Tourist Decision Support for Mobile Navigation Systems: a Demonstration

Joris Maervoet[a] Wouter Souffriau[a,b] Pieter Vansteenwegen[b]

Greet Vanden Berghe[a] Dirk Van Oudheusden[b]

[a] *KaHo Sint-Lieven, Departement Industrieel Ingenieur, Vakgroep IT, Gebr. Desmetstraat 1, 9000 Gent, Belgium*

[b] *Katholieke Universiteit Leuven, Centre for Industrial Management, Celestijnenlaan 300A, 3001 Leuven (Heverlee), Belgium*

Abstract

This demonstration paper presents a mobile tourist decision support system that suggests personal trips, tailored to the user's interests and context. The system enables planning a customised trip that maximises the interest of the tourist, while taking the opening hours of the points of interest and the available time into account. The planning problem is modelled as an orienteering problem with time windows, which is a hard combinatorial optimisation problem. It is solved by an iterated local search metaheuristic procedure that results in a personal trip. This procedure performs well, even when computational resources are limited. The tourist decision support system has been integrated in a mobile navigation platform and will be demonstrated on a Nokia N85 smartphone.

1 Introduction

A short tourist trip to a city like Barcelona or London often requires a lot of time to prepare a satisfactory schedule. Therefore, the tourist gathers information from different sources about the different points of interest (POI), makes a selection of POIs to visit and plans a route between these, taking into account the available time and the opening hours of the different POIs. This is a rather complex and time consuming process.

This planning problem was coined the Tourist Trip Design Problem (TTDP) [3]. A mobile tourist decision support system addresses this problem by suggesting a (near) optimal route along a selection of POIs, taking into account opening hours, personal preferences and external conditions. An integration with a mobile navigation device enables the tourist to plan his trip quickly and at very short notice, to navigate and track the planned route, and to replan the trip in an interactive manner whenever prompted for.

2 Tourist Decision Support System

The tourist decision support system first captures the user's operational constraints and personal preferences through a small questionnaire. The operational constraints consist of starting and end location and available time. First, the POIs that are situated within the scope of the operational constraints are retrieved from the database. Each POI belongs to exactly one type and has a degree of membership to a set of predefined interest categories. Next, the tourist's personal preferences are translated into a personal interest score for each available POI [1]. These scores, together with the coordinates and opening hours of POIs and the operational constraints of the tourist, give rise to a specific TTDP instance.

This paper models the TTDP as an Orienteering Problem [2] with Time Windows (OPTW), a vehicle routing problem in which the total score of the visited locations has to be maximised, without violating the time window constraints. As this problem is known to be NP–hard, calculating the optimal solution using traditional exact methods from the operational research literature would require vast amounts of computational resources and time, unavailable in this application scenario. Therefore, Souffriau et al. [1] opt to use a metaheuristic method for solving the OPTW in order to obtain near optimal solutions in an acceptable amount of time. They use a single tour version of the Iterated Local Search metaheuristic procedure to tackle the Team OPTW [4], in which the score of multiple tours has to be maximised. The metaheuristic starts from a set of empty tours, which only contain the start and end, and performs a number of iterations consisting of an insertion and a shaking procedure. The best solution found is updated at each iteration, and returned at the end. The heuristic loops until no improvements are found during a fixed amount of iterations.

Computational testing on a Nokia N85 smartphone showed that the planner solves instances up to 50 POIs in an acceptable execution time. Moreover, for such large instances, only 1% of the solution quality is sacrificed, while the worst-case execution time is limited to 5 seconds.

3 Mobile Navigation Platform Integration

Whereas the performance effort enabled the system mobility, the integration of the system in a mobile navigation device drastically increases the usability. The authors integrated the planning component in WeTravel[1], which is a free mobile navigation software for Java-enabled mobile phones which supports a large range of devices. The planning component allows the user to manage his interest profile and to plan and navigate a tourist trip. He is offered a set of possible starting locations, including his current location, and end locations. The system tracks the execution of the plan in both time and spatial dimensions. When the current plan becomes infeasible, the component suggests to replan the trip. Replanning solutions range from selective POI deletion or insertion to a complete new match between the user's current location and his preferences.

4 Demonstration and specifications

The mobile application will be demonstrated on a Nokia N85 device. Visitors will be offered the possibility to enter their personal preferences together with place and time constraints in order to plan a tourist trip in Eindhoven. The advantages of the mobile navigation platform integration will be shown.

The application software runs on MIDP/CLDC enabled devices. Availability of the Location API is preferable. The tourist decision support system was originally developed as a web application[2], which is the result of a joint effort between the Centre for Industrial Management, K.U.Leuven, and Vakgroep IT, KaHo Sint–Lieven. The functionality was ported to Java ME, using J2ME Polish.

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