

Point-of-Interest Recommender Systems: Nudging towards Sustainable Tourism

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ABSTRACT

With the increasing attention to environmental sustainability, matching user preferences and green behavior has become a must in several domains, including tourism. However, changing people's traveling habits is hard and requires a relevant motivation effort. This short paper investigates the exploitation of digital nudges to promote sustainable tourism in personalized mobile guides for natural and cultural heritage exploration. The ultimate goal is to enhance point-of-interest recommender systems with the capability to drive users toward the selection of itineraries that they like and that can be managed by exploiting green means of transportation. For this purpose, we propose to integrate the recommendation of Points of Interest that satisfy the user's interests with an explicit presentation of the environmental impact of traveling to such places, using digital nudges to drive the user toward the selection of sustainable tour management solutions.

CCS CONCEPTS

• **Information systems** → *Web searching and information discovery; Recommender systems*; • **Human-centered computing** → *Interaction techniques*.

KEYWORDS

Tourist Recommender Systems, Environmental Sustainability, Natural Heritage, Cultural Heritage

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1 INTRODUCTION

Traditional personalized mobile guides center the recommendation of Points of Interest around the selection of the area to be explored and the user's interests. However, with the increasing attention to environmental sustainability, mobile guides have to be extended to take the environmental impact of traveling into account in the suggestion of places to visit and in the generation of itineraries. In other words, it is not just a matter of recommending places that the user will like, but also driving tourists to move in an eco-friendly way. This issue impacts Point of Interest recommendation because not all the options, or aggregations of options that the user might like are feasible when these additional evaluation criteria are considered. Thus, the suggestion of places to visit should be combined with itinerary planning to identify bundle solutions that simultaneously satisfy users and preserve the environment.

In the OPENALPLAB project¹, we developed a mobile guide that supports the mixed-initiative design of tour plans by helping the user actively select Points of Interest and activities that satisfy the user's interests and the time constraints of the tour [2]. Moreover, we developed the FieldTripOrganizer guide empowering teachers to design custom field trips for school classes [14]. Different from most mobile guides, which propose complete tours (e.g., [7, 11]), we focused on enabling users to actively create their travel plans. We thus developed an interactive model that empowers the user to proactively configure the tours using the system as a support to identify the feasible options to choose from.

Our current work pursues the interactive design of itineraries, supporting the user in the selection of the places to visit and in the organization of the tour. However, we also aim to induce green tourism. This is a big challenge because the most comfortable (and possibly quicker) solution is often to move by car, which is poorly sustainable. Given the observed positive effect of nudges in inducing pro-environmental behavior [21], we are investigating digital nudges [22] in mobile guides to enforce green travel behavior. Specifically, we investigate extending point-of-interest recommendations and the generation of itineraries in a mobile guide to show the environmental impact of different transportation modes, promoting the most eco-friendly ones. In this paper, we describe a proof-of-concept prototype we have designed to present cultural and natural heritage information about Piedmont, a region in the North-West of Italy. While the prototype is currently in its initial

¹<https://openalplab.unito.it/>

development phase, we plan to extend and employ it in a user study to evaluate the influence of digital nudges on users' travel choices.

The remainder of this paper is organized as follows: Section 2 positions our work in the related one. Section 3 describes our approach and Section 4 concludes the paper.

2 RELATED WORK

2.1 Digital Nudges

Digital nudging is described as "the use of user-interface design elements to guide people's behavior in digital choice environments" [22]. Moreover, [9] defined a taxonomy of techniques that have been applied in recommender systems, building on previous categorizations such as [5]. In our work, we aim to induce virtuous decision-making behavior by improving user awareness about items. For this reason, w.r.t. the taxonomy described in [9], we employ "decision information" nudges, which change the data that is presented to the user without changing the options themselves.

In the recommender systems research, digital nudges modifying the choice architecture have been used to steer human behavior in the adoption of energy-saving solutions [18], as well as in the use of green transportation modes [1]. Specifically, in [1] the authors leverage pervasive mobile sensing to uncover users' mobility patterns and use of transportation modes. Then, they build users' profiles by considering their personality and mobility behavior and, consequently, they apply personalized nudges to adopt sustainable transportation habits. As previously mentioned, our work differs because we invest in the enhancement of user awareness, rather than modifying the set of solutions to propose, to drive users toward sustainable choices.

2.2 Mobile Guides and Tour Planners

A large part of the research about mobile guides and tour planners overlooks sustainability and the issues related with driving people towards it. In detail:

- Mobile tourist guides privilege the recommendation of natural and cultural heritage items based on the user's preferences to meet individual information needs; e.g., see PIL [10], and [3] that also takes the user's context and mood into account. While these applications offer advanced and personalized support for information exploration, they overlook travel issues, which are very important to fully support users in tour planning.
- Tourist trip planners take the practical aspects of traveling into account but most of them fail to actively engage the user in the design of the tours, which we believe is the first step to drive her/him to change travel habits towards sustainability. Specifically, most trip planners generate pre-built tour plans (e.g., see [7, 11]). A few, like [20], allow the user to modify the proposed solutions but they maintain control of the generation process.

Some personalized itinerary generators create the tour plans by exploiting other tourists' past behavior and/or the popularity of places [4, 6, 8], or the user's past traveling behavior [12]. Moreover, some systems use information extracted from Location-Based Social Networks for personalization [17].

Very few personalized tourist recommenders take sustainability into account. Noticeably, Merinov et al. propose multistakeholder recommendation techniques to optimize itinerary suggestions to prevent the overcrowding of places [15]. In comparison, we aim to drive people toward sustainable travel behavior. Thus, we invest in empowering the user to actively build the tourist plan by considering both the features of the Points of Interest *and* the environmental impact of traveling from place to place.

3 SUSTAINABILITY-AWARE, PERSONALIZED POINT OF INTEREST RECOMMENDATION

Similarly to other works, the interaction model we envisage starts eliciting from the user two types of information:

- The geographical area to be explored. This is the place where the user is located or (s)he wishes to visit.
- The user's interests, e.g., arts, nature, food, and so forth, which the system uses to select relevant Points of Interest to suggest.

Starting from this information, the mobile guide can suggest the places to visit, using a first type of nudge to separate the places representing environmentally sustainable options from the other ones:

- The first list ("Luoghi consigliati" - suggested places) shows the places that meet the expressed preferences and can be reached using sustainable transportation; see Figure 1. For each place, the system shows in green the most eco-friendly transportation means ("Scelta ecologica" - sustainable choice), and in bold black, with a warning symbol, the less sustainable ones (in the figure, by car). For each travel solution, the system shows the expected displacement duration to enable the user to evaluate it by taking both sustainability and convenience into account.
- Another list ("Altri luoghi raggiungibili" - "Other reachable places") shows the places that meet the expressed preferences but cannot be reached using sustainable transportation means ("Scelta con maggior emissioni di CO₂" - "Choice with higher CO₂ emissions"); see Figure 2.

For transparency purposes, the system describes the types of interest best characterizing the places by showing small icons below the name of the place. For instance, Moncalieri city is tagged as relevant for arts (yellow icon) and nature (green one). We plan to identify the types of icons to show based on the popularity of the natural and cultural items available in the places, as well as on the services they offer (e.g., for food).

For each suggested place, the user can inspect the Points of Interest it offers by clicking on it. For instance, Figure 3 shows the suggestions concerning the city of Alba. When the user chooses the place that (s)he would like to visit, the system applies further nudges to push the selection of the greenest transportation means. Specifically:

- It recaps the traveling information to reach the place ("Come arrivare" - how to reach the place). Specifically (see Figure 4):
 - It highlights in green the best option(s) ("Scelta consigliata" - suggested option) and makes this graphical component

Luoghi consigliati

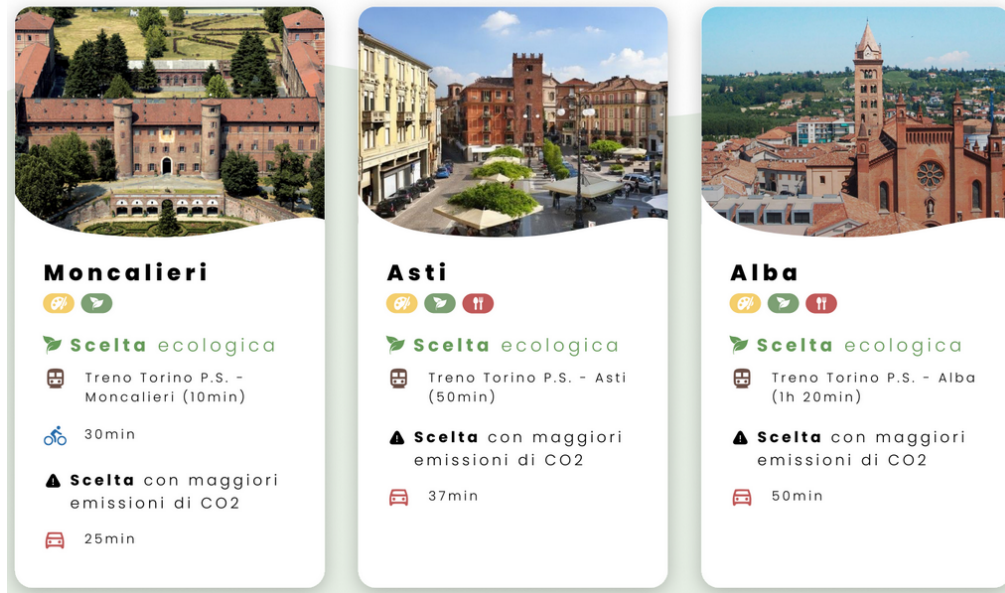


Figure 1: List of suggested places to visit, based on the selected geographical area and the user's interests.

Altri luoghi raggiungibili



Figure 2: Other places that could be visited but represent less sustainable options.

prominent in the user interface. Moreover, it explains that this solution reduces CO₂ emissions ("Con questa scelta si riducono...").

- It shows in grey the alternative option(s) ("Scelta alternativa"), explaining that in this case, the CO₂ emissions are higher ("Con questa scelta si aumentano...").
 - Moreover, it displays on a map the itinerary of the tour using green transportation. In this way, the user receives a plan to be used during the tour without the need to find supplementary information to move around.
- While the provision of this data might appear a technical aspect of the mobile guide, we point out its importance in convincing the user to adopt the system's suggestions. Specifically, providing complete information is another nudge, aimed at bridging the intention-behavior gap that might challenge the acceptance of the proposed solutions by imposing on the user the burden of retrieving information from an external source [19].

As previously specified, we have currently developed a proof-of-concept prototype of this application, which provides limited functionality. We plan to leverage the data of Openstreetmap [16] and the Open Source Routing Machine (OSRM) [13] to make the app work in any geographical area. In our future work, we plan to extend this prototype and employ it in a user study to evaluate the user experience with it and its impact on decision-making concerning the impact of environmental sustainability information on trip organization.

4 CONCLUSIONS AND FUTURE WORK

The research on point-of-interest recommender systems and mobile guides should evolve to take environmental sustainability into account in steering the suggestion and the presentation of results to

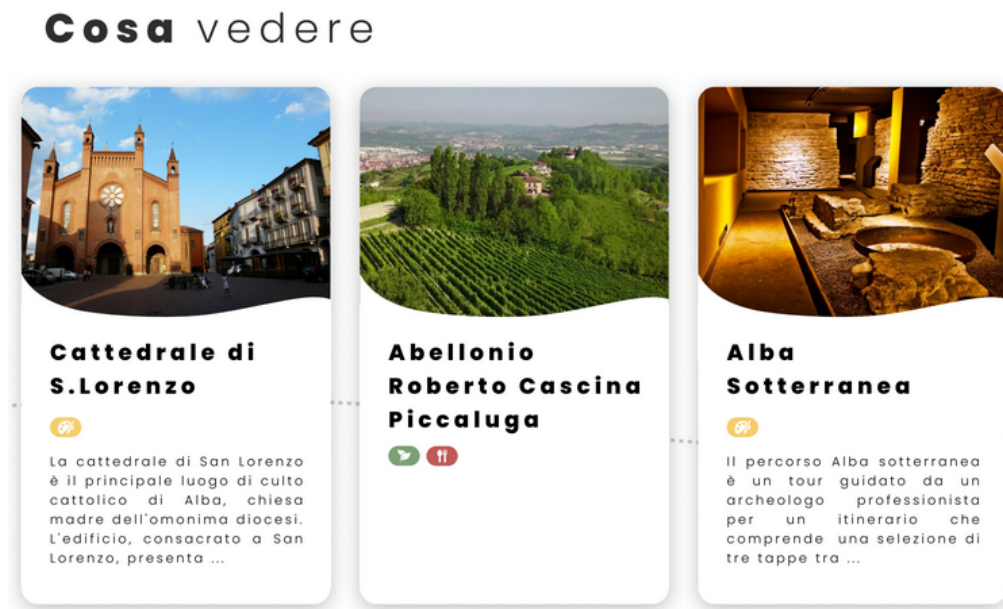


Figure 3: Points of Interest that can be visited ("Cosa vedere") in a suggested place. Each card provides a description of the Point of Interest it shows.



Figure 4: Suggested transportation mean to the selected place.

the user. In other words, it is not only a matter of suggesting the best places to visit but also convincing the user to organize eco-friendly tours. Helping this organization, and informing people about the impact of their travel choices, is a first step in this direction. Moreover, in the future, we plan to involve multiple stakeholders, such as policy makers and tourist agents to improve the functionalities of the app.

In this perspective, we described a preliminary approach to use digital nudges to inform and push the organization of green tourist plans.

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