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Web-Based Geographic Information System for Toddlers Nutritional Status in Rindi District

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Abstract

Geographic Information Systems (GIS) are technologies that facilitate the visualization and analysis of spatial data, useful in various fields including health. One of its applications is monitoring the nutritional status of toddlers, where nutritional problems can have a serious impact on the growth of toddlers. In Rindi District, East Sumba, there are 200 cases of toddlers with nutritional problems, but nutrition monitoring is still carried out using manual maps that are not updated regularly. This hampers the effectiveness of nutrition intervention programs because the data monitoring process is carried out manually and is less than optimal. This study aims to develop a web-based GIS to map the nutritional status of toddlers in Rindi District. The system is designed using the waterfall method, which includes the stages of requirements analysis, system design, implementation, testing, and maintenance. This method was chosen to ensure that system development is carried out in a structured and thorough manner. The resulting GIS is expected to be able to provide accurate and real-time information, making it easier to identify villages with nutritional problems. The results of the Black Box test showed that all menus in the system were functioning properly and from the results of the SUS test obtained a final score of 78.25 indicating that the assessment of GIS Toddlers Nutritional Status in Rindi District was Acceptable with Good rating category.

Keywords: *Nutritional Status of Toddlers, SIG, Rindi District, Waterfall Method.*

1. Introduction

Nutrition is an important need for the growth and development of toddlers, because healthy nutrition ensures the normal growth of healthy toddlers. The poor quality of food given to toddlers can affect their development. In several areas in East Sumba, especially Rindi District, in cases of malnutrition in Rindi District.

In 2024, there will be 200 cases of toddlers who are still undernourished or undernourished, but there are also toddlers who experience cases with overnutrition and each status has a different treatment and needs continuous observation regarding changes in the nutritional status itself

Based on the problems faced by Rindi District, the development of a Geographic Information System (GIS) for monitoring the nutritional status of toddlers per village is a relevant solution. This system will provide digital maps that are updated regularly, making it easier for the Tanaraing Health Center to identify villages that are vulnerable to nutritional problems for toddlers. With GIS, nutritional status data of toddlers can be processed and compared automatically every month, thereby speeding up the monitoring process and improving timeliness in decision-making. This mapping not only presents the location of villages with nutritional problems, but also helps the Health Center in designing more effective intervention programs, focusing on the villages that need it most. It is hoped that the implementation of GIS can increase the success of nutrition intervention programs in the Rindi District area and overall help reduce the number of nutritional problems in toddlers.

2. Literature Review

2.1. Nutritional Status of Toddlers

According to [1] Nutritional status is the condition of the human body resulting from the consumption and use of nutrients. This status can be measured through several indicators, one of which is Weight by Age (BB/U). Based on this indicator, nutritional status can be categorized into four types: malnutrition, undernutrition, good nutrition, and overnutrition. According to [2] Nutritional status is a condition of the human body resulting from the consumption and use of nutrients. This status can be measured through several indicators, one of which is Weight by Age (BB/U). Based on this indicator, nutritional status can be categorized into four types: poor nutrition, poor nutrition, good nutrition, and overnutrition.

2.2. Geographic Information System

According to [3] Geographic Information System (GIS) is a computer-based information system that has developed rapidly in the last five years. GIS is designed to store, process, analyze, and retrieve referential geographic data. The benefits of GIS are very visible in providing convenience to users or decision-makers in determining policies, especially those related to spatial or spatial aspects [4].

2.3. Waterfall Model

According to [5] The Waterfall *model* is one of the SDLC models that is often used in the development of information systems or software. This model uses a systematic and sequential approach. [6] The stages in this model start from the planning stage to the *maintenance* stage and are carried out in stages. Developers need to know more about the system development process if using *the waterfall* model and also the characteristics of the waterfall model.

2.4. UML

UML is one of the tools or models for designing software development that is based on an object-oriented approach. UML not only serves as a design tool, but it also provides a standard for creating blueprints of the system. This blueprint includes business process concepts, writing classes in specific programming languages, database schemas, and other coordination [7] According to [8] Unified Modeling Language (UML) is one of the visual methods for designing and creating object-based software.

2.5. Black Box

According to [9] *Black Box testing* focuses on testing of each functional specification of the software. A tester can define a set of *input* conditions and test the functionality of the software (Mustaqbal, 2015). The *Black Box testing* method consists of several methods, including *Equivalence Partitioning*, *Boundary Value Analysis*, *State Transition Testing*, and *Decision Table Testing. Black Box.*

2.6. System Usability Scale

According to [10] *System Usability Scale* (SUS) is a measurement tool used to assess the *usability* of a product, application or system. SUS consists of ten questions each of which has a five-point scale that ranges from "Strongly Disagree" to "Strongly Agree."

1. Oddly numbered questions, the answer is in – 1.
2. Question numbered even 5 – answers.
3. The total score obtained is multiplied by 2.5 to produce a score between 0-100.
4. The results can be summed up and then divided by 10 to get the final result

3. Research Methodology

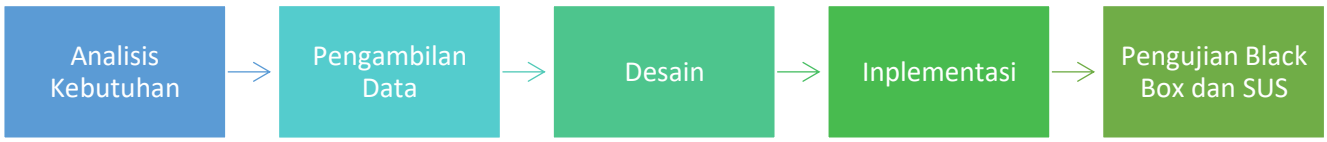


Figure 1: Research Flow

Information:

1. Requirement Analysis
   At this stage, the researcher collects data.
2. Data capture
   At this stage, data is collected in accordance with the needs of the geographic information system through an observation process in Rindi District and interviews with sub-district officials and medical personnel at the local health center. The data obtained is then entered into the geographic information system for mapping the area based on the nutritional status of toddlers Analysis and system design are carried out to understand the needs of users in the system being built. The website trial was carried out to assess the success of the website in processing and displaying the information needed by the community.
3. Design Using the Waterfall Method
   At this stage, researchers begin to design the UI display according to the needs of users.
4. Implementation
   In building the Geographic Information System, I use three software, namely PHP, MySQL, and Leaflet Js.
5. Black Box and SUS Testing
   At this stage, Black Box testing is carried out to test the performance of the system whether it is running well or not and SUS is used to test the usability of the system whether the system is easy to use or not.

4. Results

4.1. System Design

Use Case

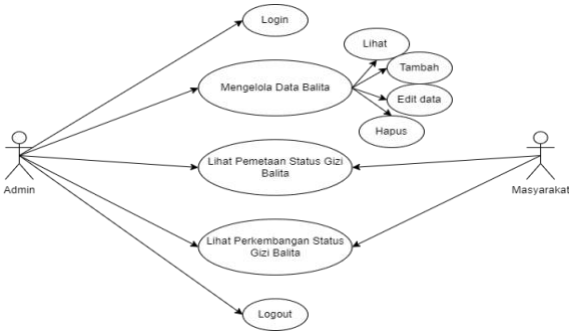


Figure 2: Use Case Diagram

The Use Case above shows two actors, namely Admin and User. Admins can log in, access all menus, and run CRUD functions. Users can view the distribution map of the nutritional status of toddlers and the distribution to monitor the nutritional development of toddlers.

Activity Diagram.

1. Activity View Toddler Nutrition Status Data

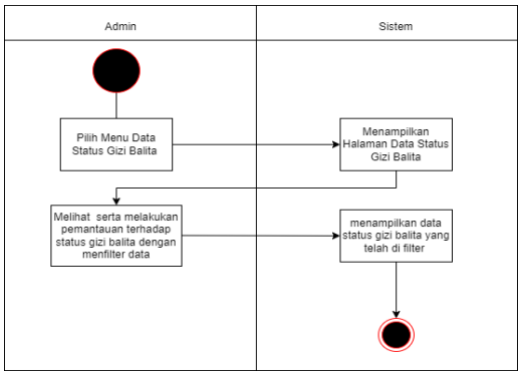


Figure 3: Activity View Toddler Nutrition Status Data

The Activity Diagram above illustrates *the activities of the admin* in the system. Where *admins* can see the nutritional status data that has been added, and can also monitor the nutritional status of toddlers per village to find out whether there is progress or not.

2. Activity to Add Toddler Case Data

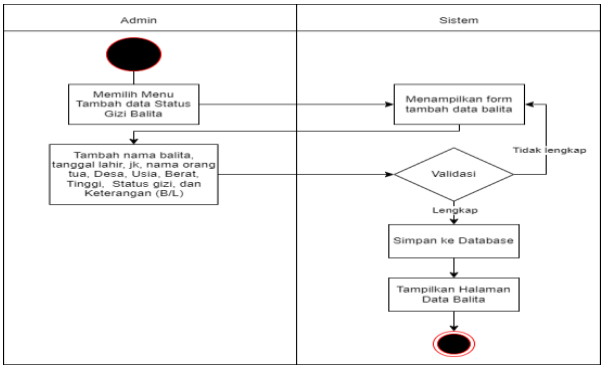


Figure 4: Activity to Add Toddler Case Data

The process of adding data begins with the admin selecting the Add Data menu, then the system displays the fill form. The admin fills out the form according to the toddler data, then the system validates the completeness of the data. If the data is incomplete, the admin is redirected back to the form. If complete, the data is automatically saved to the database, and the system displays the Toddler Data page.

3. Activity Edit Toddler Case Data

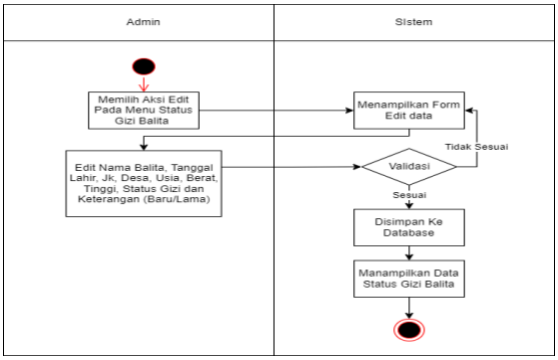


Figure 5: Activity Edit Toddler Case Data

The Activity Diagram shows the process of Editing Data by the Admin. The admin selects the Edit option on the toddler nutrition status data table, then the system displays the edit form. The admin fills out the form, and the system validates the data. If the data is not matched, the system returns it to the edit form. If the data is valid, the system saves the changes to the database and displays the updated nutritional status data of the toddler.

4. Activity Delete Toddler Nutrition Case Data

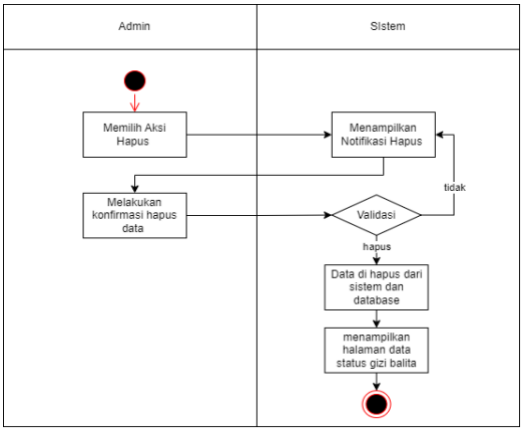


Figure 6: Activity Delete Toddler Nutrition Case Data

The Activity Diagram of deleting toddler nutrition status data above shows the process of deleting data carried out by the admin, starting from selecting the delete action in the nutrition status data table, the system will display a delete notification which will be confirmed by the admin who wants to delete the data or not which will then be validated by the system.

5. Activity View Mapping Map

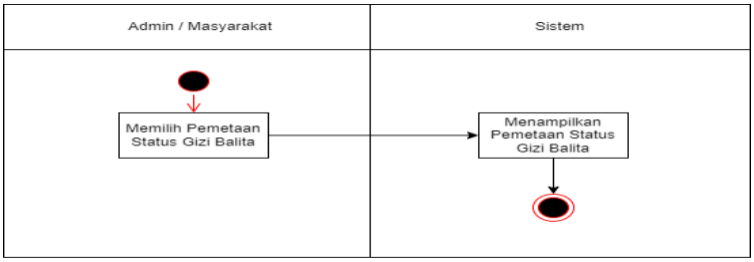


Figure 7: Activity View Map Mapping

This Activity Diagram describes the process of Mapping the Nutritional Status of Toddlers. The community enters the system, the system displays the home page. Furthermore, the community selects the Map Mapping menu, and the system displays the location points of the occurrence of nutritional status cases in the village.

6. Activity View Spread

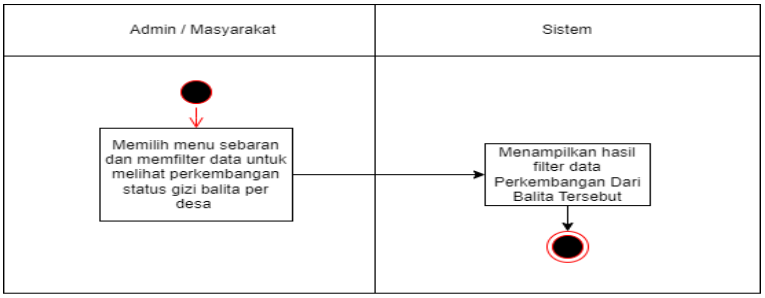


Figure 8: Activity View Distribution

The Activity Diagram above explains the process of interaction carried out by the community in the system, starting from the community choosing the menu for the distribution of the nutritional status of toddlers, then the system will display the results of the recap that can be filtered every three months, the community can also monitor the development of toddlers by looking at the recap.

Class Diagram

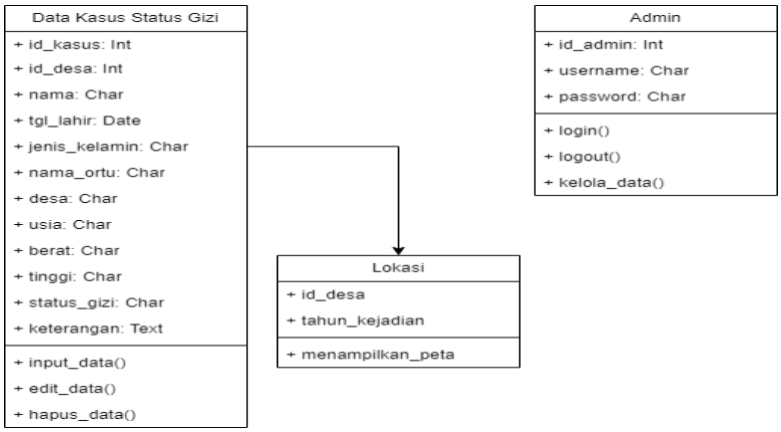


Figure 9: Activity View Distribution

The following Class Diagram describes the relationship between classes, namely Admin with Nutritional Status Case Data. The Admin class has a table with *fields* id_admin (primary key), username, and password for login validation to manage toddler nutrition case data. The Nutritional Status Case Data Class has a table with *fields* id_desa (primary key) and id_kasus (foreign key), containing information such as the name of the toddler, date of birth, gender, parent's name, village, age, weight, height, nutritional status (good, more, poor, less), and description. The Location class has a table with *a field* id_desa (foreign key) that records the year of the event.

4.2. Implementation

1. Login Admin

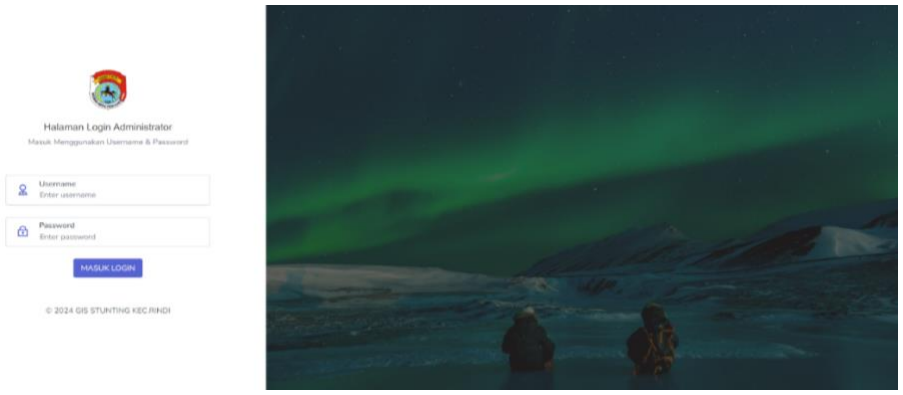


Figure 10: Yard Login Admin

The image displays a login page that provides a form to fill in the username and password needed to log in as an admin. If the username and password entered are correct or correct, the system will display the admin home page and if the username and password entered do not match, the system will display an alert message that the login failed and will remain on the login page.

2. Home Page Admin

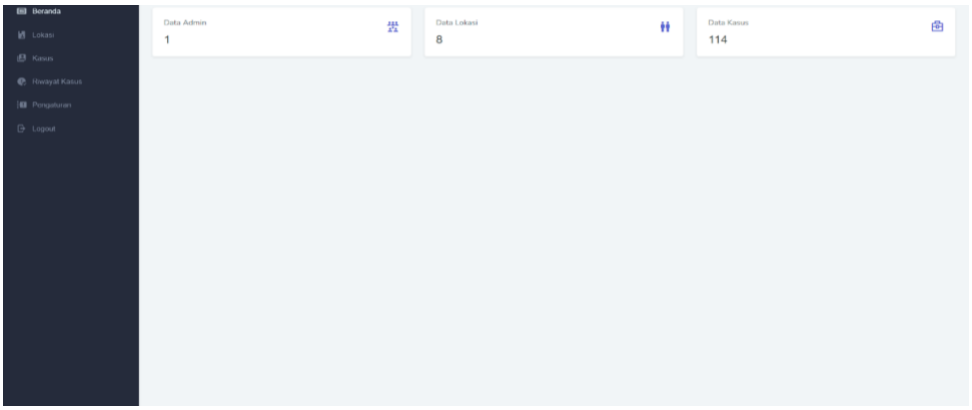


Figure 11: Home Page Admin

The image shows the admin home page with information about admin data, the total number of locations, and the total number of cases logged. On the left side there is a menu that can be accessed by admins starting from the location containing village location data, the case menu containing toddler data, the history menu containing case records and the setting and logout menus.

3. Location Page

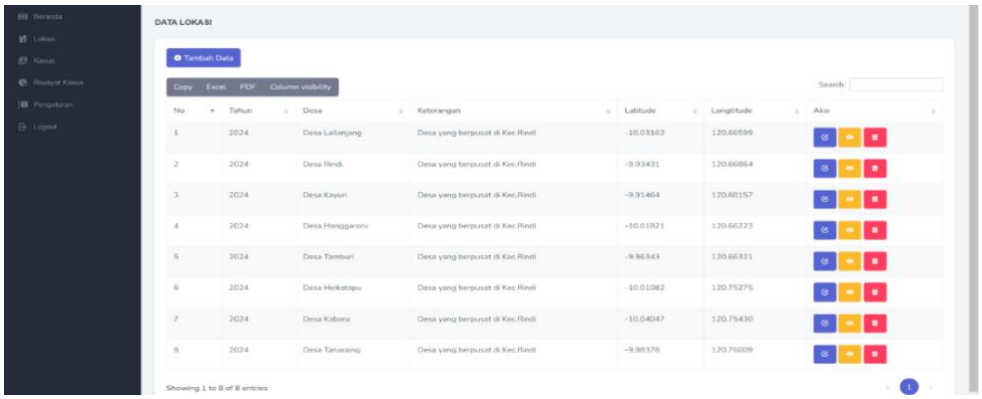


Figure 12: Location Page

The image is an admin location page, which allows admins to add, edit, and delete location data, as well as download data in PDF and Excel formats.

4. Toddler Case Page

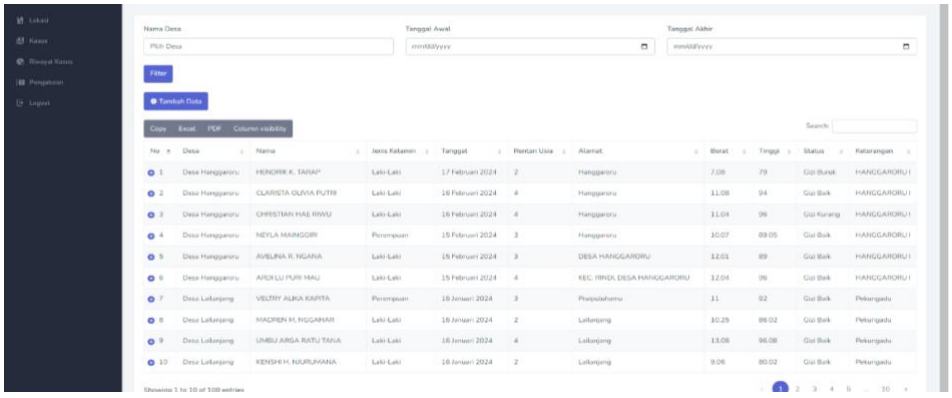


Figure 13: Toddler Case Page

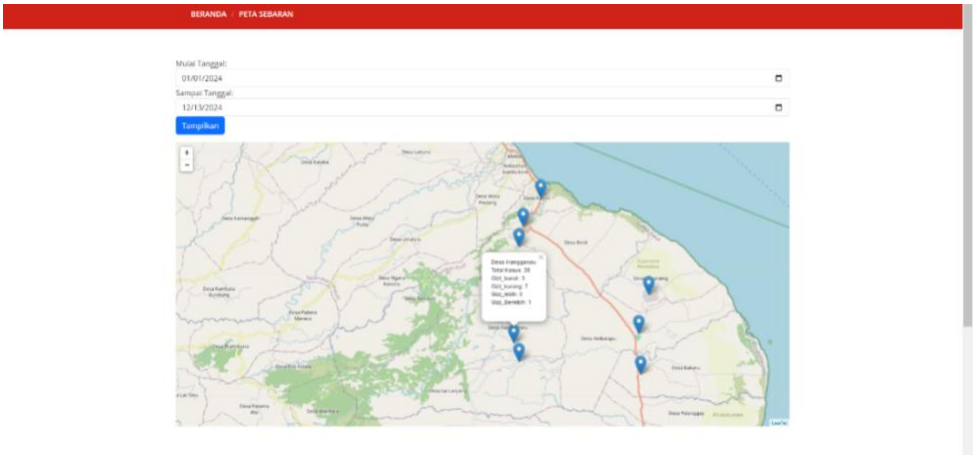
The image shows the admin case data page, where admins can add, edit, and delete case data. In addition, admins can also download the displayed data and filter the data based on the name of the village and the date of the incident to see the existing cases of toddlers.

5. Distribution Page

Figure 14: Distribution Page

The image shows a distribution page on the visitor page, where visitors can filter to see the data recap data displayed in the recap is data per three months. Visitors can also monitor the development of toddlers from the recap.

6. Distribution Map Page



Gambar 15: Peta Sebaran

The image shows the distribution map menu page, where the map can display the total cases by village. When a dot or mark on the map is clicked, detailed information related to the nutritional status problem in the village will be displayed.

5. Black Box Testing

1. Black Box Admin Testing

Table 1: Black Box Admin Testing

It	Test Name	Form of testing	Expected results	Result	
				Succeed	Fail
1	*Login.*	*Correct username* and *password*	*Admin* successfully enters the *admin dashboard* page.	Success[√]	
		Incorrect username *and* password	*Admins* cannot access the system and a *login* failure *alert will appear.*	Success[√]	
2	Dashboard Menu	View admin data , location data, and, case data.	*Admins* can see the data displayed in the home menu.	Success[√]	
3	Location Menu	Add location data.	Data was successfully added.	Success[√]	
		Edit location data.	The data was successfully edited.	Success[√]	
		Clear location data.	The data was successfully deleted.	Success[√]	
		Search.	Successfully conducted a search.	Success[√]	
4	Toddler case menu.	Filtering the village.	It can filter villages to display data on toddler cases.	Success[√]	
		Add toddler data.	Can add toddler data.	Success[√]	
		Edit toddler data	Can edit toddler data.	Success[√]	

		Delete toddler data	Can delete toddler data	Success[√]
		Search.	Can do a search.	Success[√]
5	Case history menu	Filter quarterly to see data recap.	You can filter by quarter to see the records.	Success[√]
7	*Logout.*	Click the *logout button.*	Can log out to the login page.	Success[√]

This Black Box Admin *test* is used to test the functionality of the system, especially on the admin page, starting from *login,* dashboard menu, location menu, case menu, case history menu and *logout. The results of this* black box *test* all show that all the pages tested are working properly.

2. Black Box Visitor Testing

This visitor black box *test* is used to test whether the distribution menu and distribution map are on the *user display*. The test results showed that the distribution menu and distribution map worked well.

Table 2: Black Box Visitor Testing

It	Test Name	Form of testing	Expected results	Result	
				Succeed	**Fail**
1	Spread menu	Filter to see recaps and progress over a 3-month period	The public can see the recap data	Success[√]	
2	Distribution map	Filter per month to see the location and information of toddlers who have nutritional status problems.	It can filter and view the location and information of toddlers who experience nutritional status problems for toddlers.	Success[√]	

6. SUS Testing

System *Usability Scale* (SUS) testing is a test carried out to test the usability of the system. SUS consists of 10 questions, each of which has a five-point scale that ranges from "Strongly Disagree" to "Strongly Agree.".

Table 3: SUS Testing

It	Question
1.	I think I will use this website a lot .
2.	*This website* is not very complicated.
3.	I think the web is easy to use.
4.	It looks like I need help to be able to use this web.
5.	I found the various features in this web that can be learned by everyone quickly and precisely.
6.	I find inconsistencies in this web.
7.	I imagine that the web can be learned by everyone quickly
8.	I found complexity in this web.
9.	I am very confident in using this website.
10.	It seems like I've just learned a lot to be able to use this website.

The above question was addressed to 10 communities with 5 health center employees and 1 person who plays the role of nutrition manager for toddlers. The score calculation is as follows.

1. Oddly numbered questions, the answer is in – 1.
2. Question numbered even 5 – answers.
3. The total score obtained is multiplied by 2.5 to produce a score between 0-100.
4. The results can be summed up and then divided by 10 to get the final result

The table below shows the data on the results of respondents conducted by 10 people, 5 health center employees and 1 person who is a nutritionist at the Tanaraing Health Center.

Table 4: SUS Score

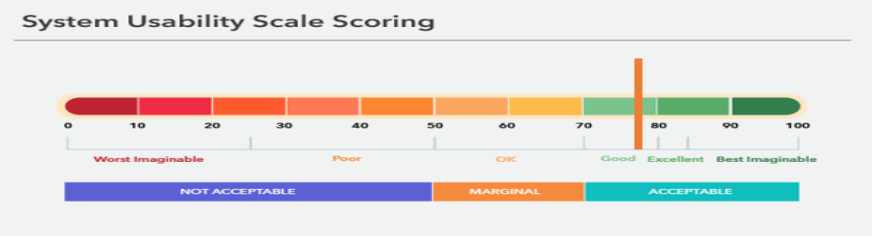
Jawaban	Skor
Strongly disagree (SD)	1
Disagree (D)	2
Hesitant (H)	3
Agree(A)	4
Strongly agree (SA)	5

Table 5: SUS Calculation Results

R	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Jumlah	Jumlah x 2,5
R1	3	3	4	2	3	4	4	3	3	3	32	80
R2	4	3	4	3	3	4	3	4	3	4	35	87,5
R3	3	4	3	3	3	3	3	4	3	3	32	80
R4	3	3	3	3	4	3	3	3	3	3	41	102,5
R5	3	4	3	3	4	4	4	3	4	3	35	87,5
R6	4	3	4	3	4	3	4	2	4	3	34	85
R7	4	3	3	3	4	3	3	4	3	4	34	85

R8	3	2	4	4	3	4	3	4	3	4	34	85
R9	3	3	3	3	3	4	4	3	3	4	33	82,5
R10	4	4	3	3	3	4	3	3	4	4	35	87,5

80 + 87,5 + 80 + 102,5 + 87,5 + 85 + 85 + 85 + 82,5 + 87,5 = 782.5
782.5 / 10 = 78.25



Gambar 16: SUS Scoring

The determination of *Acceptability Ranges*, *Grade Scale*, and *Adjective Rating* was used to evaluate the level of satisfaction of GIS Stunting users in Rindi District. Based on the results of the average respondent score of 78.25, it can be concluded that the assessment of GIS toddlers nutritional status in Rindi District is *Acceptable with* Good rating category.

5. Conclusion

After going through the stages of analysis, design, implementation, and testing, the Web-Based Geographic Information System (GIS) for Mapping Nutrition Status in Rindi District was successfully developed. This system is able to display a distribution map that presents information on nutritional cases of toddlers in each village, calculate the total cases displayed on the map, and make it easier for managers to store and maintain data. Thus, the implementation of the system has been completed, and testing using the black box method proves that the website works according to specifications without errors. In addition, the results of the SUS test gave a score of 78.25, showing that GIS Stunting in Rindi District is in the Acceptable category with a Good rating.

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