Personalized Tourist Guide for People with Autism

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ABSTRACT

Cultural Heritage exploration is interesting for the development of inclusive tourist guides because it exposes visitors to different types of challenges, from steering content recommendation to visitors' interests and cognitive capabilities, to the suggestion of places that can be effectively reached and visited under different types of constraints: e.g., temporal and physical ones. In this work we are interested in the needs of people with Autism in order to support them in the exploration of a geographic area. Specifically, this paper presents a mobile tourist guide that we are developing to help people in visiting new places. The app is an evolution of PIUMA (Personalised Interactive Urban Maps for Autism), conceived to help autistic citizens in their everyday movements. It shows a map tailored to users with Autism Spectrum Disorder. In particular, it presents a personalized selection of safe Points of Interest, i.e., places that are, at the same time, interesting for the user and have "safe" characteristics from the sensory point of view, such as being quiet, scarcely crowded, or with smooth lights. In this paper, we present how we intend to extend PIUMA to support tourists.

CCS CONCEPTS

• Information systems → Recommender systems; **Geographic information systems**; **• Social and professional topics → People with disabilities**; **• Human-centered computing → Accessibility technologies**.

KEYWORDS

Cultural Heritage exploration, Tourism, Recommender Systems, Autism Spectrum Disorder, Accessibility.

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1 INTRODUCTION

Cultural Heritage exploration is interesting for the development of inclusive tourist guides because it exposes visitors to different challenges, from steering content recommendation to individual interests and cognitive capabilities, to the suggestion of places that can be effectively reached and visited under different types of constraints; e.g., temporal and physical ones. In this work we are interested in the needs of people with Autism and in the development of tourist guides supporting them in the exploration of a geographic area.

Autism can be defined as a lifelong developmental disability that affects how people perceive the world and interact with others. Autism is a spectrum condition, i.e., it affects individuals in different ways. Some autistic people, for example, also have learning disabilities and cognitive issues, while others have full intellectual abilities. What is common in all people with autism is an atypical social functioning, which often results in isolation [13]. In general, they tend to avoid any novel situation since it can be perceived as stressful [27].

Moreover, people with Autism Spectrum Disorder (ASD) perceive the world differently from others, which means that they appear to react differently to sensory stimulation [1, 25, 31]. A majority of them may become overwhelmed by environmental features that are easily managed by neurotypical persons [24].

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People with ASD tend to have a reduced range of activities and interests, often preferring deterministic situations, having the need to find reassurance by sticking to rigid and repetitious routines [27]. As consequence, they are less likely to explore new environments, and more likely to revisit well-known locations [29]. Indeed, this heavily affects the tourist experience. While traveling, people with autism experience an enormous level of stress because of the unfamiliar, of the unknown, and because their routine is interrupted. The result is that they simply tend to avoid going on trips.

Our idea is to develop a technological support able to help ASD people in traveling trying to minimize the level of stress. For this purpose, we aim at satisfying autistic people's spatial needs by focusing on aversions derived from their high sensitivity to sensory stimulation and by suggesting Points of Interest (PoIs) that fulfil such needs. In particular, we want to present a personalized selection of such PoIs in order to address the specificity of each person in perceiving sensory stimulation. As PoI we mean a place that can be relevant in a trip in a new city: from accommodations, restaurants, bars, shops, to outdoor places (squares, stations, ...) and tourist attractions (museums, exhibitions, sightseeings, ...).

This paper presents a tourist guide that can help people in visiting new places. It is based on PIUMA (Personalised Interactive Urban Maps for Autism), a system conceived for support autistic citizens in their everyday movements by showing a customized map [20, 21]. In particular, it presents a personalized selection of safe PoIs; i.e., it suggests places which, at the same time, are relevant to the user and present "safe" characteristics from the sensory point of view, such as being quiet, scarcely crowded, or with smooth lights. The targets of the application are autistic adults with medium-high functioning. In this paper we present how we intent to extend PIUMA support autistic people in tourist explorations.

In the following, Section 2 describes the autistic users' requirements for traveling and Section 3 presents the related work. Section 4 describes our mobile guide as implemented so far. Section 5 concludes the paper.

2 TRAVELLING REQUIREMENTS

Travelling causes several issues to people with autism: from a level of stress derived from unexpected situations to social inclusion in community activities, from emotional and physical well-being to the management of interpersonal social relations [17, 26].

Most of these issues can be addressed by means of a meticulous planning of the tour, in order to prepare the user to tackle each of its steps; i.e., transportation, accommodation, visiting etc. [12]. In this line, a few airports offer some pre-planned visits of the place. For example, the airport of Dublin offers on-line material that visually describes the different parts of the building, following the logical sequence of actions which a traveller is supposed to do. The material also provides tips about how to face all the different situations and also some general rules to follow during a trip.[1]

However, it is also necessary to select accommodations, restaurants and places to visit that can be perceived as safe by autistic people, i.e., which do not negatively impact on their senses [9, 24]. Sight, smell and hearing are relevant to mobility in urban environments and high sensory stimulation negatively influences people in their movements. Further relevant environmental dimensions that could impact the sense of safeness are the temperature, openness, and crowding of a place [22]. Thus, following these insights, in the following we use the term "safe PoI" to indicate a place that is comfortable for the person; e.g., not too noisy, or not too crowded, according to the idiosyncratic user's sensory dispositions. Of course, this definition is highly personal. The same rationale could be applied for the definition of "safe" paths, i.e., paths that satisfy the perceptual needs of ASD people. So, for example, for those who are inclined to avoid noisy places, busy routes should not be selected, nor routes near schools, hospitals, or shopping areas, marketplaces and road works. By contrast, quieter routes for pedestrians should be proposed, with benches and trees, far from the busiest streets, and next to parks. We do not describe this functionality in the paper because is not fully implemented in the system.

3 RELATED WORK

The use of ICT has proven to be a useful support of ADS users' lives, for simplifying interaction with the other people and organizing daily activities [19]. Users with ASD show a positive attitude towards computer technologies due to the predictability of the interaction.

In general, ICT-based solutions focus on social problems, such as face-to-face conversation [3] and emotion management [27], because these are considered as the core characteristics of autism. Moreover, technologies tend to focus mainly on children [10]. Most of the personalized systems for ASD people regard the educational domain, such as [14] and [7].

To the best of our knowledge, very few works deal with autism and tourist experience.

Some work focuses on how to make tourist websites accessible and usable by ASD people. In [5], the authors define a set of recommendations for the design of tourist websites for people with Autism Spectrum Disorders and present two examples, one for the area of Rieti and the other for Mestre, in Italy. Both websites have been designed to be easily accessed.

Other works describe more informative websites providing data that is particular useful for ASD people. For instance, Autistic Globetrotting [6] is aimed to encourage families with people with ASD to travel and it gives hints such as how to pack luggage, and so forth. Moreover, the Toerisme voor Autisme[2] website aims to help tourists by making the unknown a little bit more known. It reviews more than 20 tourist attractions in Flanders and it describes in detail what visitors can expect there. For example, the photo-illustrated step-by-step guide to the Stoomgroep park in Turnhout describes what visitors will see when they visit the miniature railway in the city park: it specifies the colors of the different types of entry tickets (yellow or green-and-yellow), the number of windows in the little ticket booth (two) and the duration of a train ride (eight minutes).

Some work exploits Virtual Reality (VR) for training specific skills needed to travel. For example, [2, 28] describe the creation of a serious game based on VR that prepares individuals with ASD to use buses for moving. Virtual reality increases the realism of the experience, simulating the presence, and thus it is a good learning support technology [15].

[1] www.dublinairport.com/at-the-airport/help-and-support/travelling-with-autism

[2] www.toerismevoorautisme.be/

Before concluding it is worth mentioning that we did not find any mobile guide specifically designed for people in the spectrum similar to the one we propose.

4 A PERSONALIZED TOURIST GUIDE FOR ASD PEOPLE

The suggestion of Points of Interest to people with ASD is challenging for recommender systems [23] research. Traditional data about user interests, employed in recommenders for "neurotypical" individuals (i.e., not belonging to the autism spectrum), should be combined with idiosyncratic aversions because what bothers autistic people has great importance in their daily choices and can determine a high level of stress and anxiety [8]. As previously discussed, regardless of the user's interest in a PoI, its sensory features might negatively stimulate her/him and mine her/his experience with it [1, 25, 31].

We thus conceived our mobile tourist app as an interactive urban map that presents safe PoIs selected according to the user's preferences *and* aversions. The guide is currently under development: while for the recommendation component, described in the following, we initially based on [16], we are designing the portion of the use interface devoted to the presentation of information about PoIs, which should cover both the safety aspect and the cultural one.

The management of this type of guide has as a prerequisite the availability of data about safe PoIs of the city, i.e. a wide amount of (crowdsourced) annotations about the sensory features of the places, as well as information about users. Figure 1 presents a screenshot of the map with some PoIs. The current map has been developed for the City of Torino but it can be extended to other towns.

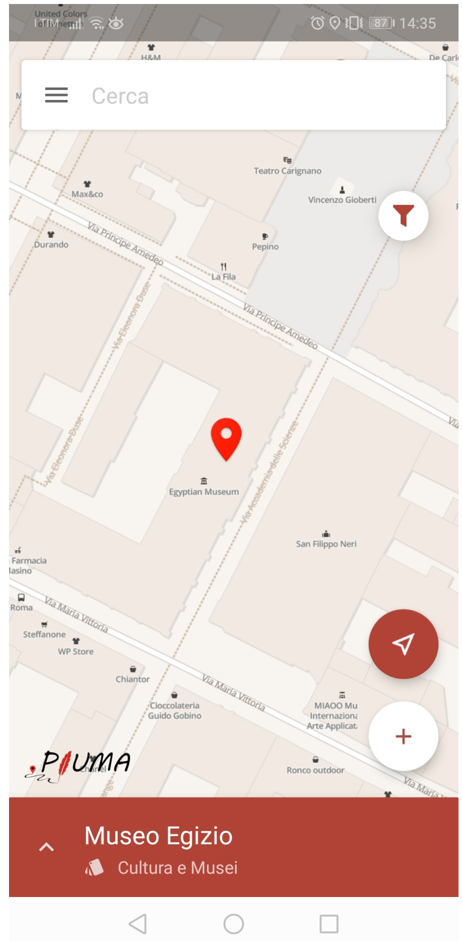

Figure 1: A screenshot of the PIUMA app.

4.1 Safe PoIs

Open Data made available by web sites like OpenStreetMap [18], which provides tags and comments about places, lack the sensory information we need to assess the safety of a PoI. For this reason, we needed to collect the information about PoIs from an *ad hoc* designed crowdsourcing platform: Maps4all [21, 30]. This kind of georeferenced data, also known as Volunteered Geographic Information (VGI), is knowledge provided by a non-expert crowd; see [11]. Maps4all allows the collection of data from people and integrates it with information extracted from heterogeneous information sources. Using that platform, for each place, the user can rate its sensory features, and in particular its level of i) brightness, ii) crowding, iii) noise, iv) smell, v) openness, and vi) temperature. Ratings are in a [1, 5] Likert scale in which 5 is the highest value. Sensory features have been defined on the basis of an authors' user study findings [22] and state-of-art researches [24, 25]. The user can also provide a global evaluation of the place. For each datum, the system returns the mean evaluation it collected.

4.2 Users features

We gather user preferences about categories of PoIs (what users like) and aversions (what bothers them) when they register to the app. In that context we ask users to select aspects that they bear less in a place: quite/noisy, isolated/crowded, cold/warm, narrow/big, bright/dark. For example, a user, by rating these aspects through a score that spans from 1 to 5, can express that (s)he has a strong aversion to bright (e.g., aversion = 4), cold (3), and crowded (4) places. This information, together with her/his preferences for categories of PoIs, and the context data, will contribute to determine the generation of recommendations in the app; see Section 4.3.

It should be noticed that we cannot afford eliciting users' aversions to each possible value of noise, crowd, brightness, etc., as this would lead us to impose very long registration forms to users. We thus ask a limited number of questions, aimed at understanding how the individual user's aversion varies according to the scale of values that the feature can take, and we interpolate such values in order to estimate the user's aversion towards the missing values [16]. For the interpolation we consider that:

- For some features, such as noise, low values do not trigger aversion, while high values do. Therefore, we can approximate aversion as a linearly increasing function. If we represent feature values in the X axis and user aversion in the Y axis of a plane, we can define this function as a line which connects point (1, 1), corresponding to minimum aversion, to point (5, $aversion_5$); see the left portion of Figure 2.

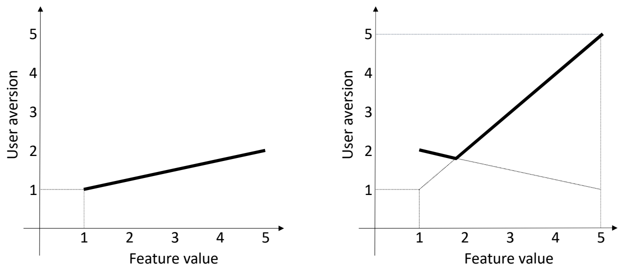

Figure 2: Representation of a user's aversion to a feature.

Therefore, given a feature having value x

$$aversion_x = 1 + \frac{(aversion_5 - 1)(x - 1)}{4} \quad (1)$$

- For other features, such as brightness, the user might be challenged both by low and high values; therefore, her/his aversion can be approximated to a concave function on the range of values that the feature can take. The aversion function has a "V" shape which can be approximated by drawing two lines:
  - The first line connects points (1, 1) and (5, $aversion_5$) to represent the increment of aversion towards the maximum value of the feature.
  - The second line connects points (1, $aversion_1$) and (5, 1) to represent the decrease in aversion while the feature takes higher values than its minimum.

  Therefore, the user's aversion to a value x of the feature corresponds to the maximum values of these two lines; see the right portion of Figure 2.

Having interpolated the user's aversion to a feature of an item, the compatibility of the feature with her/him can be derived by complementing aversion in [1, 5].

4.3 Suggesting Safe PoIs

When dealing with ASD people, during Cultural Heritage exploration, it is important to take into account both the user's interests and the her/his idiosyncratic sensory aversion. Indeed, a specific PoI might be interesting for the user but not accessible to her/him. For example, the cinema museum in Torino is pretty noisy because besides the noise caused by visitors there are a lot of sounds and videos. Thus, a person that is really sensible to the noise should not visit it even if (s)he is really interested in cinema.

We thus propose a recommendation model that combines the user's idiosyncratic aversions with her/his preferences in a personalized way to suggest the Top-N most compatible and likable Points of Interest for her/him. In line with recommender systems's research [23], the suggestion is based on the estimation of the user's ratings of PoIs, and the selection of the highest rated items as those to be suggested in the tourist guide.

We notice that not all autistic users weight compatibility and preferences in the same way and some people are ready to face the negative effects of sensory features when they visit PoIs that they like very much. We thus conclude that a good tourist guide should find a user-specific balance of compatibility and interest within a recommendation model that integrates heterogeneous evaluation criteria to appropriately take these two aspects into account. For this purpose we organize the recommendation process by combining two types of evaluation. The former is aimed at assessing the compatibility of the available PoIs with the user; the latter concerns preference-based evaluation of items:

(1) We assume that the overall compatibility of a PoI with the user (denoted as $comp$) depends on the compatibility of each of its sensory features. In turn, each value depends on how sensible the user is to the associated feature, as specified in Section 4.2. We thus compute feature-specific compatibility values which we aggregate into a value representing overall compatibility of the PoI with the user.
(2) As far as user preferences are concerned, at the current stage we only model preferences for categories of PoIs. We thus assume that the user's interest in a PoI (denoted as $pref$) depends on her/his preference for the category to which the item belongs.

We combine the compatibility ($comp$) and preference ($pref$) evaluation of an item to estimate its rating ($\hat{r}$) by means of a weighted model which makes it possible to balance these two components in a way that is personalized to the individual user:

$$\hat{r} = \alpha * comp + (1 - \alpha) * pref \quad (2)$$

A user-specific value of α can be learned by analyzing the ratings provided by the individual user while (s)he interacts with the mobile app, in combination with the preference and compatibility evaluation obtained on the basis of her/his declared preferences and aversions.

For the integration of individual compatibility values to obtain $comp$ we considered alternative aggregation models, from a pessimistic one, which assumes that the overall compatibility of an item with the user coincides with the minimum compatibility of all the features, to more optimistic ones, such as the mean feature compatibility. The best performing model can be empirically identified by optimizing rating estimation with respect to the ground-truth given by the ratings of PoIs provided by users themselves.

In our previous experiments [16] on generic PoI's recommendation we performed an offline evaluation and we found out that our model achieves the best performance (in terms of MAP) by evaluating $comp$ as the Cosine similarity between the compatibility of the item features with that of an ideal item which minimizes user aversion.

5 CONCLUSIONS

This paper has presented a personalized mobile guide especially conceived for people with Autism Spectrum Disorder (ASD). The app is an interactive urban map that can be populated by people with reviews and annotations regarding relevant sensory features of places. Given this type of information, the app presents a subset of such PoIs which should satisfy the user's interests and avoid irritating her/him.

This is an ongoing work. So far, as seen in Section 4.3, we designed and tested a PoI recommendation model which considers both users' interests and aversions in PoI selection. Now we plan to evaluate it in a Cultural Heritage scenario with ASD people. However, exploring Cultural Heritage poses further challenges: it means choosing where to go and what to see, given the available time and other possible constraints. Therefore, a PoI that could be very relevant from a cultural point of view could be unsuitable for an autistic person because it is very different from what (s)he is used to experience and this fact can cause anxiety. Thus, we expect it will be necessary to partially modify the recommendation algorithm, for suggesting only things to do that are somehow similar to what the people already know and like. This is interesting because it brings a totally different perspective on recommender systems evaluation, the opposite of the serendipity that is usually considered as an important goal to be reached [4]. Moreover, we are working to add personalized safe paths and tours in the city, as well as some tips and social stories to train traveling skills; e.g. how to get a train, and so forth. Finally, as future work we plan to investigate the adaptation of our approach to other needs, for example related to motor disabilities, by extending the type of features that influence item compatibility.

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