MoTIR: A Multi-Objective Framework for Traveler's Itinerary Recommendations

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ABSTRACT: Public transport is an integral part of traveling that should inspire effective and innovative ways of commuting. For tourism purposes, reducing private vehicles into the popular areas is demanded and at the same time to ease the mobility of foreign tourists visiting Point of Interests (POIs) via public transport. However, most of the existing research only considers traveling on a private car and the itinerary recommendation is designed with a single objective: POIs characteristics. The suggested framework aims to consider multiple objectives whereby in choosing POIs, the itinerary also considers the availability of public transport as well. This study aims to adapt the Industrial Revolution (IR) for realizing tourism 4.0 in Melaka. This project is about developing an ultimate navigation solution by incorporating available public transportation to support the Melaka tourism initiative. The expected outcome from this research is an optimized routing that applied to Traveler's Itinerary Recommendations for Melaka Point of Interests (POIs). This research will positively impact the realization of a green-friendly environment that is stated in the vision of Melaka that is Melaka Maju Negeriku Sayang Negeri Bandar Teknologi Hijau.

Keywords: *point-of-interest recommendations; Multi-objective Framework; Traveler's Navigation*

1. INTRODUCTION

Tourism has become one of the primary income generations for the Melaka state government. To encourage more tourism activity, the government of Melaka has announced a new project known as Melaka Waterfront Economic Zone or M-WEZ [1]. Since no restriction to bring cars into the city, the point of interest (POIs) areas quickly gets congested. This situation indeed gives a horrible experience to tourists, possibly making them cancel their visit.

The government should provide an excellent public transportation service to reduce the number of cars from getting into the POIs area. For example, in the UK, they limit the number of cars from getting into London city by introducing a congestion charge for each vehicle (congestion charge) [2]. By enforcing this, the local government enables more journeys to be made safely by foot or bike while keeping the bus network reliable.

One of the initiatives would be recommending an itinerary, which allow user to plan their visit beforehand. However, the existing research only producing the itinerary based on the POIs selection through mapping the user preferences and the POIs' selection by other users.

For details, most existing POI recommendation techniques model user preferences based on several criteria. The first criterion is the geographical position of a POI. This position significantly influences the users' visiting behaviors and becomes the main factor in location recommendations [3]. The second criterion is the category. Example of the category is historical, cafe, and waterpark. The third is other attributes such as the user's visiting or check-in behaviors [4]. All these criteria are used for a single objective POIs recommendation as presented in [5]. Recent multi-objective POI recommendations involve tourist groups that aim to achieve fairness among the tourist [6]. None of the research considers the route of public transportation as one of the elements of recommendation.

The purpose of this study is developing an ultimate navigation solution by incorporating available public transportation to support the Melaka tourism initiative. The aim is to provide journey planning to the tourist for convenient trip routing using road-based public transport. It also supports the Malaysia Intelligent Transportation System (ITS) Blueprint 2019-2023 [7]. In the report, there is a section that mentions about Journey Planner service/application. The planner's goal is to allow users to plan their trips from the comfort of their own homes, using various means of transportation. Based on the idea, the public transportation for travelers in Melaka should be improved.

The proposed system aims to develop public transport options with the emphasis on an optimized recommendation based on POI and public transportation routing path. The system proposes an itinerary by defining the availability of buses within the POIs area. The availability of the bus and the list of POIs is among the factors considered for recommending the tourist within the duration of stay.

2. METHODOLOGY

There are three main stages in the methodology: the regular preliminary inquiry is undertaken before data collection and problem creation, program implementation and review, performance evaluation, and report dissemination.

Phase 1: Identifying the characteristics of POIs that are grouped into category, location and other attributes. These inputs are retrieved from user preferences and

other users' selection. While transportation information has the traffic routing and schedule of the available public transportation in the POIs area. This includes an analysis of criteria and model features for the public transportation. A full assessment is carried out in all factors found and learned. Eventually, it is outlined in the preliminary report that work gaps are established.

Phase 2: In this phase, data is gathered, and the established problem is formulated (acquired during step 1) and defined. The three models are mapped to the specified objectives that are crucial for POIs selection and traffic routes. The data analysis is carried out for usability parameters such as latency and the accuracy percentage for proposing the itinerary based on the user preferences.

Phase 3: The proposed framework is developed. The proposed framework is tested with several benchmark functions. It then will be fine-tuned based on the usability performance metrics. The evaluation with the real user also involved at this stage using the usability testing tool. The performance evaluation is carried out in the context of mobility, route planning, and usability.

3.   RESULTS AND DISCUSSION

This research focuses on the following new POIs itinerary recommendation, which can help users decide before beginning their journey. In real life, tourist decisions are influenced by many factors, such as location, category of places they select, ease of access, food, etc. This research considers the user's preference model, collaborative model, and route model. Each of the models is briefly discussed next with other's preference of the POIs.
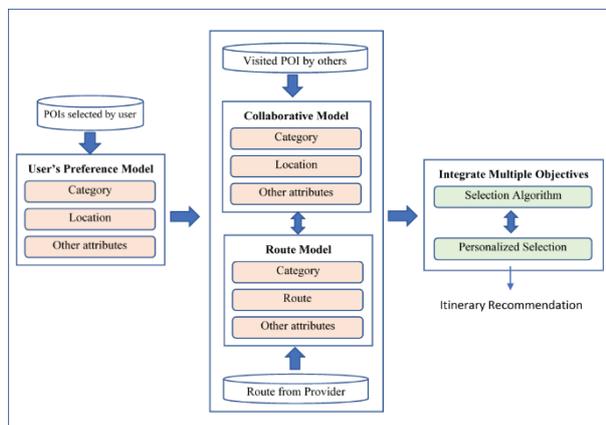

Figure 1 MoTIR Framework

The framework of MoTIR is depicted in Fig. 1. Given a user, MoTIR first builds the user's preference model on the POI category, location, and attribute from the selected POIs. The collaborative model measures the similarities of other users' visited POIs under similar criteria separately. The route model retrieves the information of transport available, the route between POIs, and other attributes such as fare, schedule, and the provider. Apart from the user preference, the route model is an important factor that significantly influences the decision of selection algorithms. The final stage integrates the multiple objectives that integrate the multiple objectives that are finalized through a selection algorithm and the user's personalized selection. Personalized selection is retrieving from the pattern of the user's selection in the previous visit.

The recommended itinerary is efficient and user-friendly, considering user selection, collaborative input from others, and route information for the POIs. Duration of stay for each visit, opening hours, tour popularity for each POIs are examples of factors that can be considered in generating the itinerary.

4.   CONCLUSIONS

This paper proposed a new POIs itinerary recommendation framework called MoTIR by considering user preferences on user's selection, collaborative input from others, and routes for the selected POIs. Based on MoTIR, this paper proposed the route model by considering public transportation navigation among POIs apart from the collaborative input from others. The next aim is to implement the framework and do related experiments on the performance and user experience.

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