Route-Planning Algorithms for Amusement-Park Navigation

Hayato Ohwada, Department of Industrial Administration, Tokyo University of Science, Noda, Japan
Masato Okada, Department of Industrial Administration, Tokyo University of Science, Noda, Japan
Katsutoshi Kanamori, Department of Industrial Administration, Tokyo University of Science, Noda, Japan

ABSTRACT

This paper describes route-planning algorithms for navigation in amusement parks (e.g. Disneyland). Unlike conventional shortest-path-finding used for traveling salesman problems, the authors provide several algorithms that consider waiting time estimates in real time, exploit the reservation facilities of an attraction such as Fastpass in Disneyland, and balance a series of enjoyment types such as excitement or relaxation. These features make the new shortest-path algorithms more flexible and dynamic for supporting the cognitive aspects of enjoyment. The authors developed a navigation tool as a Web application in which users select their attractions of interest and the application suggests reasonable and enjoyable routes. An experiment was conducted to demonstrate the performance of this application, focusing on well-known attractions in Tokyo Disneyland.

Keywords: Algorithm, Amusement Parks, Route-Planning Algorithms, Tokyo Disneyland, Web Application

1. INTRODUCTION

Popular amusement parks have many attractions, making it difficult for visitors to find the fastest way of moving about with enjoyment, excitement, and relaxation. A visitor choosing a very slow route may become tired from walking and waiting, and may miss the opportunity to experience the desired attraction. Generally, we think that visitors could move around more quickly if there were a system to find the fastest order for visiting the attractions of interest.

This traveling problem is similar to the “traveling salesman problem” (Lin & Kernighan, 1973). A traveling salesman must find the shortest possible route that visits each of a group of cities exactly once, given a list of the cities and their pairwise distances.

Research is being conducted to solve the attraction-routing problem by applying the traveling salesman problem. We have developed an amusement park navigation system featuring dynamic...
route planning with waiting time estimation (Shibuya et al., 2013), using a reservation function for quick entrance into a popular attraction (Shibuya et al., 2012).

In this paper, we provide several algorithms that consider waiting-time estimates in real time, exploit the reservation facilities of an attraction such as Fastpass in Disneyland, and balance a series of enjoyment types such as excitement or relaxation. These features make the new shortest-path algorithms (Dijkstra, 1959) more flexible and dynamic for supporting the cognitive aspects of enjoyment. We developed a navigation tool as a Web application in which users select their attractions of interest and the application suggests reasonable and enjoyable routes.

This paper is organized as follows: The next section focuses on an extended shortest-path algorithm with waiting-time estimation called the NT-1 algorithm. Section 3 considers a reservation service that enables visitors to enjoy attractions without waiting, and presents a suitable route-search algorithm called the RT-1 algorithm. In Section 4, we attempt to balance a series of attraction types for excitement or relaxation. Section 5 demonstrates our smartphone-based application for route finding, and Section 6 presents our conclusions.

2. EXTENDED SHORTEST-PATH ALGORITHM

This paper considers an approach using the traveling-salesman problem. The traveling-salesman problem (TSP) is an NP-hard problem in combinatorial optimization that is studied in operations research and theoretical computer science. Given a list of cities and their pairwise distances, the task is to find the shortest possible route that visits each city exactly once and returns to the origin city. It is a special case of the traveling purchaser problem. This study regards the cities in the traveling-salesman problem as attractions in amusement parks.

The salesman must visit all cities in the traveling-salesman problem, but it is impossible for a visitor to visit all attractions in this attraction problem. Accordingly, users select the attractions they want to visit, and then we apply the traveling-salesman problem method to the selected attractions.

Our paper solves this problem with an algorithm using the branch and bound method. We call this algorithm the Normal Traveling 1 (NT-1) algorithm. Figure 1 presents the NT-1 algorithm. We determine the optimum path to minimize the total time, including transit time, waiting time, and duration time. We then generate a specific formulation to find the optimal solution. First, we define the following notation. We define I as a set of attractions and T as a set of time zones. We further define M_{ij} as the transit time from “attraction j \in I” to “attraction i \in I,” W_{it} as the waiting time of “attraction i \in I” when the time is t \in T, and P_{i} as the duration time of “attraction i \in I.” In particular, t of W_{it} is the arrival time at attraction i. The traveling time between the departure from attraction j and the departure from attraction i is defined as follows:

\[ M_{ij} + W_{it} + P_{i} \]  \hspace{1cm} (1)

The branching in this case is that of the direct path between any two attractions. X_{ij} is a 0-1 variable, defined below:

\[ X_{ij} = \begin{cases} 1 & \text{if there is a path from attraction } j \in I \text{ to } i \in I \\ 0 & \text{if there is no path from attraction } j \in I \text{ to } i \in I \end{cases} \]  \hspace{1cm} (2)
Related Content

Adaptive Median Filtering Based on Unsupervised Classification of Pixels
[www.igi-global.com/chapter/adaptive-median-filtering-based-unsupervised/72497?camid=4v1a](www.igi-global.com/chapter/adaptive-median-filtering-based-unsupervised/72497?camid=4v1a)

CoPBoard: A Catalyst for Distributed Communities of Practice
Gilson Yukio Sato and Jean-Paul A. Barthès (2010). *International Journal of Software Science and Computational Intelligence* (pp. 52-71).
[www.igi-global.com/article/copboard-catalyst-distributed-communities-practice/39105?camid=4v1a](www.igi-global.com/article/copboard-catalyst-distributed-communities-practice/39105?camid=4v1a)
Challenges in the Design of Adoptive, Intelligent and Cognitive Systems
www.igi-global.com/chapter/challenges-design-adoptive-intelligent-cognitive/65122?camid=4v1a

A Practical Software Quality Classification Model Using Genetic Programming
www.igi-global.com/chapter/practical-software-quality-classification-model/4862?camid=4v1a