JOURNAL OF INFORMATIKA BUDIDARMA
Volume 5, Number X, Month 2021, Page 999-999
ISSN 2614-5278 (print media), ISSN 2548-8368 (online media)
Available Online at https://ejurnal.stmik-budidarma.ac.id/index.php/mib
DOI 10.30865/mib.v5i1.2293

Analysis and Design of a Route Recommendation System and Bicycle Rental Fees at Tourist Destinations with Genetic Algorithms

Danu Fawwaz Gimnastian[1], Rahmat Yasirandi[2], Dita Oktaria[3*]

[1]School of Computing, Informatics, Telkom University, Bandung Indonesia
Email: [1]danugimnastian@student.telkomuniversity.ac.id, [2]batanganhitam@telkomuniversity.ac.id , [3]dioktaria@telkomuniversity.ac.id
Correspondent Author Email: danugimnastian@student.telkomuniversity.ac.id

Abstract− The tourism sector is one of the country's most significant sources of income, especially in Indonesia. This is inseparable from many visitors or foreign tourists who come to Indonesia. Bandung is a tourist destination that is famous for its natural beauty and traditional culture, one example is in Desa Alamendah which has several tourist destinations, namely agro-tourism, nature tourism, and cultural tourism. However, access that can be passed from every tourist spot in Desa Alamendah can only be given on foot or by bicycle. Responding to this matter, bicycle facilities as a means of rotation are needed to access tourist attractions in Desa Alamendah. Based on these problems, this study aims to create a recommendation system for tourist attractions and bicycle rentals using an application in Desa Alamendah, Bandung. Using the Genetic Algorithm, an algorithm that can solve multi-objective problems can be applied to a tourist spot recommendation system in Desa Alamendah. In this system, the Genetic Algorithm is also used to determine fares based on the total distance traveled, so that bicycle rentals are more efficient. The study combines Google Maps as an appropriate route selection based on the recommendation of tourist destination points that tourists can visit using Genetic Algorithms, so that bicycle rentals are more efficient. This is study combines Google Maps as an appropriate route selection based on the recommendation of tourist destination points that tourists can visit using Genetic Algorithms. So that bicycle rentals are more efficient. The study combines Google Maps as an appropriate route selection based on the recommendation of tourist destination points that tourists can visit using Genetic Algorithms. Based on the results of tests that have been carried out in the process of forming tourist attractions recommendations with a Genetic Algorithm that using mutation probability 1.0 and Crossover Probability 0.6, can produce a Mobile Application with a Genetic Algorithm as a tourist spot recommendation system in Desa Alamendah. In addition, it also can provide recommendations, namely displaying tourist points, route using Google Maps. The rental fee is based on the total distance traveled.

Keywords: Genetic Algorithm, a recommendation system for tourist attractions, Google Maps

1. INTRODUCTION

The tourism sector is a sector that plays a vital role in increasing income. Sustainable tourism not only considers its economic, social, and environmental impacts but must also address the needs of tourists, industry, the environment, and the local population.[1]. Bandung is a tourist destination that is famous for its natural beauty and traditional culture, one example is in Desa Alamendah, which has several tourist destinations, namely agro-tourism, nature tourism, and cultural tourism. However, access that can be passed from every tourist spot in Desa Alamendah can only be done on foot or by bicycle. Responding to this matter, bicycle facilities as a means of ratio are needed to access tourist attractions in Desa Alamendah.

Bicycles offer an advantage over other vehicles likely to produce pollution; besides, other vehicles often cause traffic jams in tourist areas[2]. Therefore, a bicycle rental system is needed at tourist attractions. To facilitate access to transportation, for tourists to be able to explore all tourist attractions.

Study[3]proposed a Genetic Algorithm for a bicycle sharing system for tourism. Their research aims to improve bicycle-sharing services, thanks to the Mobile Tourist Guide (MTG), which can support bicycle renters to recommend exciting places to visit. Based on this research, it takes a simulation of destination point recommendations, and the author will build the application by combining it with Google Maps. In a study [4], the Genetic Algorithm can solve multi-objective problems, applying it to a culinary tourism recommendation system. The crossover method with one cut point and mutation with gene shift in the Genetic Algorithm can solve the problem. Each destination visited also has time and load constraints. Close the place. Based on this research, it takes a simulation of destination point recommendations, and the author will build the application by combining it with Google Maps. As a recommendation system to tourist destination points, with the development of tourist spot recommendations based on real-time time, the application will automatically recommend tourist attractions at the right time according to the schedule of opening and closing hours.

In Desa Alamendah, there are various kinds of tourist attractions, sometimes making it difficult for tourists to choose which tourist attractions they will visit. The Genetic Algorithm will recommend tourists to visit tourist attractions in Desa Alamendah by knowing which tourist attractions are open or closed when tourists are at the location. This is implemented into an application on a smartphone[5], which can detect where the area of tourists is[6]so that you can find out all the tourist points that have been divided according to opening and closing hours. Therefore, it is hoped that tourists will get an easy route to visit tourist attractions in Desa Alamendah.

Submitted: dd/mm/yyyy; Accepted: dd/mm/yyyy; Published: dd/mm/yyyy

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In designing the application system, it uses Genetic Algorithms to recommend tourist destination points that tourists can pass. The total places traveled by tourists will also be calculated using a Genetic Algorithm and route results or directions displayed using Google Maps.

A study named "An optimization model for product returns using genetic algorithms and artificial immune system" was undertaken by Ali Diabat, Devika Kannan, Mathiyazhagan Kaliyan, and Davor Svetinovic (2013). This study creates a mathematical model that connects clients, initial collection places, and control centers in order to optimize reverse logistics. However, network design for used products is time-consuming and complex. The number and location of starting collection points and return centers, as well as the maximum waiting time (collection frequency) for the sum of tiny volumes of returned items, must be determined using a mixed-integer non-linear programming (MINLP) model developed for this study. There are two techniques to finding a solution[7].

In the following research by Farhad Ghassemi Tari Zahra Hashemi (2016) conducted a study entitled "A priority-based genetic algorithm for nonlinear transportation costs problems." In this study, the problem of allocating goods delivery vehicles from manufacturing companies to goods storage depots. Each depot has a certain number of orders, and transportation costs consist of fixed and variable transportation costs. The goal is to assign the right type and number of vehicles to each depot lane to minimize transportation costs. To succeed in today's rapidly evolving business competition, companies need to design and build logistics models that are productive and cost-effective. Therefore, the author uses a genetic algorithm to overcome the distribution of vehicles that have been determined[8]. A new real-time personalized route recommendation system, as presented in this study, is needed to solve the problem and to provide route recommendation services for the increasing number of self-driving tourists in tourist attractions by Long Liu, Jin Xu, Stephen Shaoyi Liao, Huaping Chen, who entitled "A real-time personalized route recommendation system for self-drive tourists based on vehicle to vehicle communication" Finally, with real-time queue information, a recommended path was developed based on the interests and preferences of comparable travelers in the same group[9].

Based on research conducted by Kevin Krisnandi, Halim Agung (2017) conducted a study entitled "Implementation of Genetic Algorithms to Predict Construction Project Work Time and Costs." The problems faced by construction companies have stages in working on a construction project. To obtain accurate results, an algorithm is needed that is used in the Application of Prediction of Time and Cost of Work on Construction Projects, namely a Genetic Algorithm that helps construction companies predict the time and costs required to complete a construction project. In addition to predicting this application can also provide solutions to the foreman if there are problems in working on a construction project so that the project can run according to the predicted time. . To obtain accurate results, an algorithm is needed that is used in the Application of Prediction of Time and Cost of Work on Construction Projects, namely a Genetic Algorithm that helps construction companies predict the time and costs required to complete a construction project[10]. Genetic algorithms based on a variety of crossover operators have been published in the literature to solve this problem; selecting an effective crossover operator can result in a successful GA. For resolving the MTSP entitled "Genetic Algorithms for the Multiple Travelling Salesman Problem," Maha Ata Al-Furhud and Zakir Hussain Ahmed propose employing sequential constructive crossover (SCX), adaptive SCX, greedy SCX, reverse greedy SCX, and comprehensive SCX to produce simple and effective GAs. Because this paper offers genetic algorithms (GAs) to solve the problem, we conduct a literature review on GAs, focusing on crossover operators[11].

In another research on Genetic Algorithms that have been carried out by Herdiesel Santoso Rachmad Sanuri(2019) conducted a study entitled "Implementation of Genetic Algorithms and Google Maps APIs in Solving Traveling Salesman Problems with Time Window (TSP-TW) in Scheduling Travel Routes in the Marketing Division of STMIK El Rahma." In this study, the test scenarios were testing the optimal number of generations, testing the optimal number of populations, testing the combination of crossover probability (Pc) and mutation probability (Pm), and testing the consistency of the solutions produced by the Genetic Algorithm. Recommendations are given by considering the distance and travel time Symmetrical and asymmetrical and traffic density obtained from Google Maps using Google Maps. The results of the study are routes with costs[12].

Then as for research conducted by Handy Eka Putra Anwar, Deviani Titi Nautami, Dhina Puspasari Wijaya (2016), conducted a study entitled "Prototype of Search System Recommendations for Local Craft Locations in Yogyakarta Using Traveling Salesman Problem (TSP) With Genetic Algorithm." In this study, TSP with genetic algorithms helps determine what and where the locations of local crafts in Yogyakarta are in the grip of their smartphone by utilizing the Global Positioning System (GPS) to detect where they are located that can be determined at any point. - local craft points that have been categorized according to the types of local crafts in Yogyakarta, the genetic algorithm aims to find the individual with the highest fitness value[13].

Another research conducted by Cokorda Pramartha and Hendra Saputra (2020) conducted a study entitled "Recommendations for Web-Based Travel Routes Using Genetic Algorithms." In this study, based on the problem, the sites on the internet only display information and cannot respond and interact directly with the user's particular needs such as a travel agenda, the problem has been resolved previously), the prototype built by the author has been able to provide recommendations according to user needs. The system that was built still has a weakness. Namely, the system will produce too many recommendations (less than optimal because not all of them are appropriate)[14]. Multi-trip is a method of resolving the VRPTW that focuses on trip scheduling to achieve the

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best results. To overcome the problem, a genetic algorithm is combined with a simulated annealing algorithm in this study. By Amalia Kartika Ariyani, Wayan Firdaus Mahmudy, Yusuf Priyo Anggodo. Who entitled "Hybrid Genetic Algorithms and Simulated Annealing for Multi-trip Vehicle Routing Problem with Time Windows". In this study, we suggest a new genetic algorithm and simulated annealing (GA-SA) combination model to address the problem. The goal of this study is to construct a new genetic algorithm and simulated annealing combination and compare all GA-SA combinations to find the best solution.[15].

2. RESEARCH METHODOLOGY

2.1 Methodology

The research methodology can be seen in Figure 1, the research stage as a series of processes from the beginning to the end of the research. The first process of designing a design system to explain the design of the application system used UML, namely Use Case Diagrams and Activity diagrams, illustrating the flow of the Genetic Algorithm on the Application system using Flowcharts. The following process discusses the implementation of the system at this stage, explaining all the functions, menus and icons in the built application. In the Implemented Genetic Algorithm determining the parameters of the Genetic Algorithm in this study and also explaining the flow of the Genetic Algorithm that is implemented into the application being built, In the final stage namely Test Result getting an output from the results of the Genetic Algorithm which is implemented from a predetermined test simulation.

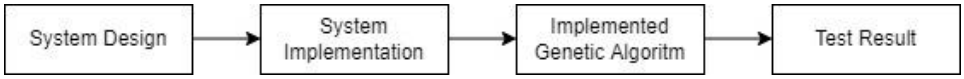

Figure 1. Research methodology

2.2 Genetic Algorithm

A Genetic Algorithm is a branch of Evolutionary algorithms based on the theory of natural selection. Genetic Algorithms are commonly used to solve optimization problems[16]. Genetic Algorithm imitates the analogy of biological evolution to determine high-quality chromosomes or individuals in a potential area called a population. The population consists of several individuals where each individual represents a solution. Each population contains several chromosomes composed of several genes[17]. Using the Genetic Algorithm in this system recommends tourist destination points based on the right time to visit, then displays tourist routes obtained from Google Maps[18].

2.3 System Design

In this study, the method for recommending tourist attractions uses a Genetic Algorithm. In this design sub-chapter, UML is used as a model that aims to help explain the design of the application system. A Flowchart is used for modeling the flow of the Genetic Algorithm Application system. The UML used in this research is Use Case Diagrams and Activity Diagrams.

2.3.1 Use Case Diagram

Use case diagrams serve to describe the outline of the application, which is the relationship between tourists and the system. The following use case diagram used in this study can be seen in Figure 2.

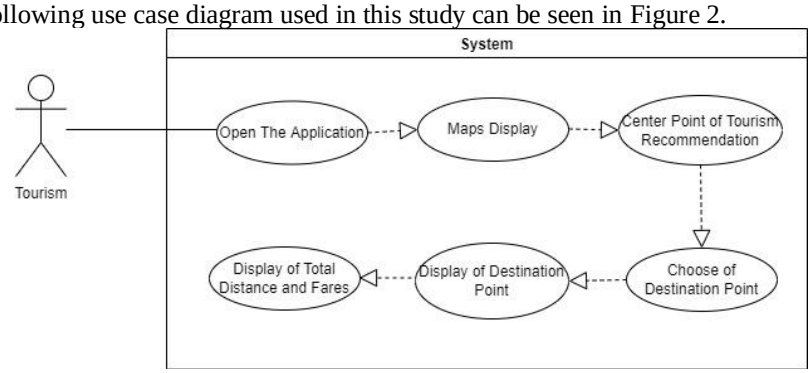

Figure 2. Use Case Diagrams