A Multi-Tier Web Service and Mobile Client for City Trip Recommendations

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ABSTRACT

This demo paper outlines a system architecture for mobile city trip planning. We present a mobile application for recommending a route comprising multiple points of interests between a starting and a destination location based on personal preferences. We evaluated the app in a preliminary user study with good usability results.

CCS Concepts

•**Human-centered computing** → *User interface design;*

Keywords

mobile application; tourist trip design problem; recommender system; user study; system architecture

1. INTRODUCTION

The scenario for this work is a tourist visiting a city. She does not only need to find points of interests (POIs) for her preferences and interests, but also wants to get a feasible route composed of these POIs. This problem is an instance of the more general Tourist Trip Design Problem (TTDP) [3].

Existing approaches in the literature are mostly optimized towards shortest paths or quickest traversal of locations and do not take the user's perspective into account. Available applications such as the City Trip Planner[1] [2] are often based on predetermined edited trips or are restricted to selected cities and cannot be used in an arbitrary location.

Our solution tries to suggest a sequence of POIs that users may find worthwhile to follow. The user can specify a starting and a destination location along with preferences and gets a walking route with interesting POIs to visit.

This paper describes a system architecture and a mobile client for city trip planning. The underlying place discovery and path finding algorithms were published in [4].

[1]An updated version of the City Trip Planner is available at http://www.citytripplanner.com/

2. SOLUTION DESIGN

This section first focuses on the multi-tiered system architecture we developed. One of the main goals was to make it easily extensible to allow the implementation of different data sources, place discovery and path finding algorithms and presentation options. We then present the interfaces of our mobile tourist trip application.

2.1 System Architecture

A mobile application is mostly considered as software designed to run on a mobile phone. Although some applications use resources and functionalities from the mobile phone only, our implementation is distributed across multiple physical devices offloading application logic, computation and storage onto a web service running in the cloud. The applications multi-tier architecture is partitioned into the presentation tier, application logic tier and data tier.

Presentation Tier

The mobile application being demonstrated is representative for the presentation tier. It is end user facing, aimed to provide high user satisfaction and is responsible to handle user input and display computed information. It utilizes services from the underlying application logic tier and external services like Google Maps.

Application Logic Tier

The two main functionalities of this tier are the gathering of POIs and the combination of POIs to routes. First, POIs located over a wide area between a starting and a destination point are retrieved from external service providers such as Foursquare. We normalize each item to a generic POI model independent from the service provider. Then the POIs are passed over to path finding algorithms that combine them to personalized composite trips.

Data Tier

We handle and store API credentials and path-finding performance metrics such as total number of POIs processed and execution time within this tier. As it might not seem urgent to dedicate an own tier for this data, the need increases when, e.g., user accounts are introduced.

Advantages

The most important advantages of a multi-tier architecture for our city trip planning application are: 1. reusability of functionality 2. modularity/exchangeability 3. developer friendliness 4. scalability

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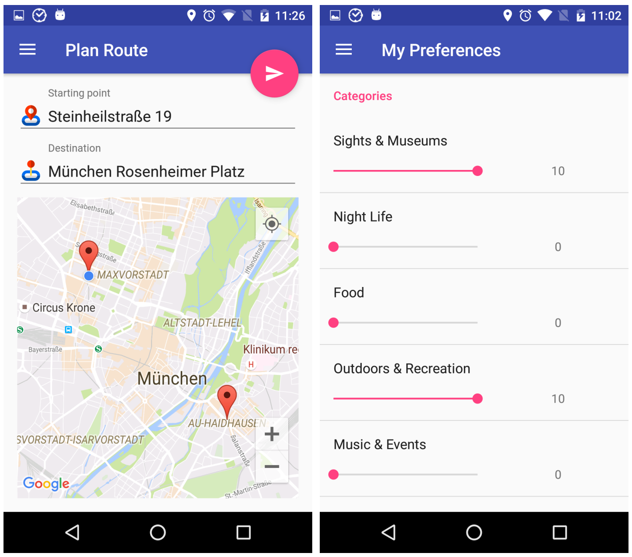
2.2 Mobile Application Design

Our mobile application applies the design language Material Design developed by Google[2]. Material Design provides a comprehensive set of principles composed of styles, layouts, components and patterns which helped us to design interfaces that require rather little input while still delivering high quality output. A lot of users engage with apps that align with these principles, e.g., Gmail, on a regular basis, therefore it can be assumed that most users are familiar with the design language.



(a) (b)

Figure 1: (a) User entered starting and destination point (b) Preference settings for the categories

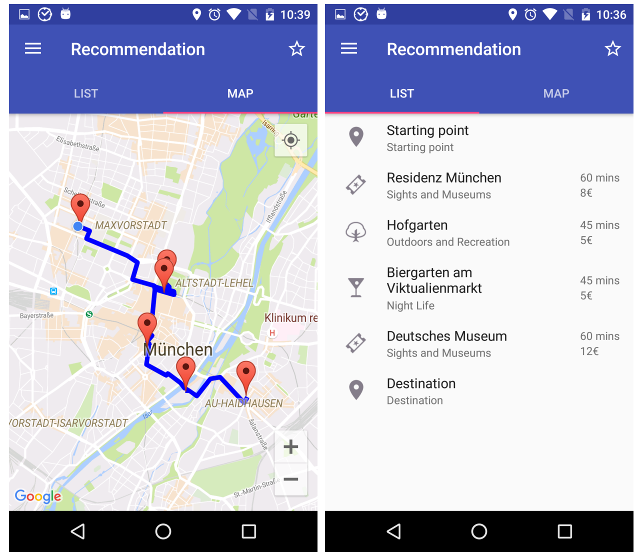
Our solution is a mobile application that recommends routes with selected POIs between the requested *starting point* and *destination* (Figure 1a). By default the users current location is selected as *starting point* and converted into an actual street address. Through a dedicated UI dialog that displays an interactive map and a list of nearby POIs, users can search and can choose an explicit POI or an arbitrary geographical location.

The recommendation takes user preferences for six different categories (Figure 1b) and optional constraints like time and budget into account. Since a user may not change her preferences often, this information is stored on the mobile device.

After the route is generated, the user can choose between a map (Figure 2a) and a list (Figure 2b) view. If the result is satisfactory to the user, the route can also be starred and thereby stored on the device. With this feature, a user could also prepare a trip beforehand, take a look at a route on-the-go and have some sort of travel diary afterwards.

2.3 Usability Evaluation

We conducted a preliminary user study using the System Usability Scale (SUS) [1], a questionnaire for measuring how people perceive the usability of a computer system. It is technology independent and does not require a baseline to



(a) (b)

Figure 2: (a) Generated route with POIs displayed on map (b) List of POIs with budget and time constraints

test against. The average SUS score among 39 participants was 84.64. The score converts approximately to a percentile rank of 95%, meaning that the application performs better than about 95% of tested systems in terms of perceived usability. In addition, we separated the participants into two study groups based on the user's mobile operating system (iOS and Android). Our results show, that Android users were significantly more satisfied than iOS users (SUS score of 88.06 vs. 81.25).

3. CONCLUSIONS AND FUTURE WORK

In this work, we developed a multi-tier application for city trip recommendations. Our mobile Android application achieved good usability results in a preliminary user study. In future works, we plan to extend our architecture with additional data sources, improve the tourist trip algorithms and provide new user interfaces, e.g. for public interactive screens in cities. We then want to evaluate the solution including the perceived quality of the recommendations in larger user studies.

4. REFERENCES

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[2]https://material.google.com/