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Geographic Information System for Mapping Poverty Levels In East Sumba District

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Abstract

Poverty issues in East Sumba Regency, East Nusa Tenggara Province, which is faced with a high poverty rate. The obstacle of mapping areas with poor people that are difficult to identify is the main focus. Through qualitative and quantitative approaches, this research applied the Extreme Programming (XP) method to develop a web-based Geographic Information System (GIS), aimed at mapping poverty areas. XP was applied to ensure flexibility, adaptability, and active stakeholder participation in the application development. The main objectives were to produce an effective GIS application, provide accurate information for the government and stakeholders, and improve the effectiveness of poverty reduction programs. This research is expected to contribute to the design of programs that are more targeted, effective, and can improve community welfare in East Sumba Regency.

Keyword: East Sumba, Extreme Programming (XP), Geographic Information System (GIS), Poverty, Website

1. INTRODUCTION

Poverty is a condition where a person or group of people do not have sufficient financial resources such as money, food, housing, education, and health to fulfill their basic needs and survive [1]. Mapping and Estimating the Impact of Drought on Food Crop Farmers Using Remote Sensing in East Nusa Tenggara Province. Poverty is often associated with low income, causing a person or group of people who cannot fulfill basic needs such as food, clothing, adequate housing and access to health services and education [2]. Poverty is caused by several other factors such as unemployment, low levels of education, social and economic injustice, and environmental changes that damage natural resources. Poverty can be a difficult and multidimensional problem, affecting people's quality of life and well-being [3].

In Indonesia, the problem of poverty is still one of the most important cases to be addressed so that the government can improve the welfare of the people in Indonesia. The poverty rate in Indonesia was 9.78 percent in 2020. However, this figure varies in various regions in Indonesia. East Nusa Tenggara (NTT) is a province with a relatively high poverty rate in Indonesia. NTT's poverty rate is 22.08 percent. East Sumba Regency is one of the regions in NTT that also has a fairly high poverty rate [4]. Financial, institutional, environmental, technical, and social (FIETS) aspects of water, sanitation, and hygiene conditions in indigenous-rural Indonesia. The data shows that the poverty rate in East Sumba Regency rose to 23.38 percent in 2020 [5].

In this study to design a Geographic Information System for Mapping Poverty Levels in East Sumba Regency, to provide information related to the highest poverty rate in the East Sumba Regency area. There are two previous studies that serve as references, first, with the title Designing a Web-Based Geographic Information System for Mapping Poor Families, Case Study of Sekayu City[6], and Geographic Information System for the Distribution of the Poor (DAMASKIN) in Web-Based Monggas Village [7]. As for what distinguishes the two previous studies, they only convey information about making geographic information systems, while this research is different from previous research. In this study, the system designed not only conveys information related to poverty levels in an area but there is a data management system for poverty levels in an area which includes data collection, and a percentage of the number of poor people in the region.

To address the problem of poverty in these areas, accurate and up-to-date information about the socio-economic conditions of the people in these areas is needed. By using a geographic information system (GIS), information about the population, education level, health access, and environmental conditions can be mapped geographically[8]. So that it can visualize the area with clear data and the government can also provide targeted

or appropriate assistance to those who need it more. That way, it can be known which areas have a higher poverty rate than other areas. GIS is expected to be a solution and be used as a means to identify and map areas that have underprivileged communities so that it can be used as a means of distributing assistance that will be provided by the government and other parties. The development of a geographic information system for the distribution of underprivileged communities in East Sumba Regency is presented using a website. The purpose of using web technology in GIS will make it easier for various parties to access information on underprivileged community data anytime and anywhere via the internet, because the web can be accessed easily via desktop and mobile devices.

2. MATERIAL AND METHOD

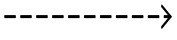
2.1 Geographic Information System (GIS)

Computer geographic information system is a system used to collect, examine and analyze information data related to geographic or earth elements. Commonly called GIS is an information technology used to process and store data, organize, transform, manipulate, and analyze geographic data, both data and nonspatial data [9]. A geographic information system (GIS) is a system made to operate with spatial data sources. Geographic information system is a very trusted medium to present Remote Sensing (RS) data into useful information for many parties for various purposes. Geographic Information System (GIS) is a computer system used to collect, examine, provide functions in GIS, which includes analysis needs and geoprocessing features[10].

2.2 Use Case Diagram

Use case diagram is a modeling for the behavior of the information system to be built. Use cases describe an interaction between one or more actors and the information system to be built. Use cases are used to find out what functions exist in an information system and who has the right to use these functions [11]. The following are the symbols of the use case diagram:

Table 1. Use Case Diagram

Symbol	Name	Description
	Actor	System users interact directly with the system, such as humans, applications and other objects.
	*Use case*	An eclipsed circle with the use case name written in the center of the circle
	Assosiciation	In the form of a line that serves to connect actors with the use case.
	*Generalization*	A generalization and specialization relationship between two use cases where one function is common to the other.
	*Extend*	The relation of an additional use case to a use case where the use case is added

2.3 Extreme Programming

Extreme Programming is one of the many system development methodologies. Extreme Programming is a method that performs rapid system development. Extreme Programming is one way to address changes in situations and conditions that are cost-effective and very fast [12]. In the context of the problems in the background above, the XP method can be an effective approach to improve efficiency in mapping the location of poverty levels in a region. Extreme Programming Model show as figure 1.

1. Planning
   The planning stage is an exploratory process that aims to evaluate the agency's needs, user needs, and system needs. In my view, this stage will also produce a schedule that reflects the time planning for system development. In the Planning stage, the top priority is to ensure that the data collection methods used include thorough observations, interviews, and documentation. By focusing on in-depth data collection, it is possible to accurately identify the functional needs of the system through direct observation, gaining in-depth insights through interactions with Social Service employees regarding poverty rate data in East Sumba district. By prioritizing these three methods, it can provide a strong

basis for designing accurate and appropriate use case modeling, class diagrams, activity diagrams and sequence diagrams in application development.

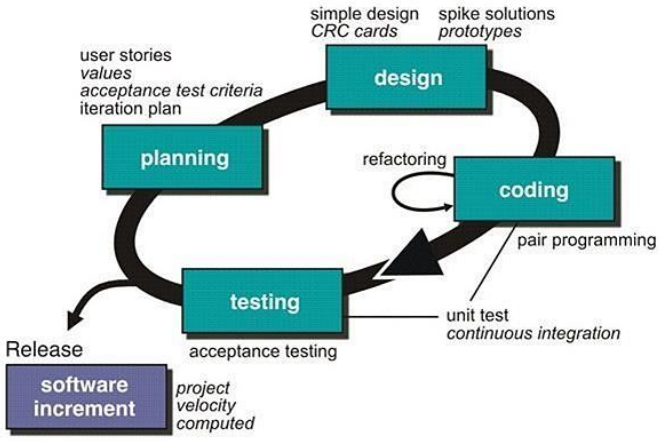


Figure 1. Extreme Programming Model

2. Design
   At the design stage, it can provide a rough look or description of the user interface frame of an application that will be built. Describes the basic structure and layout of the display of the Geographic Information System application for Mapping Poverty Levels in East Sumba Regency.

3. Coding
   The poverty level mapping geographic information system application will be built using the JavaScript programming language and utilizing ReactJS as the main framework. This application allows users to view poverty level areas online, see details related to the available areas. For the user interface design in making the poverty level mapping geographic information system application using Chakra UI to facilitate the development of a modern and responsive web application display.

4. Testing
   At the Black Box Testing Stage, an implementation will be carried out to verify the performance of the system as a whole without paying attention to its internal details. The goal is to ensure that system functions operate effectively and in accordance with predetermined specifications, while evaluating the suitability between the input provided and the resulting output. In the context of Bleck Box testing includes 2 actors, namely admin and user. Admin will access login, data management, and users will access the main page, village data search, and data details.

3. RESULTS AND DISCUSSION

In summary, this research successfully achieved its objectives by designing and implementing an effective and efficient web-based application. This application can speed up the process of finding the location of poverty levels in an area, both detailed village data from each sub-district in East Sumba Regency. Thus, this research makes an excellent contribution in improving the quality and efficiency of finding locations with high poverty rates. The successful implementation of this web application shows that the proposed solution is able to address the identified problems well, provide a positive impact, and provide a strong basis for further development at the stages of filing a thesis title in the future.

3.1. SystemDesign

At this stage, we will explain the big Figure of the system design that will be formed. In this study, it can be seen in the use case diagram. Use case diagram is to describe an interaction between one or more actors with the geographic information system created [13]. Roughly speaking, use cases are used to find out what functions are in an information system that will be created and who can use the system. Here is the use case of the designed system.

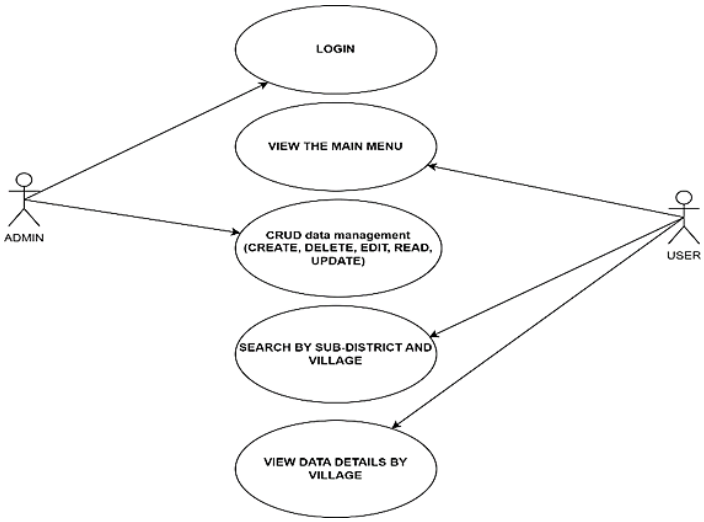


Figure 2. Use case diagram

3.2. System Implementation

1. Admin Login View

   In the Figure below is the display of the admin login page required to fill in the username, and password. If the password entered is wrong, a warning will appear, your password or username is wrong please try again!", then the admin will re-login, if the password is correct it will continue to the home menu or main page.

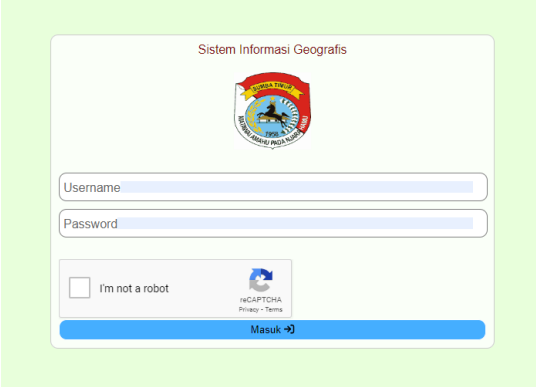


Figure 3. Admin Login View

2. Main Page Display

   Figure 3 below is the main page for users who want to search for poverty data in East Sumba Regency, where there are three menu options, namely the home menu, data menu, data search by subdistrict, and a geographic information system map that directs to the location of the subdistrict to be searched.

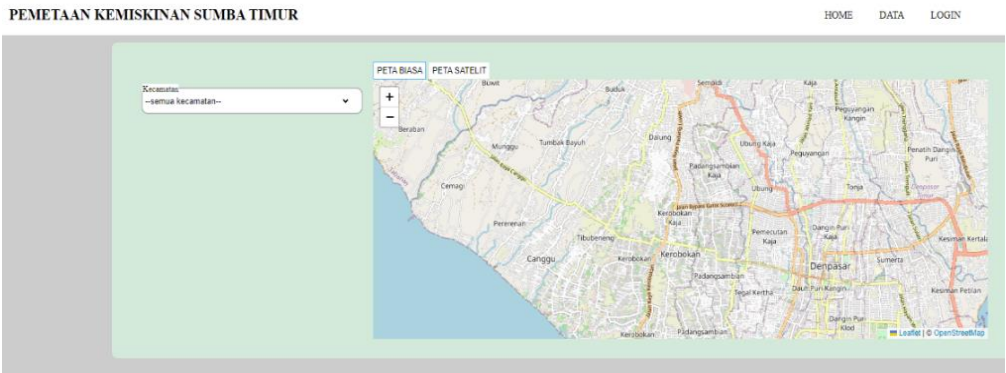


Figure 4. Main Page Display

3. Admin Dashboard View

   Figure 4 is the admin data page for adding or updating poverty data in Kabupaten Sumba Timur. The data includes the name of the sub-district, the name of the village, the number of poor people per household, the total population per household, and the percentage of beneficiaries.

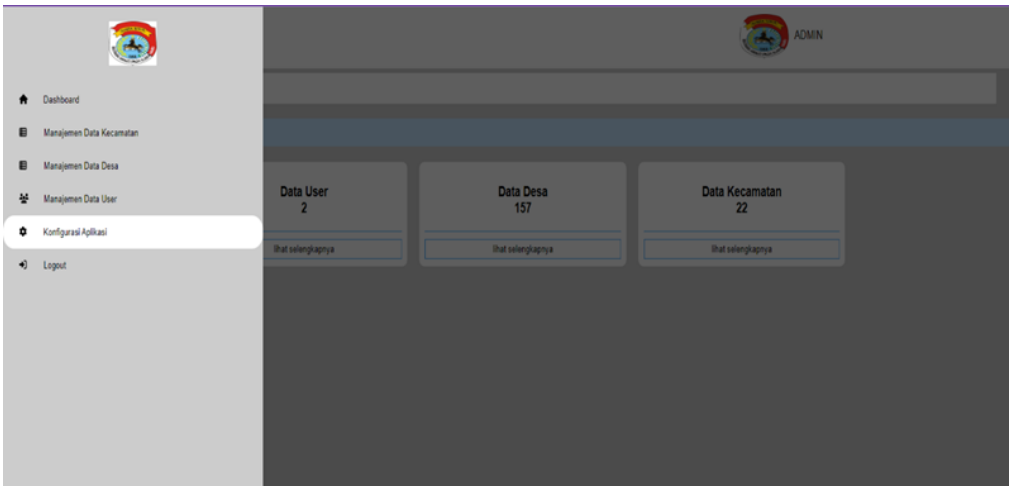


Figure 5. Admin Dashboard View

4. Edit Page View

   Figure 5 is the admin data page for editing data if an error occurs in entering data. Data such as the name of the sub-district, the name of the village, the number of poor people per household, the total population per household, and the percentage of beneficiaries.

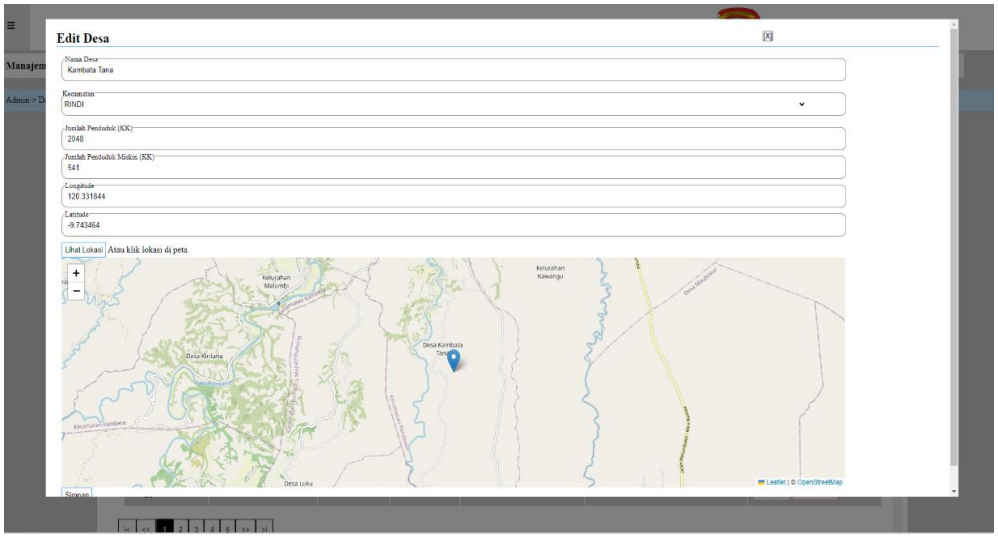


Figure 6. Edit Page View

3.3. Testing

The system testing process uses two methods, namely Black Box Testing and System Usability Testing (SUS). Black Box Testing focuses on evaluating the external functionality of the system without paying attention to internal implementation details, such as user interface testing, location search functionality, and geo-mapping accuracy [14]. Meanwhile, SUS or White Box Testing refers to usability and user experience testing, assessing the extent to which the system is usable and how efficiently users can interact with poverty mapping features [15]. These two methods combined provide a holistic picture of the performance and usability of GIS, ensuring that the mapping of poverty levels in East Sumba Regency can be accessed and utilized effectively by end users. Below is a table of test results using Black Box Testing;

Table 2. Black Box Testing

Testing Activity	Expected realization	Testing Results	Conclusion
Login	➢ If the username and password are invalid, an error message will be displayed, indicating that the username and password combination does not match. ➢ If the username and password are valid, access will be successful and the user will be directed to the dashboard page.	➢ Displays a message that the username and password do not match ➢ The system accepts login access and displays the dashboard page	[√] Accepted [ ] Rejected
Logout	Selecting the logout menu, the system will terminate access rights and return to the login page.	The system successfully terminates admin privileges and returns to the login page.	[√] Accepted [ ] Rejected
Add village location data	Select the add village data button and the system will add rows or columns for new village data input.	Successfully displays the newly added village data and can be saved.	[√]Accepted [ ] Rejected
Change village data	Select the village data to be changed and the system will appear successfully changed data	Successfully display the modified village data and can be saved.	[√] Accepted [ ] Rejected
Delete village data	Select the village data to be deleted and the system deletes the village data.	Successfully display the deleted village data and can be saved.	[√]Accepted [ ] Rejected
Search	Search for village data by village name and kecematan.	Successfully display village data based on village and sub-district names	[√] Accepted [ ] Rejected

After testing with the Black Box method, it was found that all functions on the website-based Poverty Level Mapping Geographic Information System in East Sumba Regency operate with perfect results, achieving a score of 100% in accordance with predetermined expectations.

Table 3. System Usability Testing (SUS)

No	Questions	Strongly Disagree	Disagree	Less Agree	Agree	Strongly Agree
		1	2	3	4	5
1	I feel this website is good for tracking the location of the highest poverty rate				4	
2	I feel that this website can help the government to process data on poverty levels in an area.					5
3	I find this website easy to use				4	
4	I find the interface of this website quite attractive				4	
5	I feel the features on this website work well					5
6	I feel that there are many things that are not in accordance with this website		2			
7	I feel the admin will understand how to use this website					5
8	I find this website confusing for admins	1				
9	I feel there are no obstacles in using this website					5
10	I feel the admin needs the help of others in using this website	1				

Each instrument question has a ratio scale as in the following table:

Table 4. Skor kriteria penilaian

Score	Assessment
1	Strongly Disagree
2	Disagree
3	Less Agree
4	Agree
5	Strongly Agree

At this stage, the researcher tests the system that has been made to determine the feasibility of the system based on the assessment of the user. In the development of the Geographic Information System for Mapping Poverty Levels in East Sumba Regency, it was carried out using the System Usability Scale (SUS). Respondents will be given the opportunity to fill out an assessment questionnaire. The assessment was carried out by 5 respondents, namely representatives from the social service government. There are 10 questions used with a point scale consisting of 1 (strongly disagree) to 5 (strongly agree).

4. CONCLUSION

Based on the research findings, in the development of the Geographic Information System for Mapping Poverty Levels in East Sumba Regency, it can be concluded that the web-based Geographic Information System can assist the government in monitoring the progress of poverty in East Sumba Regency. This enables quicker and more targeted interventions for those in need. The testing of the geographic information system using black box testing yielded results indicating that the features in the developed system are in accordance with expectations.

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