TRAVELING TOURIST PROBLEM FOR SELECTED POPULAR DESTINATIONSIN SRI LANKA (TTPSL)

A Thesis

By

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Declaration

I hereby certify that this thesis is my own work and it has never been submitted for any degree program.

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Abstract

Sri Lanka, known as the pearl of the Indian Ocean, is a vibrant country with delightful surroundings rich with lush greenery, natural gardens, fascinating waterfalls, wild animals and historical places. Thus it is a major tourist attraction today turning tourism into a major foreign exchange earner.

"The fastest way" or the "shortest path" is the most important aspect when a person is traveling from one place to another. It depends on distance, time and cost. Several methods can be used to find the shortest path from one place to another. GIS System and web based systems like Google maps are some of the examples. So far there is no system in Sri Lanka that allows user to find a shortest path based on "distances" providing the total traveling distance needed, all in one, using the method of "shortest path".

Although the shortest path between two points is a direct line, when applying this into real world problems such as the above, obviously it is not possible to find just a direct line to represent shortest path between two places due to limitations in the existing road network. The shortest path may be a combination of shortest paths from the origin to the destination.

In this study, the routing problem is formulated as a single objective mathematical programming problem which attempts to minimize distance. Here we apply two of the shortest path algorithms in graph theory. In the first phase getting the shortest path between the selected cities, is based on Dijkstra's algorithm. In phase II, "Breadth First Search" was used to obtain the shortest path between two chosen cities. Finally the solution is the combination of the results of phase I and phase II.

According to the algorithm in phase I, after running the program, the user gets the system interface to choose the relevant cities. For example, assume that a tourist wants to visit eight places starting from Colombo and covering Hambantota, Galle, Bandarawela, Beruwela, Matara, Nuwara-Eliya, Ella, and Wellawaya using the minimum distance. Then we can select Colombo as the first location followed by all the other places in any arbitrary order. In the second phase, we get the shortest route between two selected locations as a continuous path using other cities between the source node and the terminal node.

In this research we solved Traveling Tourist Problem (TTP) based on road distances and obtained the solution by applying shortest path algorithm in graph theory, considering forty two cities in Sri Lanka.

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List of Abbreviations

TTP	Traveling Tourist Problem
TTPSL	Traveling Tourist Problem in Sri Lanka
SP	Shortest Path
SPP	Shortest Path Problem
TP	Traveling Problem
BFS	Breadth First Search

Chapter 1

Introduction

1.1 Overview

Sri Lanka, our motherland is a vibrant country in the world known as the pearl of the Indian Ocean because of delightful surroundings, climate and culture. Furthermore it is rich with lush greenery natural gardens, fascinating waterfalls, wild animals and historical places. Therefore it is obviously famous island for tourism industry.

Most of the people from foreign countries show willingness to visit the Island not only based on the natural environment but also some other purposes like business activities, sports, educational and cultural events and many other reasons. Therefore, a great number of tourists visits and spends their leisure time here to get a pleasant experience.

Transportation and traveling are simultaneous topics in the tourism. However the main purpose of tourists to be here is to get rare experiences by visiting as many places as possible in Sri Lanka. Hence giving a prior knowledge to the tourist of the places they hope to visit is very important in the tourism industry. With the modern development of the world, people can find relevant information through sources such as guidance, web, tourism books and maps.

With the current situation, busy life and the upturn of people, they try to do most of the things in an efficient way. Furthermore, people like to do everything by minimizing the time and cost. Travelling has become a general thing in their day today activities in life. Therefore they give prior consent to fulfill transportation needs in an optimistic way.

"The fastest way" or the "shortest path" is the most important aspect when a person is traveling from one place to another. It depends on distance, time and cost. It is possible to find the shortest path by considering these three factors separately as well as by considering all three factors together. Then the optimal path according to the first approach may imply the traveling path with minimum distance or the path with minimum time or the path with minimum traveling cost. In the second case the shortest travelling path is the path consisting of traveling time, cost and distance in an optimal way. It should be noted that there may be different routes that people like to travel such as paths with scenic backgrounds or mountainous areas with hiking trails.

Several methods can be used to find the shortest path from one place to another. With the modern development of the world, more efficient systems like GIS (Geographic Information System) and web based systems like Google maps are being used. With the consideration of shortest path problem in Graph Theory, it is possible to find several

direct line, when applying this into real world problems such as the above, obviously it is not possible to find just a direct line to represent shortest path between two places due to limitations in the existing road network. The shortest path may be a combination of shortest paths from the origin to the destination.

According to the basic things in graph theory, we can represent relevant places by using nodes and paths (or routes) by using edges. Then weight of edges depends on values of parameters like time, distance or cost.

But above parameters are listed according to their priorities, it seems that distance and cost are more concerned than the time because the time factor depends on the road condition, vehicle speed, and the traffic jam as well as delay time. Though there could be other limitations, to find the fastest way it is better to consider the traveling distance first since it can be used as the base for the other cases. Thus if we have an idea about the shortest path with total traveling distance among selected places, then it helps all kinds of tourists, foreign as well as local, to manage their tour as they wish.

When we consider travel in Sri Lanka, so far there is no system that actually allows user to find the shortest path with the total traveling distance except for the limited information given by the Google maps. Therefore the main objective of our study is to make a system to find the shortest path with total travelling distances to cover all the places which has been selected by the user.

According to the geographical situation in Sri Lanka, the tourist's attractions are spread all over the country. The figure 1.1 shows the several tourist attractions and their pervasion in Sri Lanka.

Figure 1.1: Sri Lanka Tourist Attractions

Administratively the Sri Lankan is divided into 9 provinces, 25 districts and large number of cities. When considering above map, it is obvious that at least one tourists' attraction has been located in each province or each city. But according to the willingness of tourists, would like to visit only wild parks, and some wants to see beaches or only they the historical places and some of them would like to visit different types of places. According to these criteria, sometimes they may have to travel around the whole country.

Though the pervasion of the attractions, it is impossible consider all the places in to one category, therefore we have decided to limit our project scope in to some selected places having popular tourist attractions in Sri Lanka. In numerically it has limited to 42 locations.

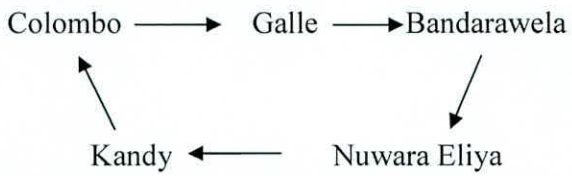
The main objective of this project is to develop a system that use to discover the shortest path with minimum distance within the places selected by the traveler. The phases of our system can be divided in to two main parts named Phase I and Phase II. Both cases have used to find the shortest paths in two different aspects which are described as follows.

Phase I

Under this category, objective is making a system to find the shortest path to visit n number of cities according to the traveling distance. Out of all these places included in the database, we can find the shortest tour displaying total distance of the given places where the traveler is willing to visit using system interface.

Phase II

Phase II can be use to find the shortest paths between intermediate locations identified in phase I. For an example, let us assume that the following closed tour was the result of the phase I.



In this closed path user wants the shortest/optimal route to travel from Galle to Bandarawela. So by using the second phase we are going to give the shortest path between intermediate locations displayed in the phase I.

1.2 Literature Review

The shortest path problem (SPP) is one of the dominant part of graph theory, has used in many researches. The graph theory based on shortest path problems and lot of them has been mentioned in literature. Among them they have pointed out several methods like Analytical Hierarchy Process (AHP) and Geographical Information System (GIS) to find the optimal route. Apart from that some researchers have shown some special algorithms to find the shortest path. Therefore several of them have considered under the literature review as follows.

Ramazani and coworkers have proposed a method to solve shortest path problems in a route choice process on "A Shortest Path Problem in an Urban Transportation network based on Driver Perceived Travel Time"[7]. Here they considered travel time by using fuzzy numbers. The algorithm they used is the fuzzy shortest path problem (FSPA) for drivers in the presence of uncertainty relevant to route travel time. They have reported that this method can be used to support the fuzzification of traffic assignment algorithms. Therefore they have tested the applicability of the resulting FSPA for traffic assignment in conjunction with incremental traffic loading. Also it has been applied to large-scale real networks. They have compared user equilibrium (UE) and a stochastic loading network model to the observed volume for certain link and the proposed method offers better accuracy than the UE for the network.

Kumari et al have done research for Public Transport Travel problems based on Shortest Path Routing Algorithms [5]. According to their findings, they have used different networks to find the shortest path such as roads, utilities, water, electricity, telecommunication, etc. Aim of this study was little bit differ compared with other studies. They mainly used cross- sectional approaches to find the results.

Maria and co-workers have presented a paper on "Evolutionary Algorithms for the Multi-objectives Shortest Path Problem [6]. They have given an overview of the multi-objectives SPP and review of essential and recent issues relevant to the methods. Further they have explored a multi-objectives evolutionary algorithm as applied to the MSPP and described its behavior.

1.3 Report Outline

The thesis is organized as follows. Chapter 2 gives an introduction about graph theory. So under graph theory, we briefly describe the basic definitions, shortest path problem and their applications and algorithms that need to find the shortest path.