A WEB-BASED GEOGRAPHIC INFORMATION SYSTEM FOR A PUBLIC FACILITIES MAPPING IN GARUT REGENCY

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ABSTRACT

Public facilities refer to basic services provided by government to facilitate the public activities. Garut, located in West Java Province, consists of 40 sub districts. Each of them has different public facilities adjusted to the local community's needs. Regarding this situation, Bappeda of Garut Regency was established to carry out the local development planning, specifically public facilities mapping. Data of the public facilities in Garut have yet to be managed in the form of database. As the result, the data are still static and less accurate; moreover, the presence of separate document data leads to a poor public facilities data management. Similarly, the less accuracy of a public facilities coordinate point and a broad geographic scope wide scope cause the low-performance development and planning. The data analysis shows that a geographic information system is useful for the effective public facilities development in Garut, in general, and for the development and mapping process in each sub district. The effectivity in the public mapping process can produce more maximal results.

Keywords: geographic information system, mapping, public facilities, Garut

1. INTRODUCTION

Garut is a regency located in West Java Province and the people call it "Swiss Van Java" because it is surrounded by a group of mountains. Garut Regency lies between 6º56'49" - 7 º45'00" south latitude and 107º25'8" - 108º7'30" East longitude. The administrative regionof Garut regency reaches 306.519 Ha (3.065,19 km²). It also has public facilities in different fields; 856 schools (in the educational field), 5 hospitals and 66 hospital centers (in the health field), 70 markets (in the economic fields) and 41 public service offices (in the administrative field). To assist the government to manage this wide area, Bappeda (*Badan Perencanaan Pembangunan Daerah*) was established. Its main tasks deal with research and local development planning.

Deni Suherlan, the current head of Bappeda, stated that the process of public facilities planning in Garut is conducted through two steps: a) directly survey the locations that need the public facilities and b) propose recommendations, based on the facilities needed by the local community, from each sub district. This planning steps have produced less accurate data and led to the difficulty in determining strategic locations.

Lack of the accurate data has contributed to poor public facilities monitoring -i.e. to filter the usable items from the needed-to-be-fixed ones- and to the poor information gathering process -i.e. to categorize the districts with lack of public facilities and the ones with incomplete public facilities.

Based on the problems above, hence, this study proposes a geographic information system (GIS) that can facilitate the public facility planning. GIS has capability to manage the data and help individuals analyze them easily, which in turn it can produce an expected outcome which is useful for Bapeda to make a decision. Bapeda Garut needs a geographic information system that can facilitate the public facilities planning process based on the geographic location accurately and efficiently and predict strategies public facilities locations to meet the local community's needs in each district.

2. THEORETICAL CONCEPTS

2.1 Geographic Information System

A Geographic Information System (SIG) is defined as a system which is designed to capture, restore, manipulate, analyze, set, and display all of the geographic data types.

Reference [1] describe that the main objective to use the geographic information system (GIS) is to facilitate the processed information gathering so that the attribute of a restorable location can be produced. The main data's characteristics used in GIS is they should be related to the location and are the basic data which are still unspecified [1].

2.1.1 Spatial Data

Reference [2] describes that spatial data refer to part of the information system presenting a location in the Earth. It will deal with the data of the atmosphere, the Earth's layers, ocean, mountains, and waters. The information generated from the spatial data will be used to predict a position of an element in the Earth [2]. In GIS, there are two spatial data models including:

1. Vector data model
   This is the mostly used model of a spatial data. To build the spatial objects, it will be based on points with the values that have coordinates

(x,y). The soon-built objects will be divided into three parts [2]:

a. Point
b. Line
c. Polygon

2. Raster data model
This model is also known as a grid sel. It stems from a sensing remote system data [2]. In the raster data, pixel (picture element) refers to the geographic object represented as a grid cell structure. In the raster data, the pixel size will determine its resolution [2].

2.1.2 Non-Spatial Data

Non-spatial data are also known as attribute data. This type of data will represent a descriptive aspect of a phenomenon modeled covering items and properties which then will produce various information. Non-spatial data have an attribute of the Earth's appearance, for example sea water has the attribute of texture, depth, etc. They will be restored in the form of "field" and "record". The examples of non-spatial data are "village name", "government office address", "website address", and "sea name" [2].

2.2. Public Facilities Mapping

Bappeda, as the establishment which bears the responsibility for the local development, takes care of the public facilities mapping. With the authority to monitor the public facilities mapping in every regency, it can gain more accurate data of the public facilities.

2.3 Dashboard

Dashboard is a sub of the computer interface that widely displays charts, reports, indicator visuals, and mechanism alerts which are consolidated into a dynamic and relevant information platform [3].

This visual display is the information that is shown up in the best way as possible. As the result, human's eyes can catch the information quickly and human's brain also can monitor it at a glance [3].

2.4 Forecasting

Forecasting is the value predictions of variables that are based on the values that are gained from the variables or related ones. Forecasting can also be based on the scoring ability adjusted to the historical data and experiences [5].

2.4.1 Simple Additive Weighting

A simple additive weighting is used to discover the most weighting addition of a performance rating in every alternative and criterion [5]".

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{Max_i\ x_{ij}} & jika\ \text{j adalah atribut keuntungan (benefit)} \\ \dfrac{Min_i\ x_{ij}}{x_{ij}} & \text{jika j adalah atribut biaya (cost)} \end{cases}$$

Keterangan
rij : rating kerja ternormalisasi
Maxij : nilai maksimal dari setiap tabel
Minij : nilai minimal dari setiap tabel
Xij : tabel dari matriks
Dengan rij adalah rating kerja ternormalisasi dari alternatif Ai pada atribut Cj : i = 1,2,...m dan j = 1,2,...n.

3. DISCUSSION

3.1 A Geographic Information System Analysis

A geographic information system analysis refers to the stage where we are figuring out the type of the geographic information system needs to create. The analysis of GIS can be seen in Figure 1.

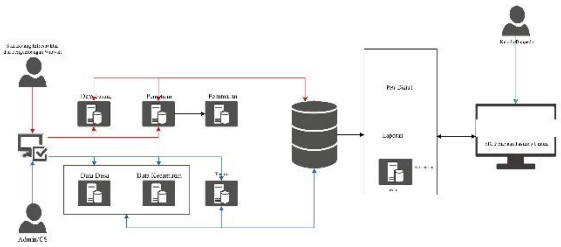

Figure 1 SIG model

3.2 Spatial Data Analysis

The spatial data that will be built on the application cover district and public facilities. The spatial data have been distinguished by the shape and color in order to make clearer the information that is shown up. The spatial data analysis can be seen in Table 1.

Table 1 Spatial Data Analysis

No.	Monitoring indicators	Description	Spatial Data	Examples
1.	Distribution of public facilities related to health centers	The points of public facilities result from latitude and longitude.	Point	
2.	Distribution of public facilities related to schools	The points of public facilities result from latitude and longitude.	Point	
3.	Borderline of a regency area	The borderline of a regency is marked with the "orange" color	Polygon	
4.	Borderline of a sub-district area	The borderline of a sub-district is marked with the "green" color	Polygon	

No.	Monitoring indicators	Description	Spatial Data	Examples
5.	Borderline of a village	The borderline of a village is marked with the "brown" color	Polygon	

3.3 Non-Spatial Data Analysis

The non-spatial data used to develop a geographic information system of the public facilities mapping in Garut Regency can be specifically seen in Table 2.

Table 2 Non-spatial data analysis

No	Name	Description	Attribute
1	Region	It contains the data of Garut regency region covering sub districts and village	Name and area
2	Public facilities	It contains the data of the public facilities which are available in Garut Regency.	Name of the facilities and address

3.4 Database Analysis

Database can be analyzed using Entity Relationship Diagram (ERD). ERD refers to information representing a relationship among data. This information plays an important role in the system and relationship among the data. ERD in the system can be seen in Figure 2.

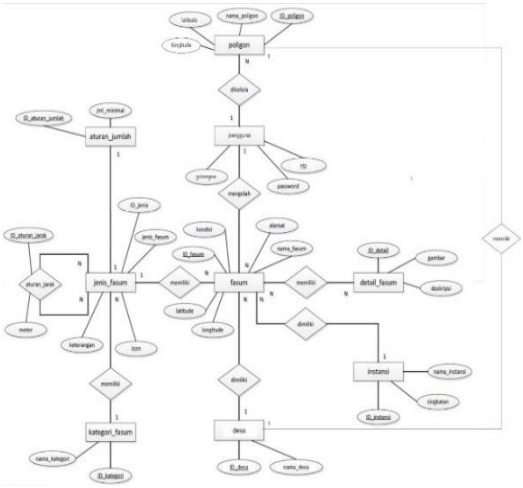

Figure 2 Entity Relationship Diagram in the Geographical Information System of a Public Facilities Mapping in Garut Regency

3.5 Context Diagram

Context diagram refers to the diagram representing a relationship between the External Entity and the sooner-built system. The detail can be seen in Figure 3.

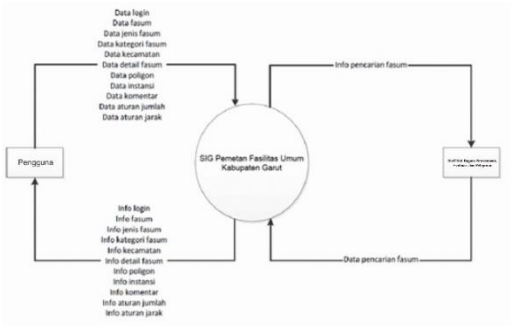

Figure 3 A Context Diagram in Geographic Information System of a Public Facilities Mapping in Garut Regency

3.6 DFD Level 1

Data Flow Diagram (DFD) Level 1 in Geographical Information System of a public facilities mapping in Garut Regency can be seen in Figure 4.

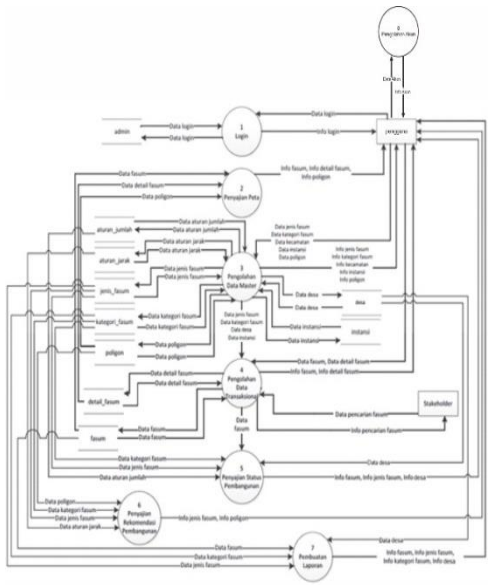

Figure 4 DFD Level 1 in Geographical Information System of a Public Facilities Mapping in Garut

3.7 Relation Diagram

Relation diagram refers to the database design. This design is the relation of each table found in the database. This diagram can be seen in Figure 5.

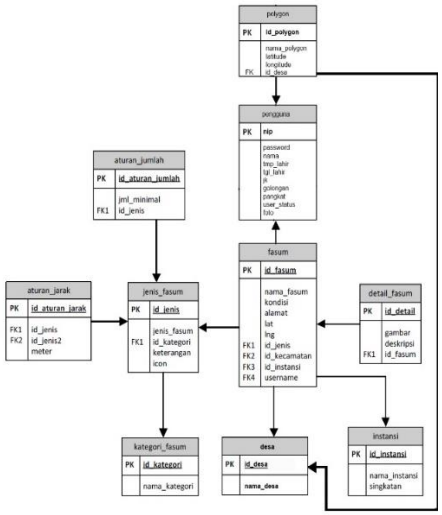

Figure 5 Relation Diagram in Geographic Information Sysrem of a Public Facilities Mapping in Garut Regency

3.8 Interface

The home interface design in Geographic Information System of a public facilities mapping in Garut Regency can be seen in Figure 6.

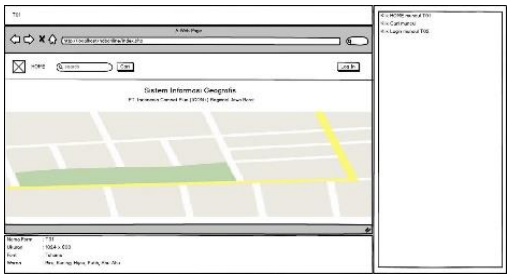

Figure 6 Home Interface Design in Geographic Information System of a Public Facilities Mapping in Garut Regency

3.8.1 Master Data Interface

Master data interface design in Geographic Information System of a Public Facilities Mapping in Garut Regency can be seen in Figure 7.

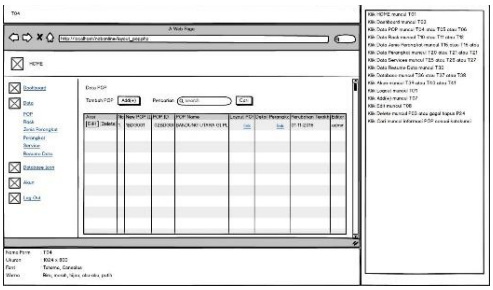

Figure 7 Master data interface design in Geographic Information System of a Public Facilities Mapping in Garut Regency

3.8.2 Interface Design Recommendation

Interface design recommendation in Geographical Information System of a public facilities mapping in Garut can be seen in Figure 8.

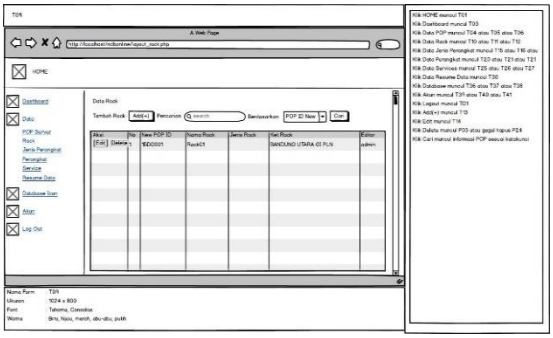

Figure 8 Interface design recommendation in Geographical Information System of a public facilities mapping in Garut

3.8.3 Report Interface

Report interface design in Geographic Information System of a public facilities mapping in Garut can be seen in Figure 9.

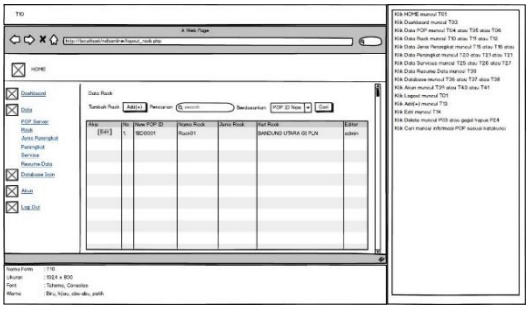

Figure 9 Report interface design in Geographic Information System of a public facilities mapping in Garut

3.9 Procedural Design

Procedural design refers to the stage where the workflow of all sooner-built system in Geographic Information System is arranged. The procedural design includes login, data addition, data change, data removal, data searching.

3.9.1 Login

Login refers to the process used to enter a system. Login can be seen in Figure 10.

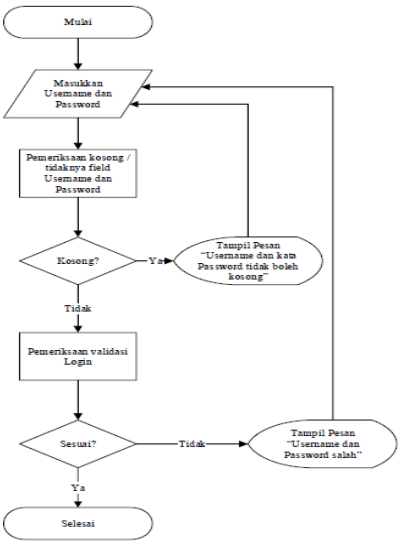

Figure 10 Login

3.9.2 Data Addition

Data addition refers to the process to add data as can be seen in Figure 11.

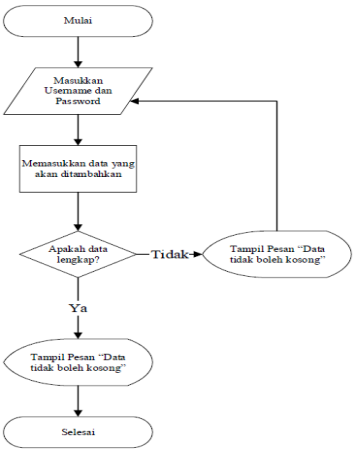

Figure 11 Data Addition

3.10 System testing

A system testing is conducted to asses whether the built system has already met the needs or not and to evaluate the strength of the new system. This testing involves two steps: Blackbox testing and UAT.

3.10.1 Blackbox Testing

Based on the Blackbox testing, this study concludes that Geographic Information System of a public facilities mapping in Garut can give the expected results.

3.10.2 UAT

Based on UAT, this study concludes that Geographic Information System of a public facilities mapping in Garut is ready to be used by end users.

3.10.3 User Acceptance

Based on the testing, this study concludes that Geographic Information System of a public facilities mapping in Garut is successfully completed and ready to be used with the purpose to help Bappeda with the public facilities mapping and monitoring according to the local needs.

4. CLOSING

4.1 Conclusion

Based on the analyses and testing, this study concludes that:

1. Geographical Information System can help Bappeda with the public facilities mapping and monitoring in Garut Regency.
2. Geographical Information System can help Bappeda with the strategic location mapping and selection related to the public facilities mapping in every sub district.

4.2 Suggestions

Based on the analysis and testing results, this study discovers gaps that need to be fulfilled. Therefore, this study suggests two points that have potentials to be further explored by future studies, they are:

1. The built Geographical Information System can be further developed by adding more features and displayed in a more eye-catching style. It also can be integrated to the system that producer.
2. The information scope and mapping can be further developed to synchronize data and to determine a location more accurately.

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