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Analysis and Design of a Food Price Prediction System using the Iconix Process Method

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Abstract

The need for food is very important for human survival. Therefore, food prices have a very big influence. Several factors cause unstable food prices, including increased demand during major holidays, and seasonal or weather factors that result in crop failure. Because of these factors, price increases can occur at any time and have an impact on society if prices rise unexpectedly. Based on these problems, a system was designed to predict food prices using the Iconix system development method, and to calculate price predictions using the Least Square method. In this system, analysis and system design is carried out to predict food prices. The predicted food ingredients will be limited to ten food ingredients, namely rice, shallots, garlic, red chilies, cayenne peppers, beef, chicken, granulated sugar, cooking oil and purebred chicken eggs. The process design used to describe information systems is the design of system flow diagrams, use case diagrams, sequence diagrams, activity diagrams. Black Box testing provides results that each feature in the food price prediction system has been successfully created and functions well.

Keywords: *food, prediction, iconix, systems*

1 Introduction

Food is the most basic and very important need for the survival of human resources. Sources of food that are intended as food or drink for consumption can come from biological sources in agriculture, animal husbandry, plantations, forestry, fisheries, and waters [1]. Based on several BAPOK (Basic Needs Goods/Barang Kebutuhan Pokok) criteria, there are ten food commodities in Indonesia that are included in the basic needs of the community including rice, shallots, garlic, red chili, cayenne pepper, beef, chicken meat, sugar, cooking oil, and chicken eggs [2]. Food ingredients that are processed into food are one of the primary needs for every human being. For this reason, food prices have a major influence on human life [3]. The availability of food in an area can maintain the stability of the price of the area, but on the contrary, if the supply of food in an area is limited, it will also have an impact on the economic decline in the area.

Food commodities are superior trade goods in import-export activities that can support the economy of a society in an agricultural country [4]. Pricing is influenced by a lot of supply and a lot of demand. At certain times, such as holiday celebrations, food commodity prices tend to rise which can ultimately lead to inflation. In this case, the government has taken anticipatory steps to maintain reasonable price developments, namely by issuing the Highest Retail Price (HET) policy [5]. Many factors cause food prices to be unstable. Examples include crop failure, increased demand on holidays, and seasonal or weather factors [6]. Because of these factors, price increases or decreases can occur at any time, so this certainly results in people, especially those at the bottom, not being able to buy food ingredients if the price jumps up unpredictably. For this reason, providing food-related information is the responsibility of each local government so that price stability is maintained so that there is no food crisis in the area [7]. That's why it feels quite useful if you can know or predict the estimated price of food in the future.

As a preventive measure, the Singkawang City government can find ways to maintain the stability of food prices. To prevent extreme price increases, an accurate and precise price prediction calculation is needed to predict food prices in the future in a state of increase, decrease or stability. In this research, a system analysis and design will be carried out to predict food prices. Foodstuffs to be

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predicted are limited to 10 (ten) foodstuffs, namely rice, shallots, garlic, red chili, cayenne pepper, beef, chicken meat, sugar, cooking oil, and chicken eggs. The data to be used uses secondary data on food prices in one of the traditional markets in Kalimantan, namely Singkawang Market, which is sourced from https://www.bi.go.id/hargapangan/ in the period from January 2018 to January 2023.

The aim of this research is to apply the ICONIX system design method to create a systematic design for predicting daily food prices in the city of Singkawang which is based on price data from previous years for various food commodities, making it easier to provide the latest price prediction information for basic commodities easily and fast. The system designed is a website-based system that can display the results of calculating predicted prices for basic food ingredients at traditional markets in the city of Singkawang. The system designed is a website-based system that can display the results of calculating predicted prices for basic food ingredients at traditional markets in the city of Singkawang. This system is expected to provide an overview to users, the people of Singkawang city, or the government regarding changes in food prices in the future, so that the community or government can prepare themselves or take action to handle this.

2 Literature Review

Several researchers have conducted research on related topics. One of the similar studies is research with the title Analysis and Design of Employee Attendance Application System Using RFID E-KTP Technology with ICONIX Process Method [8]. This research analyzes and designs an employee attendance system based on RFID e-KTP with the Iconix process method. This research aims to analyze and design employee RFID attendance information systems using the ICONIX Process method. This RFID system is made using RFID E-KTP which is supported by a database, where RFID E-KTP is very easy to use. The results of this study are the analysis and design of an information system for implementing an employee attendance system based on RFID technology. The scope of information includes records of arrival time and return time. This previous research can be a reference for the implementation of the Iconix process method in the research to be carried out. Food Price Prediction System using ICONIX process in development stage. This previous research made conclusion that the ICONIX Process method is a methodology that requires a short time, which is usually used to build the design or development of an information system and software.

Another research is Research with the title "Food Price Prediction System in Baubau City Market Using Least Square Method" [9]. This research predicts prices by applying the Least Square method using the previous year's rice price data as historical data which is then calculated so that prediction results are found. The prediction of rice commodity prices in 2019-2020 was found with an estimated retail rice price of Rp.11,474 - Rp.12,034, and a wholesale rice price of Rp.11,237 - Rp.11,561, with the results of the MAPE value for retail rice -10.31256 and wholesale rice -6.507653. This research is a reference for the food price prediction process in the system to be carried out, in terms of applying the least squares method for processing food data and producing food price predictions.

The other previous research that has been carried out is research with the title “Penerapan ICONIX Process Dalam Perancangan KAPIUP (Kantin Pintar UPN “VETERAN” JAWA TIMUR)” [10]. This research is to create a food ordering application system for the UPN canteen to overcome the problem of recording orders and validating payments which were previously done manually, using the Iconix method. This previous research used the Iconix Process Method because The ICONIX process is use case driven, which uses use cases that have been developed from the start as the basis for system development. This previous research can be a reference for the implementation of the Iconix process method to develop food price prediction to be carried out.

3 Research Method

The development of a food price prediction system using the ICONIX method was developed using the concept of System Development Life Cycle (SDLC) software development. Iconix Process is a method used to build a software system which more focused on user requirements and simplifies the process so that the software development process will be more efficient [11]. The ICONIX Process has 6 stages namely 1) Requirements gathering are collecting all the functional requirements needed in the manufacture of software; 2) Preliminary design is an early stage in estimating dimensions based on architectural and structural drawings; 3) A preliminary design review is a

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technical assessment that establishes an Allocated Baseline of a system to ensure a system is operationally effective; 4) Detailed design is a planning product made by planning consultants for civil building works such as buildings, and ponds; 5) Critical design review is a multi-disciplinary technical review to ensure that the system can proceed to fabrication, demonstration, testing, and performance requirements; 6) Implementation is an application or implementation of something [12]. Figure 1 shows the stages of the research conduct based on Iconix Process.

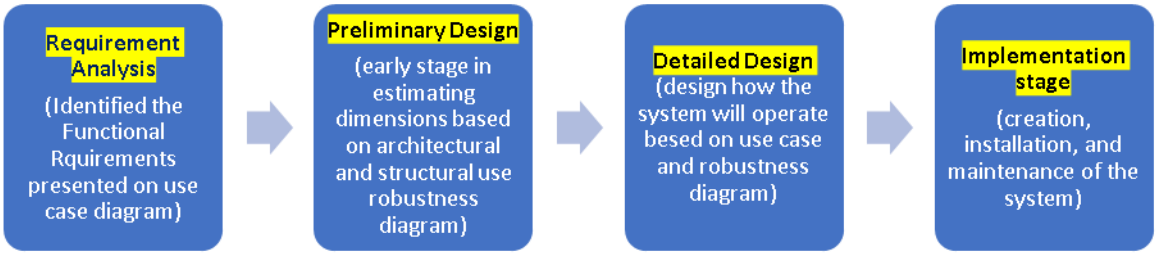

Figure 1. The research method

The stages in this research are:

a. The requirement analysis is the fundamental process of understanding why an information system should be built and determining how it will be built. The system planning stage is the stage where problems are identified and how the desired system can be achieved. The problem to be solved is how to create a website to predict food price data with a case study of Singkawang City using the ICONIX process method. The purpose of making this program is to help make it easier for users to see the estimated price of food for the coming days or months. The planning stage includes planning the programming language that will be used, namely using Python to process predictions on existing food price data. The results of system testing will be implemented into a site with the aim of visualizing the results of the system. The requirements analysis result are presented on flowchart and use case modelling.

b. The next stage after the requirement analysis is the preliminary design stage. At this stage an analysis of system requirements is carried out. The analysis stage answers the questions of who will use the system, what the system will do, and where and when it will be used. During this stage, it is necessary to analyze the current system, identify improvements and develop concepts for a new system. Currently, food prices can be accessed by the public through several government websites including https://panelharga.badanpangan.go.id and https://hargapangan.id. However, there is no facility on the web that provides food price prediction. The data used in the design of this system are food prices in excel format with a total of 1858 rows and 19 columns. Data collection for this prediction is obtained from the official government website, namely, the National Strategic Food Price Information Center (PIHPS Nasional) on the website *https://www.bi.go.id/hargapangan*. Preliminary design presented on robustness diagram to bridge the needs that have been analyzed and used as a link with the system design.

c. The detailed design phase decides how the system will operate in terms of the hardware, software, and network infrastructure that will be in place; the user interfaces, forms, and reports that will be used; and the specialized programs, databases, and files that will be needed. Although most strategic decisions about the system are made in the development of the system concept during the analysis phase, the steps in the design phase determine exactly how the system will operate. The design process that will be used to describe the system is the design of the sequence diagram, based on use case and robustness diagram.

d. The final stage in the SDLC is the implementation stage, where the system is actually built (or purchased, in the case of software package design and installed). This is the stage that usually gets the most attention, as for most systems it is the longest and most expensive part of the development process. The three activities performed are the creation, installation, and maintenance of the system. The system will be implemented after passing the testing process. The web-based system will be accessible to the general public.

4 Results and Analysis

The data used in the design of this system are food prices in excel format with a total of 1858 rows and 19 columns. Data collection for this prediction is obtained from the official government

website, namely, the National Strategic Food Price Information Center (PIHPS Nasional) on the website *https://www.bi.go.id/hargapangan/*. There are nineteen data variables that will be used, namely Rice (Lower Quality I, Medium I, and Super I), Chicken Meat, Beef (Quality I and Quality II), Chicken Eggs, Shallots, Garlic, Red Chili (Large and Curly Red Chili), Cayenne Pepper (Red and Green Cayenne Pepper), Cooking Oil (Bulk Quality Cooking Oil, Branded Packaging I, and Branded Packaging II), and Granulated Sugar (Premium and Local Quality Granulated Sugar). In Table 1 is an example of the sample dataset used. Based on previous research [13], the results obtained through evaluation using MAPE produced low values for each food type variable. The MAPE value obtained was assessed as 0.37% - 15.48%. The smaller the resulting MAPE error value, the more accurate the prediction calculation will be

Table 1. Example Of Sample Dataset Used

Tanggal	Beras Kualitas Bawah I	Beras Kualitas Medium I	Beras Kualitas Super I	Daging Ayam	Daging Sapi Kualitas 1	Daging Sapi Kualitas 2	Telur Ayam	Bawang Merah	Bawang Putih	Cabai Merah Besar	Cabai Merah Keriting	Cabai Rawit Hijau	Cabai Rawit Merah	Minyak Goreng Curah	Minyak Goreng Kemasan Bermerk 1	Minyak Goreng Kemasan Bermerk 2	Gula Pasir Kualitas Premium	Gula Pasir Lokal
01/01/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/01/2018	10.000	12.400	13.750	27.750	120.000	120.000	21.000	26.250	19.500	48.500	-	61.250	61.250	9.200	15.650	15.000	-	12.000
03/01/2018	10.000	12.400	13.750	27.750	120.000	120.000	21.000	26.250	19.500	48.500	-	61.250	61.250	9.100	15.650	15.000	-	12.000
04/01/2018	10.000	12.400	13.750	28.750	120.000	120.000	21.000	26.250	19.500	41.250	-	66.250	66.250	9.100	15.650	15.000	-	12.000
05/01/2018	10.000	12.400	13.750	28.750	120.000	120.000	21.000	26.250	19.500	41.250	-	66.250	66.250	9.100	15.400	15.000	-	12.000
06/01/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/01/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/01/2018	10.000	12.400	13.750	28.750	120.000	120.000	20.500	26.250	19.500	42.500	-	63.750	63.750	9.100	15.400	15.000	-	12.000
09/01/2018	10.000	12.400	13.750	28.750	120.000	120.000	20.500	26.250	19.500	42.500	-	63.750	63.750	9.100	15.400	15.000	-	12.000
10/01/2018	10.150	12.500	13.900	28.750	120.000	120.000	20.500	26.250	19.500	42.500	-	63.750	63.750	9.100	15.400	15.000	-	12.000
11/01/2018	10.150	12.500	13.900	28.750	120.000	120.000	20.500	25.500	19.500	42.500	-	63.750	63.750	9.100	15.400	15.000	-	12.000
12/01/2018	10.150	12.500	13.900	28.750	120.000	120.000	20.500	25.500	19.500	42.500	-	63.750	63.750	9.100	15.400	15.000	-	12.000
13/01/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14/01/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15/01/2018	10.250	12.650	14.000	28.750	120.000	120.000	20.500	25.750	19.500	41.250	-	66.250	66.250	9.700	15.400	15.000	-	12.000
16/01/2018	10.250	12.900	13.900	28.750	120.000	120.000	20.500	25.750	19.500	41.250	-	66.250	66.250	9.700	15.400	15.000	-	12.000
17/01/2018	10.250	12.900	13.900	28.750	120.000	120.000	20.500	25.750	19.500	42.500	-	66.250	66.250	9.700	15.400	15.000	-	12.000
18/01/2018	10.250	12.900	13.900	28.750	120.000	120.000	20.500	25.750	19.500	42.500	-	66.250	66.250	9.700	15.400	15.000	-	12.000
19/01/2018	10.250	12.900	13.900	28.750	120.000	120.000	20.500	24.500	19.500	42.000	-	65.000	65.000	9.700	15.400	15.000	-	12.000

The process design used to describe the information system is a system flowchart design, use case diagram, sequence diagram, activity diagram. Flowchart is a problem-solving step formed in certain symbols. Flowchart aims to display the flow in the program logically based on the sequence of procedures of a program which usually consists of three parts, namely input, process, and output. Flowchart is not only used as a communication tool but also needed as a guide [14]. Flowchart in this design describes the workflow of the system from start to finish. Starting from when the user opens the website, it will display the Home view as the main menu. On the Home page, there are several other menus such as Historical Data, Prediction Results, Prediction Results Graphs, and About that can be accessed by the user. The system flowchart in this program design can be seen in Figure 2.

Figure 2. System's User Interface Flowchart

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In addition to flowcharts, system design is also described through Use Case Diagrams which are one type of Unified Modeling Language (UML) diagram model, which work together by describing typical interactions between users (users) of a system and the system itself. Use case plays an important role in controlling the design of the Iconix process. The use case diagram illustrates the functionality performed by the system and also states a visualization of the interaction between the actor and the system [15]. Use cases are used to find out what functions exist in an information system and who has the right to use those functions [16] First, the user can see the main page when first opening the website. Furthermore, the user can see the results of the prediction process of future food prices. Use Case Diagram on this system can be seen in Figure 3.

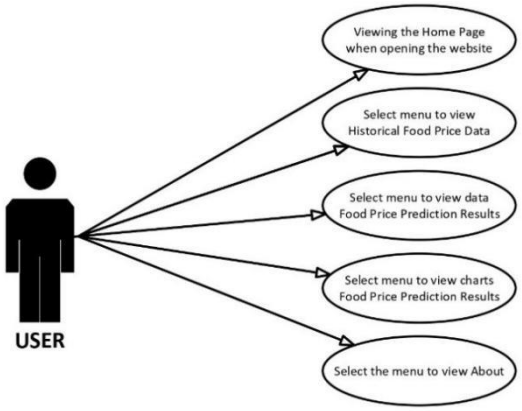

Figure 3. Use Case Diagram

Robustness Diagram is also used in the design of this system, to connect the analysis with the existing system design, to bridge the needs that have been analyzed and used as a link with the system design. Robustness diagrams are developments of use case diagrams. The robustness of this diagram is in the form of a more detailed description of the use case diagram previously designed [11]. Robustness Diagram can be seen in Figure 4, which explains the description of objects contained in the use case. Users can access the system through the Home page, then continue by entering historical data that will be used to make predictions. Users can see the historical data that has been entered in the form of a graph. Based on the historical data that has been entered, the system will display the results of the calculation of food price predictions for the next one year. The prediction results are displayed in the form of tables and graphs.

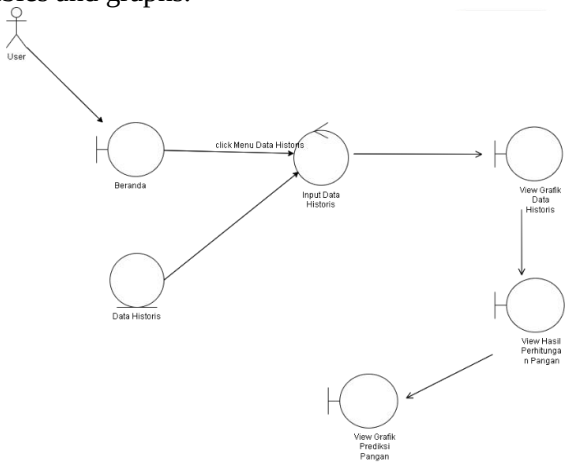

Figure 4. Robustness Diagram

In this designed system, the Sequence Diagram can display the main menu to the user. After that, the user can select the prediction page and the system will display a form to make predictions. After the user successfully makes a prediction, the system will display information in the form of prediction results. The Sequence Diagram of this system can be seen in Figure 5.

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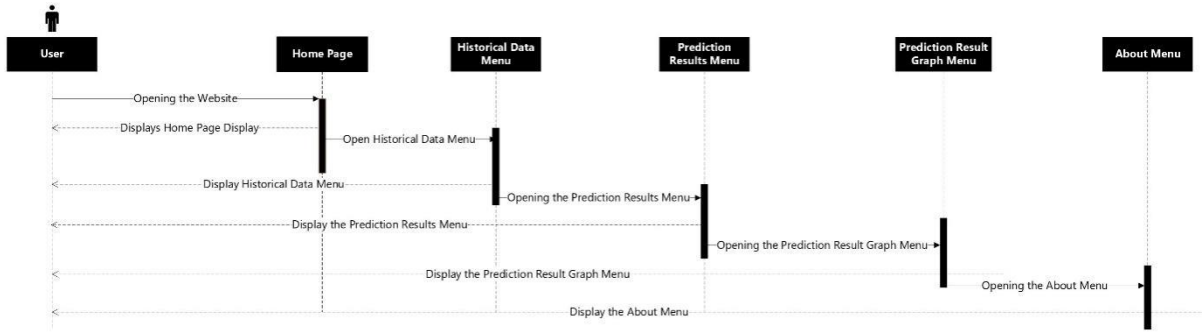

Figure 5. System Sequence Diagram

The interface is a design that describes the menu display of the website to be built. The interface design is made in such a way as to facilitate user interaction when running the system. The following is a hierarchy of menu displays from the main menu to other sub-menus found in Figure 6.

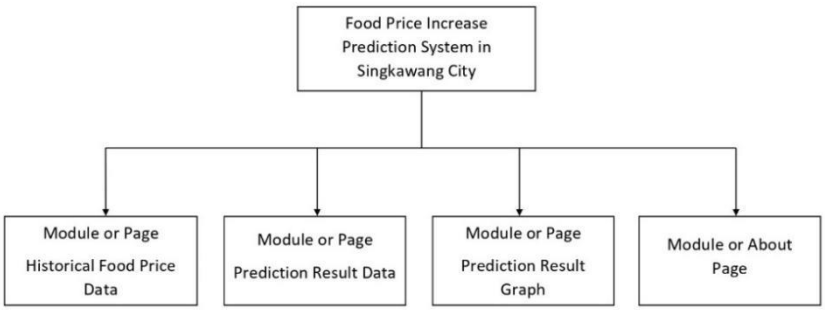

Figure 6. Menu Hierarchy Diagram of the System

After the design, the website was created using Visual Studio Code as a text editor using Streamlit with Python as the programming language. This website is assisted by several extensions such as Streamlit Library to create a menu display, navigation bar (navbar), create data tables, and functions for other features. As well as using bootstrap icons for icons in the navbar section. The appearance of the website that has been created can be seen in the figure below.

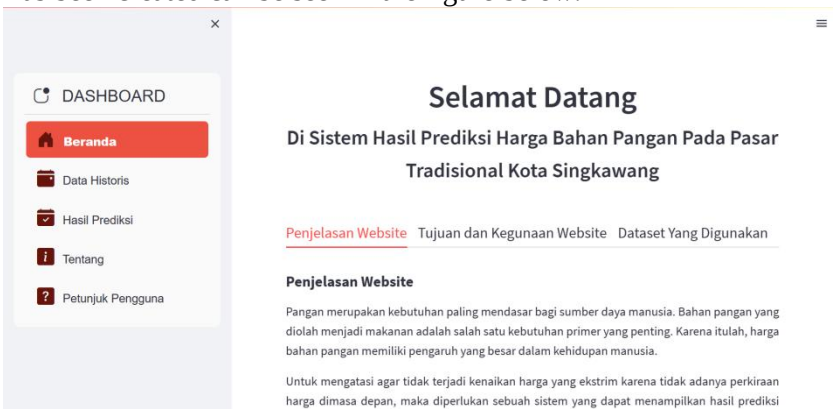

Figure 7. Home Page

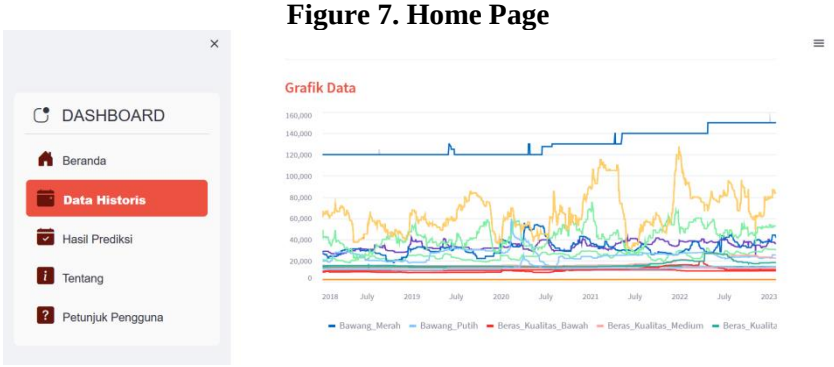

Figure 8. Historical Data Page

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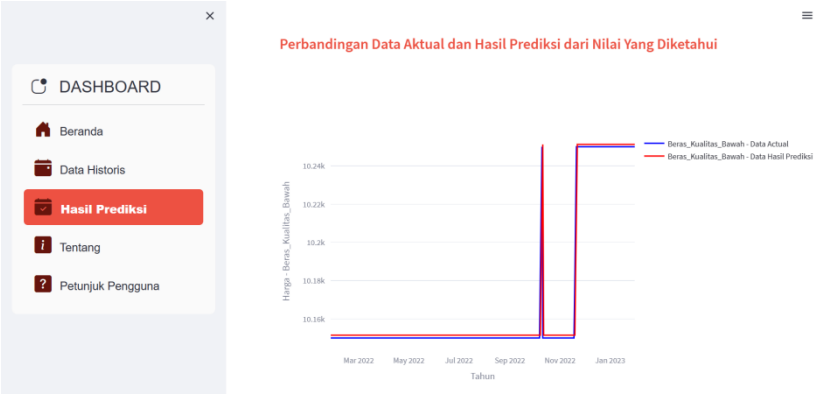

Figure 9. Prediction Result Page

5 Conclusion

In accordance with the design and manufacture of systems that have been carried out, it can be concluded that the system design has been completed in accordance with the stages of system design with the ICONIX process method. ICONIX process can be used to build a software system that more focuses on user requirements to make the software development process more efficient. Based on the results of testing with the Black Box method, it is found that each feature of the food price prediction system has been successfully created and has functioned properly. For the evaluation results of prediction results using MAPE, the best results (smallest error) were obtained in the type of Super Quality Rice food with a MAPE value of 0.37%, while the worst results (largest error) in the type of Red Onion food with a MAPE of 15.48%.

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