	Rp. 27,001,245.82	-Rp. 39,754.18	-0.1472%
14	31/05/2022	Rp. 28,355,000.00	Rp. 28,272,377.02	-Rp. 82,622.98	-0.2922%
15	30/05/2022	Rp. 29, 010,000.00	Rp. 25,588,276.22	-Rp. 3,421,723.78	-13.3722%

16	29/05/2022	Rp. 26,416,000.00	Rp. 25,644,781.82	-Rp. 771,218.18	-3.0073%
17	28/05/2022	Rp. 26,190,000.00	Rp. 25,072,786.62	-Rp. 1,117,213.38	-4.4559%
18	27/05/2022	Rp. 25,275,000.00	Rp. 25,268,701.82	-Rp. 6,298.18	-0.0249%
19	26/05/2022	Rp. 26,384,000.00	Rp. 25,960,900.22	-Rp. 423,099.78	-1.6298%
20	25/05/2022	Rp. 28,559,000.00	Rp. 28,699,825.02	Rp. 140,825.02	0.4907%
21	24/05/2022	Rp. 29,069,000.00	Rp. 28,093,748.22	-Rp. 975,251.78	-3.4714%
22	23/05/2022	Rp. 29,010,000.00	Rp. 29,133,106.62	Rp. 123,106.62	0.4226%
23	22/05/2022	Rp. 29,933,000.00	Rp. 28,609,578.62	-Rp. 1,323,421.38	-4.6258%
24	21/05/2022	Rp. 29,031,000.00	Rp. 28,529,733.82	-Rp. 501,266.18	-1.7570%
25	20/05/2022	Rp. 28,905,000.00	Rp. 28,362,941.82	-Rp. 542,058.18	-1.9111%
26	19/05/2022	Rp. 29,694,000.00	Rp. 27,790,447.42	-Rp. 1,903,552.58	-6.8497%
27	18/05/2022	Rp. 28,326,000.00	Rp. 28,669,505.02	Rp. 343,505.02	1.1982%
28	17/05/2022	Rp. 30,701,000.00	Rp. 29,403,729.02	-Rp. 1,297,270.98	-4.4119%
29	16/05/2022	Rp. 29,902,000.00	Rp. 28,863,533.82	-Rp. 1,038,466.18	-3.5978%
30	15/05/2022	Rp. 31,426,000.00	Rp. 29,004,797.82	-Rp. 2,421,202.18	-8.3476%
31	14/05/2022	Rp. 30,285,000.00	Rp. 28,621,471.42	-Rp. 1,663,528.58	-5.8122%
32	13/05/2022	Rp. 29,697,000.00	Rp. 28,888,530.62	-Rp. 808,469.38	-2.7986%

3. Testing Results by comparing today's price with tomorrow's price.

As explained earlier, the next step is to test the data by testing the MAPE value. Which is where the average value of the percentage level difference will be sought. So the results obtained are:

No	Now	Price (Close)	Tomorow	Prediction	Diffrence	Percent (%)
1	13/05/2022	Rp 29,697,000.00	14/05/2022	Rp 28,621,471.42	-Rp 1,075,528.58	-3.6217%
2	14/05/2022	Rp 30,285,000.00	15/05/2022	Rp 29,004,797.82	-Rp 1,280,202.18	-4.2272%
3	15/05/2022	Rp 31,426,000.00	16/05/2022	Rp 28,863,533.82	-Rp 2,562,466.18	-8.1540%
4	16/05/2022	Rp 29,902,000.00	17/05/2022	Rp 29,403,729.02	-Rp 498,270.98	-1.6663%
5	17/05/2022	Rp 30,701,000.00	18/05/2022	Rp 28,669,505.02	-Rp 2,031,494.98	-6.6170%
6	18/05/2022	Rp 28,326,000.00	19/05/2022	Rp 27,790,447.42	-Rp 535,552.58	-1.8907%
7	19/05/2022	Rp 29,694,000.00	20/05/2022	Rp 28,362,941.82	-Rp 1,331,058.18	-4.4826%
8	20/05/2022	Rp 28,905,000.00	21/05/2022	Rp 28,529,733.82	-Rp 375,266.18	-1.2983%
9	21/05/2022	Rp 29,031,000.00	22/05/2022	Rp 28,609,578.62	-Rp 421,421.38	-1.4516%
10	22/05/2022	Rp 29,933,000.00	23/05/2022	Rp 29,133,106.62	-Rp 799,893.38	-2.6723%
11	23/05/2022	Rp 29,010,000.00	24/05/2022	Rp 28,093,748.22	-Rp 916,251.78	-3.1584%
12	24/05/2022	Rp 29,069,000.00	25/05/2022	Rp 28,699,825.02	-Rp 369,174.98	-

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						1.2700%
13	25/05/2022	Rp 28,559,000.00	26/05/2022	Rp 25,960,900.22	-Rp 2,598,099.78	-9.0973%
14	26/05/2022	Rp 26,384,000.00	27/05/2022	Rp 25,268,701.82	-Rp 1,115,298.18	-4.2272%
15	27/05/2022	Rp 25,275,000.00	28/05/2022	Rp 25,072,786.62	-Rp 202,213.38	-0.8001%
16	28/05/2022	Rp 26,190,000.00	29/05/2022	Rp 25,644,781.82	-Rp 545,218.18	-2.0818%
17	29/05/2022	Rp 26,416,000.00	30/05/2022	Rp 25,588,276.22	-Rp 827,723.78	-3.1334%
18	30/05/2022	Rp 29,010,000.00	31/05/2022	Rp 28,272,377.02	-Rp 737,622.98	-2.5427%
19	31/05/2022	Rp 28,355,000.00	01/06/2022	Rp 27,001,245.82	-Rp 1,353,754.18	-4.7743%
20	01/06/2022	Rp 27,041,000.00	02/06/2022	Rp 25,918,821.82	-Rp 1,122,178.18	-4.1499%
21	02/06/2022	Rp 26,700,000.00	03/06/2022	Rp 25,394,834.62	-Rp 1,305,165.38	-4.8883%
22	03/06/2022	Rp 25,777,000.00	04/06/2022	Rp 25,305,037.82	-Rp 471,962.18	-1.8309%
23	04/06/2022	Rp 26,150,000.00	05/06/2022	Rp 25,747,468.22	-Rp 402,531.78	-1.5393%
24	05/06/2022	Rp 26,174,000.00	06/06/2022	Rp 26,151,321.02	-Rp 22,678.98	-0.0866%
25	06/06/2022	Rp 26,879,000.00	07/06/2022	Rp 24,840,521.02	-Rp 2,038,478.98	-7.5839%
26	07/06/2022	Rp 26,249,000.00	08/06/2022	Rp 25,599,994.62	-Rp 649,005.38	-2.4725%
27	08/06/2022	Rp 26,006,000.00	09/06/2022	Rp 25,853,100.22	-Rp 152,899.78	-0.5879%
28	09/06/2022	Rp 26,030,000.00	10/06/2022	Rp 24,593,500.22	-Rp 1,436,499.78	-5.5186%
29	10/06/2022	Rp 24,424,000.00	11/06/2022	Rp 22,220,615.42	-Rp 2,203,384.58	-9.0214%
30	11/06/2022	Rp 22,412,000.00	12/06/2022	Rp 21,228,364.22	-Rp 1,183,635.78	-5.2813%
31	12/06/2022	Rp 21,050,000.00	13/06/2022	Rp 19,925,044.22	-Rp 1,124,955.78	-5.3442%
32	13/06/2022	Rp 19,704,000.00	14/06/2022	-	-	-
Mape						**3.7249%**

So it can be seen that the average percentage of the difference in predictions is 3.7249%. where the result is the average difference between today's price and tomorrow's prediction. Later it will be a reference for investors. Then it will be illustrated the difference in the graph between the prediction and the original price, which results are as follows:
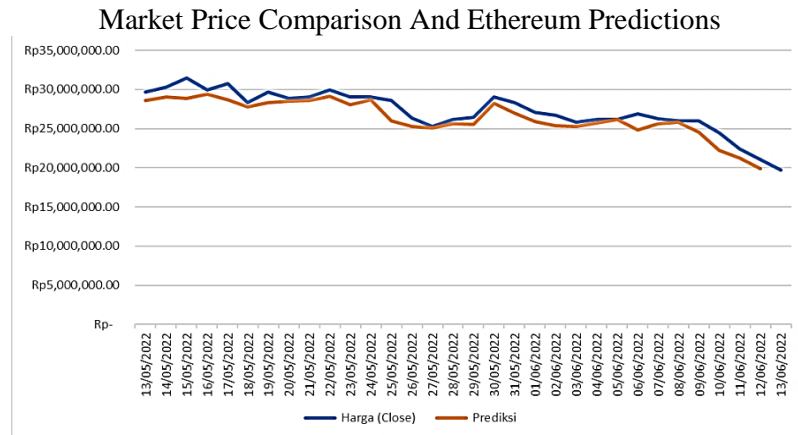
Image 7. Test Result Graph

The following is the result of a page that will display data by date and visualize it in the form of graphs and data tables.
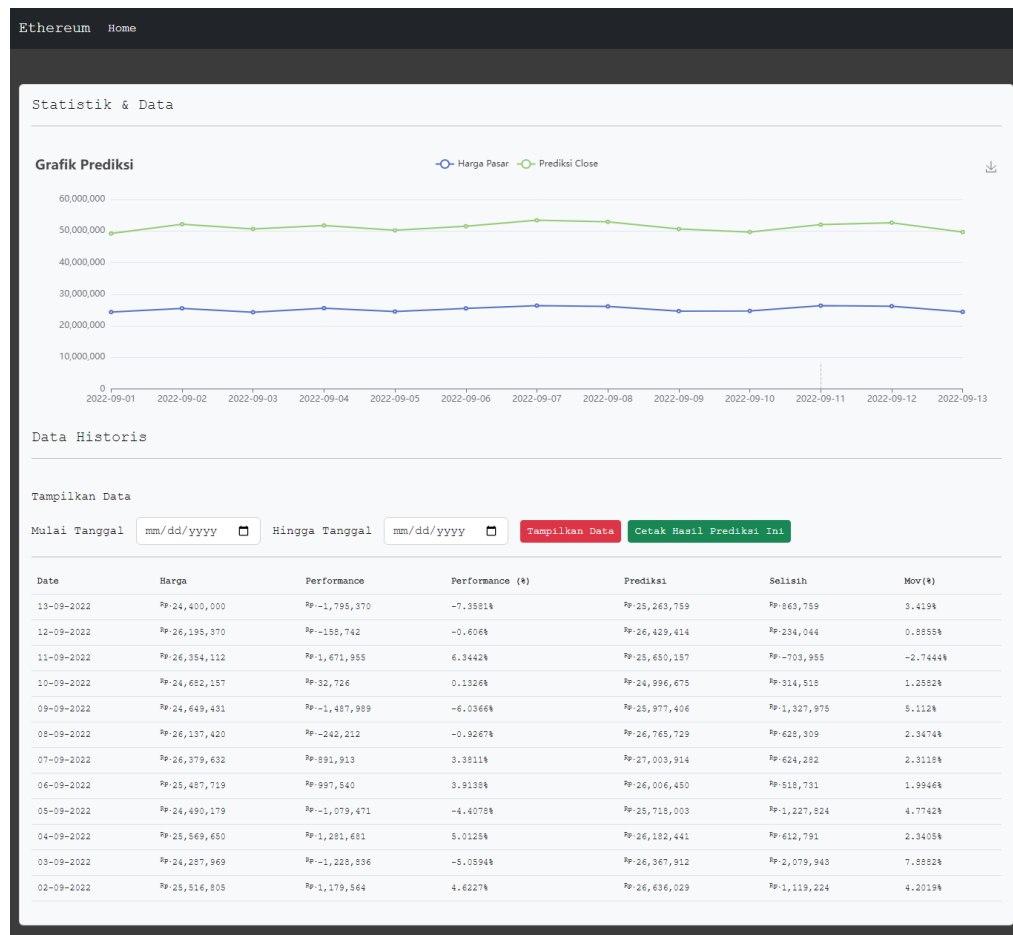

Image 8. Data Pages by Date

4. RESULTS AND DISCUSSION
Results

To find out the results of the test where it will be measured whether the market price will go up or down, also whether the predicted price will go up or down after the calculation, then compare the similarity between the market price and the predicted price.

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ETHEREUM CRYPTOCURRENCY PRICE MOVEMENT PREDICTION SYSTEM USING TRIPLE EXPONENTIAL SMOOTHING METHOD

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a. System Implementation

After designing and processing data using a schema that has been described with a diagram, it will be implemented using web programming languages such as HTML (Hypertext Markup Language), PHP (Hypertext Preprocessor), Java Script, and CSS (Cascading Style Sheet). Using MYSQL database and utilizing data visualization with Java Script library, namely chart. So here are the applications that were developed.

5. CONCLUSION

Based on the stages that have been compiled previously, the conclusions that can be drawn are as follows:

a. The Ethereum to Rupiah price prediction application using the Triple Exponential Smoothing method was developed by analyzing the needs of the application. Where will be input historical data and input parameters. The data will be processed using the Triple Exponential Smoothing method. Prediction results will be displayed in the form of graphs and data tables. In its implementation, various procedures will be calculated, starting from the first smoothing, second smoothing, third smoothing, constant calculation, slope, parabolic and forecasting calculations. Later, the effectiveness of the Triple Exponential Smoothing implementation will be measured by calculating the difference and percentage.

b. In implementing Triple Exponential Smoothing, historical data is needed which will later be processed to produce prediction results, for that we need parameters that can be used as historical data counters, in this study alpha 0.40 was used as Exponential Smoothing parameter and 0.60 as Beta parameter. In the process, starting from calculating the first to third smoothing, determining Constants, Slopes, and Parabolics, to completing the process by producing Forecasting, the results of the measurement of the margin error level with a margin of error of 0.94638% using the final 2021 period data, which is between November - December on the simulation of the Triple Exponential implementation and on the implementation into the system that has been developed is 3.7249% using data from May 2022 to June 2022. It can be concluded that the error rate in prediction using this method is relatively small if it uses 30 data samples and 50 data samples.

c. The result of developing a prediction application using the web is an application that can retrieve data from the latest Ethereum price data API from the Indodax server. Which will display graphs and data tables from the prediction results. Later it will be used for the general public in the process of technical analysis of Ethereum price movements.

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