

# Newspaper Route Determination System in Palu City Using Genetic Algorithm

Deny WiriaNugraha<sup>1\*</sup>, Yusuf Anshori<sup>1</sup>, Akhmad Abdul Rohman

<sup>1</sup>Information Technology Department, Universitas Tadulako, Palu, Indonesia

\*Email: deny.wiria.nugraha@gmail.com

**Abstrak.** Newspaper distribution route is a common problem faced by a deliveryman alongside the high demand of Radar Sulteng newspaper that must be satisfied. A deliveryman must deliver newspapers in a timely fashion to the customers. The Travelling Salesman Problem (TSP) is a method that may be used to solve deliverymen's problem, the tedious nature of visiting each customer exactly once until they come back to the starting point. This study aims to implement Genetic Algorithm (*AG*) to TSP model to develop a route determination system of Radar Sulteng newspaper distribution using Hypertext Preprocessor (PHP) programming language. With this system, it is expected that an optimal newspaper distribution route can be created, which would result in reduction in travel time and cost and, ultimately, maximum profit for the company. Genetic Algorithm (*AG*) is an algorithm that mimics how genetic process works in living creatures, where selection, recombination and mutation processes take place to obtain the best chromosome in a generation. One aspect that plays an important role in *AG* method is the determination of recombination involving crossover and mutation. In this study, *AG* parameters used to solve the TSP are a crossover probability of 0.05, mutation probability of 0.5, total chromosome of 800 and total generation of 200, by inputting data from 66 customers. The best fitness obtained at 194<sup>th</sup> generation with 24,569 KM with computation time of 8197,48182371652 seconds or 2 Hours 16 Minutes.

**Keyword:** Genetic Algorithm, crossover, chromosome, mutation, Travelling Salesman Problem

## 1. Introduction

Gazettes or newspapers are a common information media in the society. Newspaper readers include all kinds of people. By reading newspapers, we can keep abreast of actual developments, both from within the country and from abroad. Radar Sulteng is one of many newspapers published in Palu City, Central Sulawesi. The distribution of Radar Sulteng newspaper starts from the production warehouse to the marketing division. Then, the marketing division distributes the newspapers to every deliveryman who will then distribute them to existing stores or customers. The high demand of Radar Sulteng newspaper must be satisfied by the deliverymen. The distribution to the customers must be carried out in a timely

fashion starting usually from 5 in the morning, since it is the hour where customers are eager to catch up with events from the previous day and upcoming events. A termination of subscription is commonly due to tardy newspaper delivery as a result of ineffective route chosen by the deliverymen when distributing the newspapers.

The problem in the determination of newspaper distribution in this study is the Travelling Salesman Problem (TSP). The crux of the TSP is that a deliveryman has to visit every customer once until they return to the starting point. The method used to solve this problem is Genetic Algorithm (*AG*). Genetic Algorithm (*AG*) is an algorithm that mimics how genetic process works in living creatures, where selection, recombination and mutation processes take place to obtain the best chromosome in a generation. One aspect that plays an important role in *AG* method is the determination of recombination involving crossover and mutation. This study aims to implement Genetic Algorithm (*AG*) to TSP model to develop a route determination system of Radar Sulteng newspaper distribution using Hypertext Preprocessor (PHP) programming language.

The literature study by the author revealed that some studies on distribution routes had been done by some authors. In research [1], the author examined the Optimization of Newspaper Deliveryman Routes in Fidi Agency using Rank Selection Method Genetic Algorithm. This study aimed to obtain a mathematical model of the shortest route search of newspaper distribution in Fidi Agency. This study concerned itself with the problem of a deliveryman with two-wheeled vehicle. A deliveryman started delivering newspaper at 05.00 a.m. WIB, after the newspapers were distributed from the warehouse to agents. They had to complete their task of delivering newspapers before 07.30 WIB since office workers made up most of the customers. The reality in the field was that the deliveryman distributed

newspapers with a travel distance of 72 km, a speed of 50 km/hour and a completion time of 2.5 hours. The common problem is that delayed distribution of newspapers often results in the cancellation of newspaper subscription. This is where research [1] is similar to the author's research in this paper. Both are trying to optimize newspaper distribution routes using Genetic Algorithm. However, the study in this paper attempted to develop a web mobile-based geographic information system of Radar Sulteng newspaper distribution route determination while research [1] only modelled the shortest routes of newspaper distribution using mathematical model.

Research [2] concerned itself with the Multi Travelling Salesman Problem (MTSP) using Genetic Algorithm to Determine Newspaper Deliveryman Routes in Newspaper Agency. Newspaper deliverymen in a newspaper agency are tasked with delivering newspaper before the day starts. Common problem faced in the distribution process is delay in the delivery to customers. Generally, the majority of newspaper customers are office workers who want their newspaper to be delivered before they go to work, usually at 07.00 WIB. At 05.00 WIB, newspapers are ready to be distributed. This means that deliverymen only have two hours to deliver them. A newspaper agency employs several deliverymen. To expedite the delivery of newspapers directly to customers, newspaper deliverymen use motor vehicles with a maximum transport capacity of 70 newspapers. The similarity between research [2] and research in this paper lies in the fact that both are trying to optimize newspaper distribution routes using Genetic Algorithm. What distinguished the two is that this paper attempted to develop a web mobile-based geographic information system of Radar Sulteng newspaper distribution route determination while research [2] only modelled the shortest routes of newspaper distribution using mathematical model.

In research [3], the author examined the Implementation of Genetic Algorithm of Travelling Salesman Problem with Time Window: A Case Study of Laundry Pick Up and Delivery Routes. The aim of the study was to determine an optimal shuttle routes to facilitate customers who could not visit the laundry place in person while at the same time suppressing travel cost and maximizing profit. The similarity between research [3] and research in this paper lies in the fact that both are trying to achieve route optimization using Genetic Algorithm. What distinguished the two is that this paper attempted to develop a web mobile-based geographic information system of Radar Sulteng newspaper distribution route determination while research [3] concerned itself with the implementation of genetic algorithm to determine laundry shuttle routes.

A study on Graph was conducted by Wardhani, Farisi and Prasetyo where a graph is a group of vertices and edges which are mathematically stated as  $G = (V, E)$ , where  $G$  = graph,  $V$  = vertices,  $E$  = edges. Graphs are divided into weighted and unweighted graphs. The Travelling Salesman Problem (TSP) is a combinatorial optimization problem a salesman has to visit every city in a region exactly once and go back to the starting point or the city he departs from. The solution of the TSP is a route with a minimum weight. Some of the problems that can be resolved with the TSP are problems of tourist visit planning, logistics, integrated circuits (IC), and others. The Genetic Algorithm is a search algorithm that is based on natural selection and genetics mechanisms. Initially, the Genetic algorithm was indeed used as an algorithm for finding optimal parameters. But in its development, Genetic algorithms can be applied to various other problems such as learning, forecasting, automatic programming, and so on. In the field of soft computing, Genetic algorithm is widely used to obtain optimal parameter values in artificial neural network or fuzzy system.

## 2. Materials and Methods

In this study, research materials used were literature review results regarding the Genetic algorithm and data related to Radar Sulteng newspaper distribution consisting of deliveryman data, customer data and distribution route data. This is a qualitative study in the field of information technology, specifically, the field of software engineering in which the author excels at. Qualitative studies are a study that intends to understand phenomena about what is experienced by research subjects such as behavior, perception, motivation, action, and others. It is a research procedure that results in descriptive data in the form of written and spoken words from individuals whose behaviors are observed. The study was done at PT. Radar Sulteng Membangun located on Yos Sudarso Street No. 9, Palu, Central Sulawesi. Data collection was done using observation technique by observing newspaper distribution flow that was currently running in Radar Sulteng to find out existing problems and solutions to them. Then, the author interviewed marketing division employees and deliverymen to learn about the work flow of newspaper distribution. Literature review in this study was done by collecting data from reference books and surfing the internet to obtain necessary supplemental data.

The study was done in several steps, which are:

1. Literature Study. The purpose of this process was to obtain and learn about Genetic Algorithm. The literatures were sourced from books, internet, or other written materials.

2. Data Collection. Data used in this study were deliveryman data, customer data, and newspaper distribution data.
3. Software Design. In this stage newspaper distribution route determination system was developed using Genetic algorithm.
4. Software Development. In this stage, the software was prepared and database and coding design were created.
5. Software Operation. After software development and data collection were done, the software was run to find out whether the software is able to provide optimal newspaper distribution routes.
6. Data Input. After the data was collected, then the data collected was inputted into the system.
7. Software Testing. In this stage, all software functions that have been developed must be tested thoroughly to ensure that there were no bugs or errors in the software and that the software ran as intended. The author used Blackbox Testing and Algorithm Testing as the testing method in this study.
8. Conclusion. The conclusion is the final result that is expected to be able to answer the purpose of this study, which is to create a system for determining the route of newspaper distribution using the Genetic algorithm.

### **3. Results and Discussion**

#### **3.1. System Analysis**

System analysis methods in this study are: Context Diagram, Data Flow Diagram (DFD), Use Case Diagram (UCD), and Entity Relationship Diagram (ERD). For level 1DFD and

level 2DFD Schemes, the Route Determination System of Newspaper Distribution in Palu City Using Genetic Algorithm can be seen in Figure 1 below.

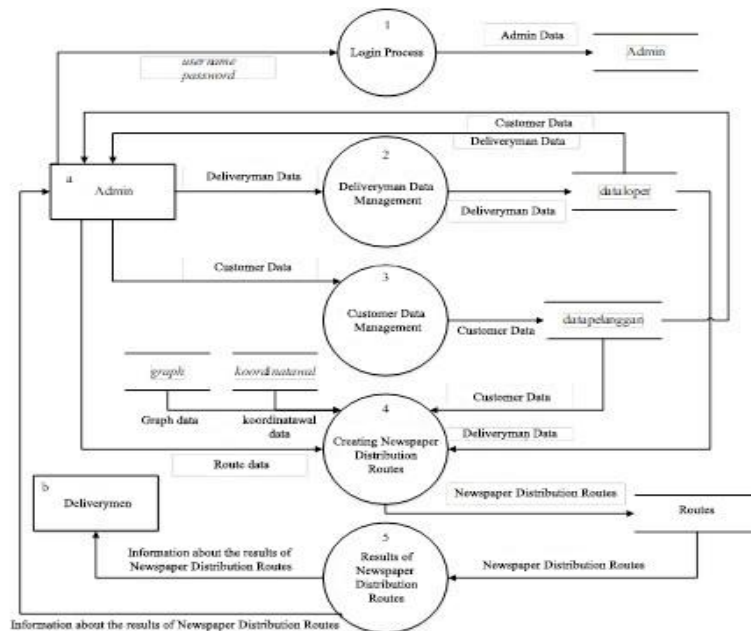


Figure 1. Level 1 DFD of the Route Determination System of Newspaper Distribution in Palu City Using Genetic Algorithm

Following is the description of Figure 1:

a. Login Process

This process is done by an admin to log into the system. The admin enters registered username and password.

b. Deliveryman Data Management

This process is done by an admin to manage deliveryman data. The admin can add, alter, and erase data. The required deliveryman data are deliveryman's id, name, phone number, and photo. The data are then stored in the *dataloger* table in the database.

c. Managing Customer Data

This process is done by an admin to manage customer data. Admin can add, alter, and erase data. The required deliveryman data are customer's id, deliveryman's id, name, address, latitude, and longitude. The data are then stored in the *datapelanggan* table in the database.

d. Creating Newspaper Distribution Routes

This process is done by an admin to create newspaper distribution routes. The admin can create or erase routes. The required data are taken from *datapelanggan*, *dataloper* table, graph, and *koordinatawal* table from the database.

### 3.2. Input Implementation

In the Route Determination System of Newspaper Distribution in Palu City Using Genetic Algorithm, there are two forms for data input, which are:

This form is used by the admin to log into the system so that they can manage the Route Determination System of Newspaper Distribution in Palu City Using Genetic Algorithm. Data that are inputted are username and password. The login form can be seen in figure 7.

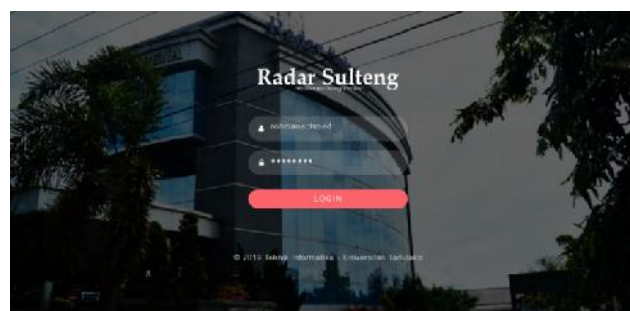


Figure 2. Login form of Route Determination System of Newspaper Distribution in Palu City Using Genetic Algorithm



This form will display the routes of newspaper distribution of a deliveryman according to his working area. See Newspaper Distribution Route form can be seen in Figure 3.

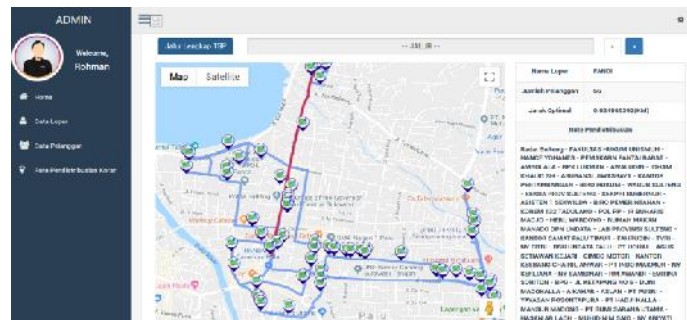


Figure 3. See Newspaper Distribution Route form of the Route Determination System of Newspaper Distribution in Palu City Using Genetic Algorithm.

Based on the testing results in this study, Genetic algorithm can be used in the implementation of newspaper distribution routes and provide the best solution. The system is developed using Hypertext Preprocessor (PHP) programming language and utilizes computer hardware to run the admin system and smartphones to run deliveryman system. In order to operate the newspaper distribution route system, the admin must enter username and password in Login form to access main menu. Before starting to create distribution routes, the admin has to first enter all deliveryman and customer data. The required deliveryman data are deliveryman's id, name, address, phone number, and customer data consist of customer's id, deliveryman name, customer name, address, latitude, and longitude. After all required data are inputted, the admin can now access 'create route' menu. In the 'create route' menu, the admin must enter route id, choose deliveryman name, enter chromosome, generation, mutation probability and crossover probability. After that, the admin creates distribution routes by pressing process button, then the genetic algorithm will process the data inputted to generate the best routes.

Genetic Algorithm (*AG*) is an algorithm that mimics how genetic process works in living creatures, where selection, recombination and mutation processes take place to obtain the best chromosome in a generation. One aspect that plays an important role in *AG* method is the determination of recombination involving crossover and mutation. In this study, two testing methods were used which are Blackbox testing to test whether functions in the system run well, and genetic algorithm testing to identify optimal genetic algorithms to generate optimal distances/the best fitness. The genetic algorithm testing produces the best parameters used to solve problems of TSP. The parameters are crossover probability of 0.05, mutation probability of 0.5, chromosome of 800 and total generation of 200, by entering data input of 66 customers. The best fitness was obtained at 194<sup>th</sup> generation with 24,569 KM with a computation time of 8197,48182371652 seconds or 2 Hours 16 Minutes.

#### **4. Conclusion**

Based on the testing and system analysis results of the implementation of genetic algorithm for Radar Sulteng newspaper distribution, it can be concluded that the Route Determination System of Newspaper Distribution in Palu City Using Genetic Algorithm can generate optimal routes for the distribution of newspaper that starts from the warehouse of PT. Radar Sulteng Membangun to the location of newspaper customers. The system is developed using Hypertext Preprocessor (PHP) programming language and utilizes computer hardware to run the admin system and smartphones to run deliveryman system. Genetic algorithm parameters used were crossover probability of 0.05, mutation probability of 0.5, total chromosome of 800 and total generation of 200, which yield the best fitness value of 24,569 KM at 194<sup>th</sup> generation with a computation time of 8197,48182371652 seconds or 2 Hours 16 Minutes. Genetic algorithm does not always generate identical results even though similar

parameter values are used. This is caused by random initialization process as well as crossover and mutation processes.

## 5. Acknowledgement

Thanks to the Ministry of Research, Technology, and Higher Education (KEMERISTEKDIKTI) through the General Directorate of Higher Education that have funded this research so that it can be completed without meaningful difficulties.

## References

- [1] Setiyawan, A. Y., 2014. Optimasi Rute Loper Koran di Fidi Agency menggunakan Algoritma Genetika Metode Seleksi Ranking, *Skripsi Universitas Negeri Yogyakarta* Yogyakarta.
- [2] Saptaningtyas, 2015. Multi Traveling Salesman Problem (MTSP) dengan Algoritma Genetika untuk Menentukan Rute Loper Koran di Agen Surat Kabar, *Jurnal Universitas Negeri Yogyakarta*, Yogyakarta.
- [3] Suprayogi & Mahmudy, 2014. Penerapan Algoritma Genetika Traveling Salesman Problem with Time Window: Studi Kasus Rute Antar Jemput Laundry, *Jurnal Universitas Negeri Jakarta*, Jakarta.
- [4] Wardhani, N. 2014. "Optimisasi Traveling Salesman Problem (TSP) Menggunakan Algoritma Semut", *Jurnal IT STMIK Handayani*, Vol 15, Desember 2014
- [5] Farisi, O. I. R. dan Pratamasunu, G. Q. O. 2016. Penyelesaian Multi-Depot Multiple Traveling Salesmanproblem menggunakan K-Means dan Ant Colony Optimization, *Nusantara Journal of Computers and its Applications*, Vol 2, No.5.
- [6] Prasetyo, E.B. 2014. Penerapan Algoritma Genetika dan Jaringan Syaraf Tiru dalam Penjadwalan Mata Kuliah di Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Gadjah Mada. Skripsi. Universitas Gajah Mada, Yogyakarta.
- [7] Sam'ani, S. 2012. Rancang Bangun Sistem Penjadwalan Perkuliahan dan Ujian Akhir Semester Dengan Pendekatan Algoritma Genetika. Tesis. Universitas Diponegoro, Semarang.