Information System Website Of Surabaya Sharia Waste Bank Based Using The Traveling Salesman Problem (TSP) Method

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Information System Website Of Surabaya Sharia Waste Bank Based Using The Traveling Salesman Problem (TSP) Method

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Abstract— UIN Sunan Ampel Surabaya is committed to maintaining environmental sustainability in accordance with the teachings of Islam Rahmatan Lil'Alamin by promoting effective waste management in all aspects of the university's three pillars and environmental governance. However, waste management at UINSA, both internally and externally, remains suboptimal, especially after the discontinuation of the UINSA Waste Bank (BSS), which previously could only reduce waste by about 5 percent. To address this issue, this study examines the use of the Travelling Salesman Problem (TSP) method to design an information system that can optimize waste collection routes. Information was gathered from various relevant parties to ensure a comprehensive and effective system design. By applying the TSP method, this information system is expected to enhance the efficiency of waste collection, reduce operational time and costs, and minimize human errors in data management. This system design aims to assist all relevant parties in managing waste more effectively and supporting environmental sustainability at UINSA

Keywords— Management Information System, website, Online Waste Bank, Laravel, Travelling Salesman Problem Method.

I. INTRODUCTION

Waste is the result of daily activities conducted by humans. A study conducted by the University of Georgia in 2015 stated that "Indonesia is the second-largest country in the world after China in terms of plastic waste production into the ocean, amounting to 0.48-1.29 million metric tons per year." The increasing amount of waste corresponds to the growing population and the limited land available for final disposal, which is a problem that needs to be addressed[1].

A web-based waste management and transportation information system is a system designed to assist in the effective management and transportation of waste. In previous research, the design and development of web-based information systems have been conducted in various fields. An example of a system that can be applied in the field of environmental management is waste bank information system. The aim of this research is to address problems in waste management by utilizing information technology that can facilitate management in the recording and transportation of waste.[2].

The development of information technology is advancing rapidly. Information technology has been utilized in various fields of human life. The use of ICT includes: government, defense and security, health, environment, and education. Information technology has become an essential part of organizations; ICT has supported operational activities within organizations.[3].

The UINSA Islamic Waste Bank is a waste bank established in 2014, operating in the field of cooperatives with a Sharia-based application. BSS began operating on April 21, 2014, inaugurated by the Rector of UIN Sunan Ampel Surabaya, represented by Mrs. Hj. Shofiyah Asmu, M.Si. In its operations, the UINSA Islamic Waste Bank obtains customers from the academic community as well as from the external environment around the campus. Some innovations from the UINSA Islamic Waste Bank include Green-UKT, Green-Gold, Green-Showwaste, and

Green Health. The vision and mission of the UINSA Islamic Waste Bank are also as follows.

The processing system at the UINSA Islamic Waste Bank in Surabaya still uses manual tools and is not well-organized, which causes many problems to arise. Starting from students and external residents who want to register as customers, the collection of waste from customers, the distribution of waste, the transaction process, and the accumulation of transaction results are still done manually or conventionally. Some transaction data is still in paper form. This leads to many cases occurring during the process within the Islamic Waste Bank.

This research aims to develop an information system using the Travelling Salesman Problem method, which can provide services in managing and serving waste collection at the UINSA Waste Bank in Surabaya based on location priority, the closest distance, making it more effective in its use, starting from customer registration, the delivery of waste from a location to the storage place, namely the UINSA Waste Bank..

II. METHOD

The Traveling Salesman Problem (TSP) is a method used to achieve an optimal value that is quite classic and non-deterministic polynomial-time complete (NPC), where there is no most optimal solution other than trying all possible solutions. To determine the optimal (shortest) route, the delivery of goods is carried out with several possible travel paths until returning to the origin point without any place being passed twice.

Based on previous research, the problem of route determination using the nearest neighbor method to solve the issue of determining the route for customer pickup to the waste bank, with the aim of reducing the total distance of delivery, time, and cost burden on the company.[4]

Data collection is done using interviews and observations. Researchers interviewed parties directly involved in the use of information technology. Then the researcher made observations with the parties directly involved in the use of information technology, the involvement of information technology in each transaction, and the parties involved in the transaction.[5]

The Traveling Salesman Problem model used is as follows:[6]

a) The first procedure in determining the route is to obtain the coordinate values of the starting point and the various locations that will be sorted. These coordinates are gathered into a single matrix to calculate the distances.

current_location=(start_latitude,start_longitude) [6]

b) Define a set loc representing the waste locations as:

loc={(sampah1,latitude1,longitude1), (sampah2,latitude2,longitude2), ...,(sampahn,latituden,longituden)}

Where:

- {sampah}_isampahi is the identifier for each waste location,
- {latitude}_ilatitudei andlongitudei\t{longitude}_ilongitudei, are the latitude and longitude coordinates of the iii-th waste location.

c) Finding the Nearest Location For each location Li within the unvisited locations:

distance=calculateDistance(current_latitude,current_longitude, Li[latitude], Li[longitude])

Select Lnearest from the locations with the minimum distance:

Lnearest= argLimin(calculateDistance(current latitude,current longitude, Li[latitude],Li[longitude]))

d) Move to the nearest location *current_location=(latitudenearest,longitudenearest)*

Select Lnearest within the location with the minimum distance:

Lnearest= argLimin(calculateDistance(current latitude,current longitude, Li[latitude],Li[longitude]))

e) Adding Lnearest to the route from the list of unvisited locations. New sorting, Using the sorted savings, new routes are formed by combining several routes with the greatest savings in the saving matrix. This process is carried out iteratively until all distribution points or customers are connected in one optimized route.[6]

III. RESULTS AND DISCUSSION

A. Analysis with the TSP Nearest Neighbor Algorhytm

In the implementation of the TSP method, the first step is to obtain the value from the user input in the form of location_maps, which will then be used to calculate the distance and subsequently sort the route. This process is essential for determining the optimal route for the delivery of goods, ensuring that each location is visited only once and the shortest route is identified.

Overall, the process involves creating a structured data repository for customer location input, validating and formatting the input data, and implementing error handling mechanisms to ensure the accuracy and reliability of the collected location information, like bottom:

Table 1. Data Location Sample

`no_reff`	`coordinat`	distance'
12324	-7.2939205958 11269, 112.78107581349151	0
12331	-7.309599708807903, 112.7297358148249	0
12332	-7.320206661935708, 112.7301988558192	0
12333	-7.326675481476499, 112.7329454558192	0
12334	-7.312793285565457, 112.732377	0
12335	-7.3082179414957125, 112.73444621349152	0
12336	-7.305864898479648, 112.73503551349152	0
12339	-7.312220068417552, 112.77030949206781	0
12338	-7.309600133727032, 112.77307965767231	0
12337	-7.278511367630846, 112.7361210441808	0

In the table 1 above, there are several location inputs from the user, such as addresses (locations) and points input by the admin for route calculation based on distance. The next step is to sort the array as locations, which will later be filled with the distance results calculated by the system with this formula below :

`koordinat_awal`	-7.296443370569358	112.7358404 4047468'

current_loc=(−7.322191655237305, 112.73470170620698)

loc = {(sampah1,latitude1,longitude1) ,(sampah2,latitude2,longitud2),...}

Table 2. Data Location with Distance

`no_reff`	`coordinat`	distance'
12324	-7.2939205958 11269, 112.78107581349151	6.003
12331	-7.309599708807903, 112.7297358148249	1.503
12332	-7.320206661935708, 112.7301988558192	543
12333	-7.326675481476499, 112.7329454558192	534

12334	-7.312793285565457, 112.732377	1.076
12335	- 7.30821794149571 25, 112.73444621349152	1.554
12336	-7.305864898479648, 112.73503551349152	1.815
12339	-7.312220068417552, 112.77030949206781	4.080
12338	-7.309600133727032, 112.77307965767231	4.458
12337	-7.278511367630846, 112.7361210441808	4.859

In the table 2 above, there are several location inputs from the user, such as addresses (locations) and points input by the admin for route calculation based on distance. The next step is to sort the array as locations, which filled with the distance results calculated by the system. The next step is to sort using the nearest_distance method, then update the location_maps that have been sorted and filled with the distances with formula below

nearest_distance=min{calculateDistance(current_location,(lati,loni))|(lati,loni)∈L}.

Table 3. Data Location With Sortir Route

`no_reff`	`coordinat`	`dist`
12333	-7.326675481476899, 112.73294545581192	554
12332	-7.320206661935708, 112.73019885581192	543
12334	-7.312793285565457, 112.732377	1.076
12331	-7.309599708807903, 112.7297358148249	1.503
12335	- 7.30821794149571 25, 112.73444621349152	1.554
12336	-7.305864898479648, 112.73503551349152	1.815
12337	-7.278511367630846, 112.7361210441808	4.859
12338	-7.309600133727032, 112.77307965767231	4.458
12339	-7.312220068417552, 112.77030949206781	4.080
12324	-7.293920595811269, 112.78107581349151	6.003

In the table 3 above, the optimal waste collection route is constructed using the nearest_distance formula and is arranged in order based on the nearest locations visited one by one until all locations have been visited. This website is formed using the bootstrap style for the frontend and PHP (Laravel) for the backend.

B. Implementation the TSP Nearest Neighbor Algorithm in Web Application

The implementation of this system is outlined on the UINSA Surabaya Sharia Waste Bank Information System website, using 2 Admin and User (Customer) role systems. Admin can add customers, pick up locations and generate pick up routes with a system that is integrated with TSP Nearest Neighbor. Users can register for pick-up and then wait for pick-up confirmation by the admin.

Figure 1. Landing Page Website

The image above is a website landing page, users can press the enter button to go to the login page

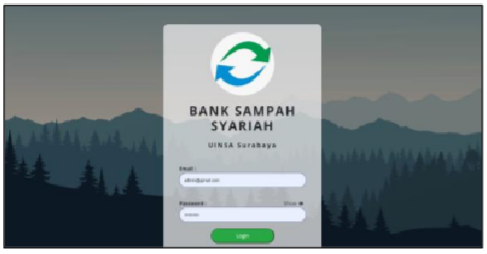

Figure 2. Login Page Website

The image above is the website login page, users can enter their registered email and password if they want to continue logging in.

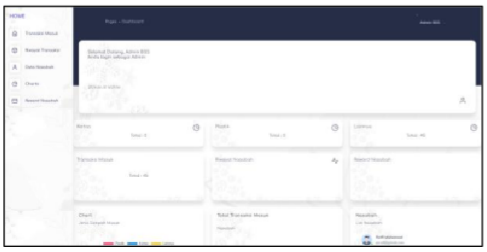

Figure 3. Dashboard Admin/ User

The image above is the Dashboard page, providing comprehensive access for customers to various important features. On this page, customers can see several menus, including transactions to track transaction history, customer data to update personal information, transaction results chart to visualize transaction data, and reward balance to see the number of rewards obtained from their participation in the waste bank program.

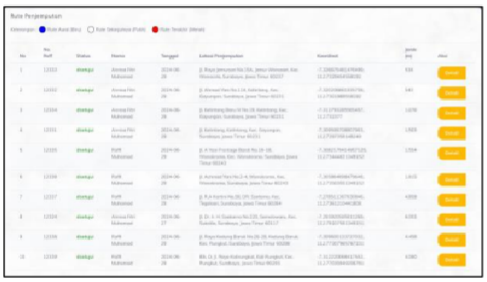

Figure 4. Route PickUp Page (Admin)

The incoming transaction page above is part of the trash bank transaction management system interface which allows admins to manage transactions submitted by customers. The main feature provided on this page is the 'acc' menu which allows admins to approve or reject transactions submitted by customers. . Then you can generate routes

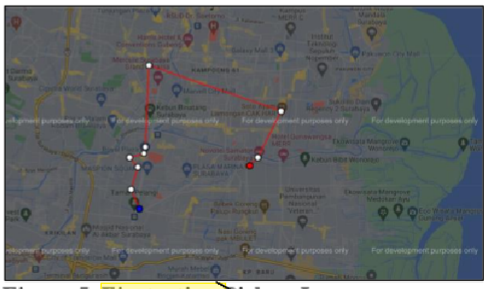

Figure 5. Iliustration Pickup Loc

On the incoming transaction (route) page above is part of the waste bank transaction management system interface which allows admins to display route generation. Here you can see the results of the system method calculations which are the closest and farthest locations to the waste bank location

IV. CONCLUSION

In this research, it can be concluded that the TSP Nearest Neighbor Method can be used appropriately to determine the pick-up route for waste locations based on website-based location distance. In black box testing, 31 test cases that have been carried out show that this system is in accordance with the functional requirements expected by the UINSA Surabaya Sharia Waste Bank.

The UINSA Surabaya Syariah Waste Bank information system contains pick-up orders, and was created with the aim of efficiency in the transaction pick-up registration process, with this the TSP Nearest Neighbor Method ensures that each step in the route is taken to the nearest unvisited location, minimizing the total distance traveled. Thus, the waste

collection process becomes more efficient, saving time and resources. This approach can be applied to various other route optimization problems that require sorting based on shortest distance.

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