How can we engage people to map places suitable for the autistic population? A crowdsourced approach

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Abstract. The crowdsourcing paradigm applied to the urban environment (i.e., people while moving can provide data from different places) may play a fundamental role in transforming users in significant actors of the places in which they live. In the last years, several crowdsourcing services have been developed to allow citizens to collaborate, by collecting data about urban accessibility. This effort, however, focused mainly on physical disabilities. We aim to help people with Autism Spectrum Disorder (ASD) move across and live in urban environments by means of a crowdsourced personalized map. The map is populated with comments and reviews by people with ASD and caregivers, in order to highlight places, routes, and activities (e.g., less crowded routes, quiet places) to make ASD people's daily lives more comfortable.

Keywords: Autism, crowdsourcing, maps.[1]

1 INTRODUCTION

Participation of the citizen in the city life is one of the pillars of the notion of smart city [1]. Participation can help to transform a smart city in an inclusive city. As defined by Douglas, an inclusive city is one that "values all people and their needs equally. It is one in which all residents - including the most marginalized of poor workers - have a representative voice in governance, planning and budgeting processes, and have access to sustainable livelihoods, legal housing and affordable basic services" [2]. ICT can support democratic participation and sharing of information through crowdsourcing and via open source platforms. In particular, the crowdsourcing paradigm applied to urban environments, i.e., people while moving collect data from places, can play a fundamental role in this process [3].

It can transform users in significant actors of society, who may become the primary source of data describing a particular city space. Such a participation is indeed more complex for people with some kind of cognitive disability or neurological difference (also known as "neurodiversity" [4]) who still face a variety of barriers in accessing the places in which they live. Autism Spectrum Disorder (ASD), for instance, is characterized by the presence of persistent deficits in social communication and interaction across contexts and deficits in social-emotional reciprocity accompanied by the presence of restricted, repetitive patterns of behavior, interests or activities and hypo/hyper reactivity to sensory stimuli. [5]. Related to social interactions, ASD people can experience loneliness and anxiety [6]. Their engagement in social events is limited and they report isolation and communication challenges [7]. Individuals with ASD may find it difficult to move across the cities in which they live, since they are particularly sensitive to environmental stimuli, such as noise and crowding, and the rigidity of their routines may make them get confused when they need to divert from a well-known path.

In the last years, several crowdsourcing services have been developed to allow citizens to collaborate through the collection of data about urban accessibility, but focusing mainly on physical disabilities [8, 9]. As a result, there are no services that allow people (with ASD and "neurotypical") to signal those places that may be suitable to the autistic population in a given city.

The Personalized Interactive Urban Maps for Autism (PIUMA) project [10] aims to provide a spatial support to ASD people, in the form of a personalized crowdsourced map. This tool can not only improve the real life of the individual, increasing her autonomy, but also enhance her participation to the urban life. In fact, the map will enable people with ASD to find places that can satisfy their "spatial needs" in terms of their sensorial features. Moreover, it aims to produce impacts on the sense of self-efficacy and empowerment of people with cognitive problems, who will be allowed to actively contribute to a collective goal.

2 BACKGROUND

In the last years, crowdsourced maps gained popularity in order to promote accessibility of urban space especially for people with physical disabilities, allowing users to review the accessibility of specific POIs (Points of Interest) [11].

Regarding ASD people, different research has recently used technology to address specific problems, such as social communications [13], learning [14], emotion recognition [15], and collaboration [16]. However, such works, despite some remarkable exceptions [17], mainly focused on children [18]. Moreover, research mostly preferred to address social behavior problems, such as speech comprehension. Finally, it often translated behavioral interventions into technological support, making the transfer of improvements gained during the treatment to the real world difficult [16]. Moreover, personalized technologies for autism are still very rare [19].

The novelties of PIUMA are: i) it addresses adult people with ASD who are commonly overlooked by current research; ii) it supports them also in urban movements;

iii) it goes beyond the limitations of behavioral interventions by designing tools to be used in everyday situations; iv) it provides personalized tools adapted to the ASD condition as well as to the specific user and contextual features; v) it allows users to annotate POIs, and uses these crowdsourced data for recommendations.

3 PIUMA SYSTEM

3.1 Crowdsourced maps

The PIUMA project aims to support ASD people in moving and living their city by means of an interactive map, designed through a participatory design process [20, 21]. It is crowdsourced, i.e., populated with POIs, comments, reviews, trails both by people with autism and caregivers, as well as by anyone wishing to contribute. People have the possibility to both add free comments in the form of text or tags, as well as choose the features of the POI from a predefined list. These allow them to express whether a place is e.g., silent or noisy, crowded or isolated, as well as to rate it.

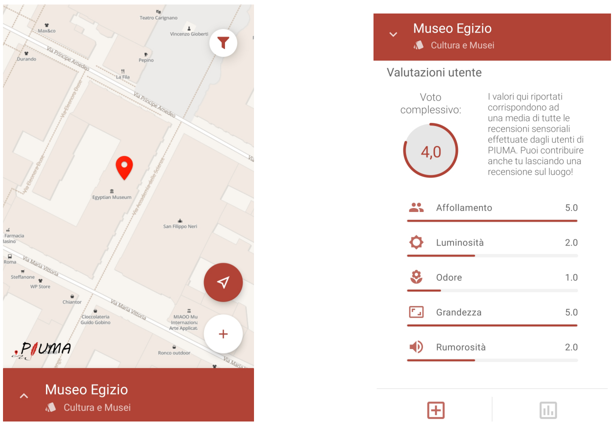

Figure 1. The mobile interface of the system

Such features have been selected by a pool of experts in ASD (psychologists and neuropsychologists, caregivers and patients). We then designed an interface displayed in overlay on the map, where the user can rate (from 1 to 5) a place with reference to five features: i) level of noise; ii) level of crowding, iii) temperature, iv) level of brightness, v) spaciousness. Moreover, a global evaluation about the “comfort” of the place can be provided. Such information will create the domain knowledge base to be used as a source for the personalized recommendations provided by the system. The implementation of the crowdsourcing project in PIUMA is based on FirstLife [22], a social network based on interactive maps (see Fig.1). It is composed of an interactive geographical map-based interface as a frontend and a backend aimed at managing and searching geographical data. The map can be accessed from both desktop computers and mobile phones.

3.2 Crowdsourced-based recommendations

System can proactively present some POIs of interest for the person, highlighting them in the interface. Crowdsourced information enriches the domain knowledge base used as a source for the personalized recommendations provided by the system. Recommendations of POIs from the crowdsourced set are then based on different factors. First, they are based on a user model, which collects the user's ratings of POIs, interests in categories of places (e.g., restaurants, parks) and aversions to specific sensory features of places (e.g., crowding). Then, it exploits the context model, especially in relation to spatial information (only reachable places are presented to the user). In other words, the recommendation of places considers both what the user likes and what she does not like, in order to present places that can be perceived as "safe" from a perceptual point of view.

4 USER STUDY

A preliminary evaluation of the system involved 8 individuals with high-functioning autism (autism level 1 according to DSM-5; average age=28.4; females=2) and eight neurotypical individuals (average age = 35.2; females = 4) [23]. The aim of the study was explorative. We were interested in gathering preliminary data about the acceptability of the solution. All the participants were unfamiliar with crowdsourcing systems. All self-reported as Internet/PC/mobile users. The researcher first presented the system. Then, each participant could freely use it for as long as she liked, exploring its functionalities. Finally, the participants had to complete eight tasks, spanning from exploratory tasks to crowdsourcing tasks. The test lasted about 60 minutes. Four participants with autism and four neurotypical users used an iPhone to access the system, whereas the others used a PC. Participants gave feedback in a thinking-aloud format. The researcher observed the interaction and kept record of the participants' comments.

Results show that participants consider the system useful, namely that they would use it to plan their everyday movements. However, it also emerged the need to adjust the system's interface as there were differences in the participants' capabilities of "reading" the map. For example, some ASD participants appeared to suffer from a high cognitive load, mainly caused by the difficulties in visually distinguishing the places they inserted from those inserted by other users. Others were overwhelmed by the number of places visualized on the maps. This may suggest that we use different filters depending on the user's needs.

5 CONCLUSION

The project represents a first step towards making cities accessible to people with cognitive disabilities. It could be adapted to other similar disabilities, such as persons with dementia (e.g., Alzheimer's disease), traumatic brain injury, spatial agnosia, and intellectual disabilities (e.g., Down Syndrome).

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