

GEOGRAPHIC INFORMATION SYSTEM AS DETERMINATION OF STRATEGIC LOCATIONS AND SHORTEST ROUTES IN BANDUNG USING DIJKSTRA METHOD

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ABSTRACT

Bandung is one of the cities which is always visited by a huge number of tourists. The frequency of the visit increases every year. This city has a large number tourism objects and strategic places to visit. Therefore, it is essential to design an information-based technology application which can make finding strategic places in Bandung easier and can give information of shortest routes from origin places to the destinations. The users of this application will include administrator and public visitor. The administrator will enter the data of places, weight, place types and other strategic location attributes. Public visitors will be able to see the map display and can enter the origin places and destinations. The output of the application which will be built in the second year is the shortest route display which is based on the inputs from both users. The research is first year competitive grant research which is funded by Higher Education Office (Dikti) in 2009. This research involves three researchers, ten students and one administration staff. In the first year, the research emphasizes on analytical and designing phase by using structured method, that is by applying Dijkstra Method in the algorithm of shortest route searching. Functions prepared in this information system is designed by using modeling tools like structure chart, menu structure, Data Flow Diagram (DFD) as modeling process explained in process specification and Entity Relationship (ER) as data modeling. Apart from that, this design is equipped with testing design which will be conducted after the information system is built in the second year of the research.

Key Words: Geographic Information System, Bandung, Shortest Routes, Dijkstra Method

1. INTRODUCTION

Information technology has spread into various fields including geography. Today, Geographic Information System (GIS) has become a tool which is used for mapping and analyzing activities on earth. GIS technology combines database operation, like query and statistic analysis, with map. GIS possesses the ability to make map, integrate information, visualize scenario, solve complicated problems, and develop effective solution on geographic objects that have never existed before.

Bandung is one of the cities which is always visited by a huge number of tourists. The frequency of the visit increases every year. This city has a large number tourism objects and strategic places to visit. Therefore, it is essential to design an information-based technology application which can make finding strategic places in Bandung easier and can give information of shortest routes from origin places to the destinations.

Based in the explanation above, in the first year of research the design of geographic information system (GIS) of strategic places and shortest routes in Bandung using Dijkstra method will be built. GIS can give information about the

shortest routes to strategic places like hotels, streets, hospitals, police offices, malls, markets, supermarkets, terminals, universities, stations and some interesting places in Bandung.

The aim of this research is to design an application model of Geographic Information System which covers the information from the basis data of strategic locations in Bandung to available routes in order to reach those places. Specific aims targeted in the first year of research include:

- 1) Strategic locations in Bandung are identified
- 2) Possible routes from each strategic location to another location that previously has been identified, are identified.
- 3) Engineering information system for application development basis.

The scope of engineered system is:

- a. Users can find or know the location of tourism objects or interesting places, malls, markets and supermarkets, hotels, restaurants, terminals, universities, police offices, hospitals, railway stations, and main streets in Bandung.
- b. Administrator can update data of street table, strategic places and users' data.

- c. Input data of origin and destination places will be in the form of main streets.

1.1 Basic Concept of Information System

System can be defined as a group of interrelated elements in order to reach a goal. System can also be defined as a group of procedures which are designed and arranged in order to gain determined aims. System can be defined as a unity which consists of two or more components or sub systems which can interact in order to reach certain aim (JOG99).

A system has a particular aim. Some say that the aim of a system is to reach a goal and, some other say, to reach certain target. Aim is usually connected to wider scope, e.g. business system, in which the term *goal* will be more appropriately applied. Target is connected to smaller scope like accounting system or other systems which are part or subsystem of business system.

There are some characteristics of a system. They are:

- a. System component consists of some components that interact with each other and corporate in order to form a unity. Each component has system characteristics for running certain functions and influences the whole system process.
- b. System border is an area that limits one system from another.
- c. Environment outside a system is all the things outside the system border that affects system operation.
- d. System connector is connecting media between one subsystem with other subsystems. This connector enables resources flow from one subsystem to another, and the subsystems interact, forming a unity.
- e. System input is the energy given to the system.
- f. System output is the result of energy which has been processed and classified and become useful output.
- g. System processing. A system can have a processing part which will transform input into output.
- h. System target. Every system has its own aim. If a system does not have target, system operation will be useless. System target is very crucial in determining input the system needs and output produced by the system.

In every system activity, there are various activity data. The reliability of the data record is firstly checked manually through a process called *Accuracy Checking*. Then, the data is transferred to a media in computer system called *Data Entry*. Later, the data prepared by *Data Entry Process* will be processed by computer in order to produce needed output.

1.2 Geographic Information System (GIS)

Geographic Information System is an assisting tool for management which provides computerized information that us strongly connected to mapping system and analysis on all thing happening on earth.

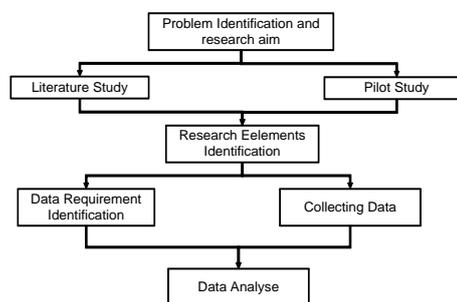
GIS technology integrates database data processing operation which is commonly used nowadays, like data taking based on needs and statistical analysis by using unique visualization and various advantages provided through geographic analysis on maps. This ability makes GIS quite different from most information system. It is also worthy for public companies or individual since it can explain an event, make prediction, and other strategic planning.

In general, there are two types of data which are usually used to design geographic information system. They are:

- a. Spatial data is a kind of data which represents space aspects of a related phenomenon. It is also often referred as position data, coordinates and space.
- b. Non spatial data or attributes are kinds of data which represent descriptive aspects of a modeled phenomenon. These descriptive aspects cover from items or properties of the modeled phenomenon to time dimension.

2. MODEL, ANALYSIS, AND DESIGN

The method of this research is waterfall model. In this model, model development is started from system level to analysis level, designing, programming, and testing. Considering the aim of each stage is different, research method is suited with each different stage. The research design in the first year is arranged by following the flow in Picture 1.



Picture 1. First year research stage

This research is started by identifying strategic locations in Bandung. From the identification, it is decided which routes that can be gone through from one strategic location to another. Then, based on the research aim, the design of Geographic Information System application is conducted.

Literature study is done in order to obtain theories or concepts, both models and components which are relevant with research problems along with the methodology, and also best practices which have been applied by typical industry. Learned theories, concepts, and models include concepts of information system, information system designing, geographic information system and route determination concept. Based on the previously learned theory, concept and practices and literature study, theoretical conclusion for determining research variables, is drawn. Pilot study stage is conducted in order to gain information about the components which should be formulated in designing Geographic Information System application compatible with Bandung condition now. Based on the pilot study and literature study, variable description needed in this research, is obtained. Pilot study is conducted in Bandung. Based on concepts relevant with this research and pilot study conducted, variables needed in this research can be identified.

Data identification stage is done for deciding which data is needed in this research. In accordance with the already built research aim and framework, the data needed includes data of landscape condition in Bandung, strategic places in Bandung, streets in Bandung, and the characteristic of each street.

There are several common methods in

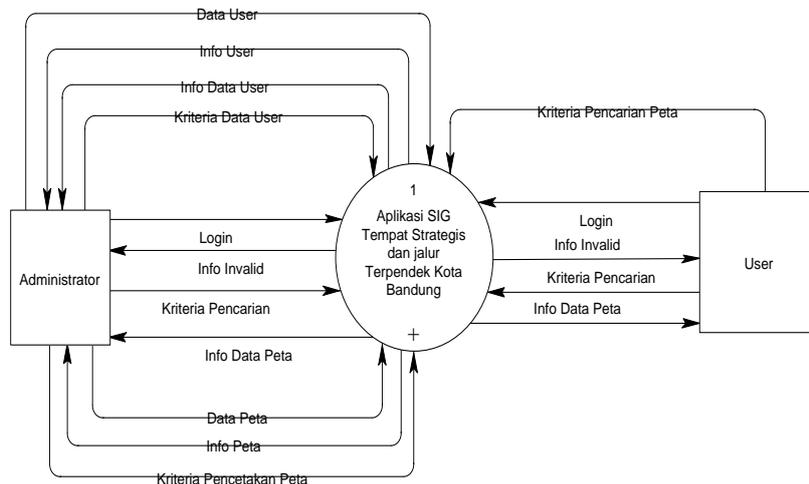
collecting data, including observation, interview, secondary data from other sources or the combination of all. Since the data needed is both primary and secondary, this research uses the combination of those methods above. To identify data of landscape condition in Bandung, observation is done. For getting data of strategic locations, streets and the characteristic of the streets in Bandung, observation is also conducted. While for model development including application design, interview and secondary data are used.

2.1 Process Design

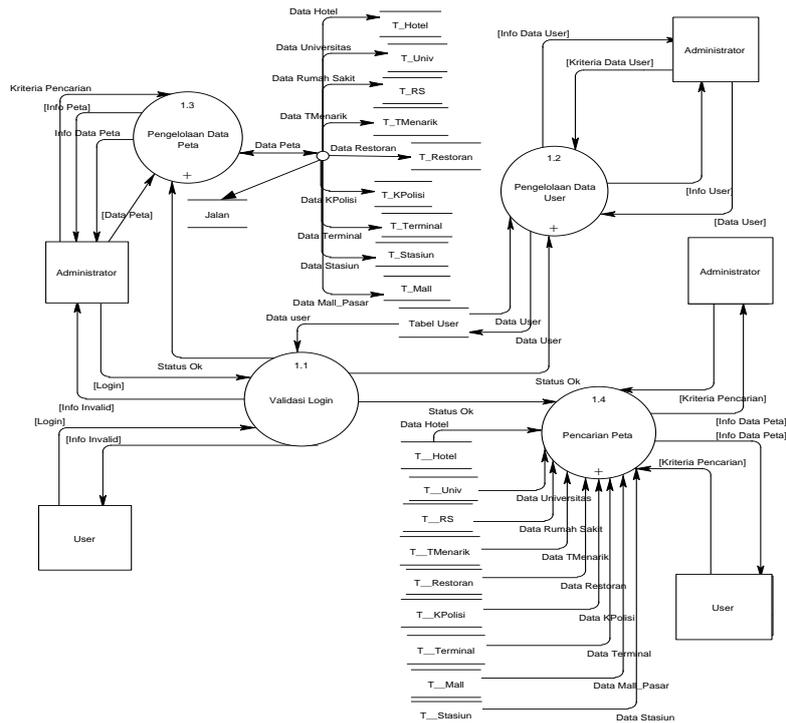
Before creating an application, design process will be done. Design process in this application is described in Context Diagram and *Data Flow Diagram (DFD)*.

In Picture 2, it is described that Geographic Information System of Strategic Locations in Bandung has two entities: GIS administrator that has a full right in GIS processing process and users that have the right to look at the map.

Data flow diagram (DFD) Level 1 Geographic Information System of Strategic Locations in Bandung consists of five processes. They are Login Validation Process, Users' Data Management, Map Data Processing, Map Finding, and Map Printing as described in Picture 3.



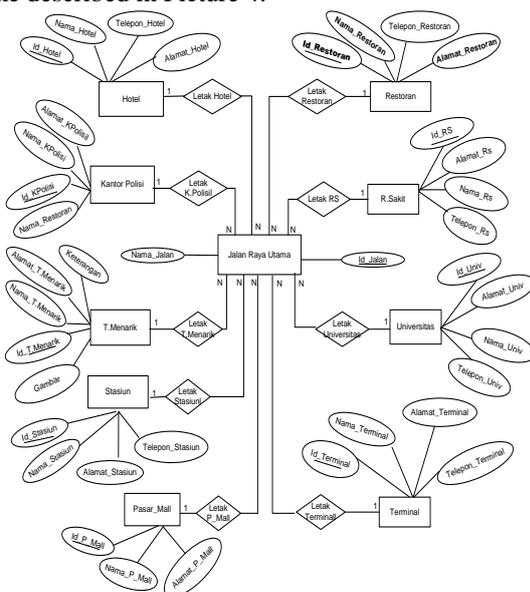
Picture 2. Context Diagram



Picture 3. DFD level 1

2.2 Data Design

Entity-Relationship Diagram which consists of entity assemble components and relation assemble. Each of relation assemble is equipped with the attributes that present the fact from the world we are observing. In this application of Geographic Information System of strategic locations in Bandung, there are several related entity including hotels, street position, hospitals, police offices, malls, markets, supermarkets, terminals, universities, stations and some interesting places, like described in Picture 4.



Picture 4. Diagram Entity Relationship (ERD)

2. RESEARCH RESULT

Information system development in the research's first year is still focused on analysis and design concept development, both need and functional analysis, and also data design (using Entity Relationship), process diagram (Data Flow Diagram), process specification, interface design, logical sequence and testing design (using Blackbox Method). The methodology of Information system development used is Waterfall method which covers some stages: analysis, design, implementation and testing.

Information technology from product development view is focused in the second year by using web-based which is open source and has reusable programming framework, collaborated with image technology in processing spatial map data. For basis data technology will use open source technology like MySQL.

Activities to fulfill need which are done during a research provide the opportunity to improve the service quality to people by applying the collaboration between information technology and landscape content which consists of information of streets and strategic locations in Bandung. This research proposes a design model which can define functional and technological need from the identification process of what needs to be fulfilled.

The implementation of information system design as research result, has the opportunity to give the following contributions:

1. Scientific Contribution

The development of geographic information system of strategic places and shortest routes in Bandung which is based on service-oriented concept and collaboration, provides information system model proposition, application architecture and formal functional need documentation.

2. Practical Contribution

Technological implementation provides contribution in the form of application architecture which can become a guidance in realizing an application by applying information technology design. Furthermore, the result of this research can become a planning basis for developing data and application base.

This research involves other units in Post Polytechnic of Indonesia. Apart from the team members who are from different units: Informatics Management Department, Business Logistics Department, and Language Laboratory Unit, other involved units are Library Unit and Research and Public Service Institution (LPPM). The collaboration of three researchers with different backgrounds: information technology, transportation and language background, easy access to books and references, and easy guidance from LPPM, make this research can be conducted on time smoothly.

However, it is some involved students who give the biggest contribution for the field study in this research. Post Polytechnic of Indonesia as a vocational institution intends to produce perceptive and competent students who are able to implement the knowledge and skill they have gained. In this way, researching atmosphere can be spread and field practice of how a research is conducted can be introduced. In this research, the researchers are helped by 10 students. Those students do the survey, collect and process field data, and classify strategic places based on areas and types of places.

4. CONCLUSION

After the researchers collect raw data, analyse and design Geographic Information System application of strategic locations in Bandung, the researchers conclude several things:

- a. A design of geographic information system is obtained. The result of this design is in the form of data design, interface design, and algorithm design.
- b. Survey data is obtained. The data is classified by types of places and distances between one strategic place to another and will be implemented as the basis of shortest routes calculation.

- c. This application design provides several feature design to make spatial data management easier and faster, information finding more accurate, and spatial data representation easier than using manual map.

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