Dijkstra algorithm for nearest route determination and estimated cost of official travel

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Abstract. The purpose of this Decision Support System (DSS) design is to analyze the nearest route of a position, which then carried out financing analysis for transportation to the specified location. The design methodology of this study is the Android-based application system by utilizing the mapping of the region on the hardware in the form of a smartphone. The analysis model chosen for this DSS is Dijkstra algorithm. The subject of system user is Coordinator of Islamic Higher Education (KOPERTAIS) region II for West Java and Banten. The design results show the good system capabilities of the system to select and determine the nearest route and estimate the cost of official travel so that official travel can be efficiently done based on the time and cost perspective.

1. Introduction
The global era and technological advancements always have an impact on demands and challenges in various aspects of life; technology is created to make quality of life [1], information system technology device can be used for business process in service education efficiently [2]. The advantages implementation of information systems in universities can run a business process on an effective and efficient [3].

For answer and compensate all changes to be quality and have power competitive, Coordinator of Islamic Higher Education (KOPERTAIS) Region II West Java and Banten continues to strive to take anticipative and strategic measures, namely through various activities and training programs to achieve quality and quantity in Private Islamic Higher Education (PTKIS)[4]. Utilizing the advancement of mobile technology, this research was carried out for service documentation and estimation of official duty travel costs. Data that can be inputted by the Staff, then the estimated costs will be calculated by the Finance Staff and will be confirmed by the Financial Leader on a web service, and the search for the nearest route is implemented from the Dijkstra algorithm.

Similar researches for analyzing the shortest routes have been implementing, including: the implementation of Dijkstra's algorithm as an effective solution for making plans in real time [5]; utilization of Geographic Information Systems (GIS) to determine location of bus ticket sellers in Solo City base on Android [6]; design of application (Android-based) for searching shortest route using Dijkstra algorithm to find hospitals in Bandung City [7]; implementation of Dijkstra's algorithm based-on android to finding the shortest route from the user's location to target plant place (Case study in Purwodadi Botanical Garden) [8]; Web-based tourism Geographic Information System and search the shortest route with Dijkstra's algorithm [9]; and implementation of Dijkstra's algorithm to determine the shortest inter-city road passes in Southern Sumatra [10]. The thing that distinguishes this research from
previous research is to analyze the shortest route, also to analyze the estimation of official travel financing. The purpose of this DSS design is to analyze the nearest route of a position, which then carried out financing analysis for transportation to the specified location.

2. Methods
The methodology used in the study is the Prototype method. The prototype is a fast development and testing of the working model of application design, through an interactive process and repeatedly used by information systems and business experts. Prototyping method has similarity with Rapid Application Design (RAD) because it simplifies and speeds up system design [11]. This prototype model starts with the communication with customers to collect the need for the software that will be created [12]. Then he made the quick planning of the software so that customers would be more imagined by what desired in the form of software flow simulations. After the developer and customer agree on the software flow that develops, the developer will implement the agreed upon the path in the program that must build. Customers evaluate the program that has been developed by this developer until specifications found that is by the customer's wishes. Expert has a role in this research for system reliability using analytical method [13].

3. Results and Discussion
The broad of the geographical working area of the KOPERTAIS Region II requires: personnel, personnel, costs, and special programs in a travel agenda to visits many PTKIS at the same time periodically. For this reason, it is deemed necessary to monitor and evaluate specifically conducted simultaneously within a certain period so that all PTKIS covering the provinces of West Java and Banten can well serve. For this purpose, an information system designed to support KOPERTAIS personal mobility needed.

Combination of information technology utilization and human activity is Information System (IS) with several procedures [14], where operation and management support [15]. IS has a content suh as organized data process [16]. Based on previous research, the information system has an accurate access data and efficient run-time [17], support a proper decision [18], high accuracy [19], low cost [20], extended accessibility [21], increase productivity [22], intensify user knowledge [23], provide data and information well [24], and used as data storage [25]. Utilization of smartphones as hardware for this Android-based application have advantages, among others: mobile [26], multimedia-based information [27], accessibility [28], fun [29], and efficient [30].

3.1. Dijkstra Algorithm
Edsger W. Dijkstra formulated the Dijkstra algorithm and published in 1959 in a Mathematic Numerische Journal entitled "A Note on Two Problems in Connection with Graphs". Dijkstra's algorithm is one variant of the popular algorithm in solving problems related to the optimization problem of finding the shortest route from a path, which has a minimum length from vertex a to z in a weighted graph, the weight is positive, wherein negative, the nodes cannot traverse. But if this happens, the solution given is infinite (∞) [10]. In Dijkstra's algorithm, nodes used because the Dijkstra algorithm uses directed graphs to determine the shortest route (Figure 1).
3.2. Design and Analysis

3.2.1. Dijkstra Algorithm and Cost Estimation. This algorithm aims to find the shortest path based on the smallest weight from one point to another\cite{9}. For example, the point of describing a building and the line describing the path, the Dijkstra algorithm calculates all possible smallest weights of each point (Figure 2). First, determine which point will make the initial node, then give weight to the first node to the nearest node one by one, Dijkstra will develop the search from one point to another and the next point step by step this is the logical sequence of the Dijkstra algorithm:

a. Give the weight (distance) for each point to another point, then set the value 0 at the initial node and the infinite value to other nodes (not filled);

b. Set all "Untouched" nodes and set the initial node as "Departure node";

c. From the departure number, consider the neighboring nodes that have not been touched and calculate the distance from the departure point;

d. When we are finished considering each distance to the neighboring node, mark the node that touched as "Touched node". The touchable node will never check again, the distance saved is the last distance and the minimum weight;

e. Set "Untouched Node" with the smallest distance (from the departure node) as "Departure Node" and then proceed to go back to step on point c.

The estimated transportation and accommodation costs are calculated based on the general cost standard set by the government, which entered as a dynamic data input into the application.

3.2.2. Data Input and Output. Official travel input is done by setting the starting point of the Koopertais office as node 0 and then placing the distance between nodes specified as the official travel destination. For example: if the staff will enter the service assigned to the Bandung City, Sukabumi Regency, and Cirebon Regency. Then the data input is made as presented in Table 1. Estimation results and order of official travel determined by the system (Figure 3.), and financing estimates shown in Table 2.
Table 1. Official Travel Distance Matrix.

| Places (nodes) visited: | Distance | 0   | 1  | 2  | 3  |
|-------------------------|----------|-----|----|----|----|
| 0: UIN Bandung          |          | 0   | 13 | 123| 231|
| 1: Universitas Islam Bandung |        | 1   | 13 | 0  | 113|
| 2: STAI Muhammadiyah Sukabumi |       | 2   | 123| 113| 0  |
| 3: Institut Studi Islam Fahmina Cirebon | 3 | 231| 231| 311| 0  |

Based on the mapping results using the Dijkstra algorithm, provided that all nodes passed, then a description of the trip is presented as shown in Figure 3.

Table 2. Cost Estimation (IDR.)

| No | Name          | Salary | Consumption | Fuel   | Total Cost  |
|----|---------------|--------|-------------|--------|-------------|
| 1  | Abdul Rahman  | 1,000,000 | 150,000     | 1,336,000 | 2,486,000   |
| 2  | Abdul Rahim   | 1,500,000 | 150,000     | 1,650,000 |             |
| 3  | Abdul Malik   | 1,500,000 | 150,000     | 1,650,000 |             |

Cost Estimation 5,786,000

Figure 3. Nearest route base on Dijkstra algorithm.

The implementation of the Dijkstra Algorithm in this application is used to find the nearest route. The implementation of the Dijkstra Algorithm applied in the nearest route search system can run well and produce almost 90% accuracy. This system is carried out to travel the nearest route and estimate the cost of service assignments that are inputted by the Staff, then the estimated costs will be calculated by the Finance Staff and will be confirmed by the Finance Leader on a web service basis to make it easier for service officials to do their work.

4. Conclusion

Based on the results of application testing, Dijkstra's algorithm use as a method in determining the shortest route, which in the later stages used as a basis for calculating the financing of official duties. The results of this calculation have a positive impact on the efficiency of time and costs in official travel.

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