CONSIDERING AFFECTIVE RESPONSES TOWARDS ENVIRONMENTS FOR ENHANCING LOCATION BASED SERVICES

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ABSTRACT:

A number of studies in the field of environmental psychology show that humans perceive and evaluate their surroundings affectively. Some places are experienced as unsafe, while some others as attractive and interesting. Experiences from daily life show that many of our daily behaviours and decision-making are often influenced by this kind of affective responses towards environments. Location based services (LBS) are often designed to assist and support people’s behaviours and decision-making in space. In order to provide services with high usefulness (usability and utility), LBS should consider these kinds of affective responses towards environments. This paper reports on the results of a research project, which studies how people’s affective responses towards environments can be modelled and acquired, as well as how LBS can benefit by considering these affective responses. As one of the most popular LBS applications, mobile pedestrian navigation systems are used as an example for illustration.

1. INTRODUCTION

Research on environmental psychology shows that stimuli, including large-scale environments, are perceived not only according to their physical features, but also affectively (Russell, 2003; Barrett et al., 2007; Bondi et al., 2007). These affective responses towards environments influence people's daily behaviour and decision-making in space. For example, some environments might be experienced as stressful or unsafe and hence may be avoided; while others might attract people to sojourn and approach (Nasar, 1984; Kaplan and Kaplan, 1989; Zacharias, 2001; Borst et al., 2009). In order to offer services with better usability, geospatial applications, such as location based services (LBS), should consider these kinds of affective responses towards environments.

However, most geospatial applications only rely on objective geospatial data to provide services and decision support. These objective geospatial data (e.g., OpenStreetMap) store abstractions of the real world, especially focusing on physical features, e.g., the geographic footprints of a park. Incorporating people's affective responses towards environments into geospatial applications (e.g., LBS) is still a challenging issue. For example, how people's affective responses towards environments should be modelled and collected is still a topic of research. Furthermore, it is unclear how these affective data collected can be used for enhancing existing geospatial applications.

The research project EmoMap (http://openemotionmap.org/) explicitly addresses the above concerns. It is a cooperated project among Vienna University of Technology, Salzburg Research and WildUrb. In the EmoMap project, we investigate how people's affective responses towards environments can be collected using crowdsourcing approaches. We also illustrate how these collected affective responses can be incorporated into LBS for providing smart services, particularly smart route planning in mobile pedestrian navigation systems. This paper summarizes the results of the EmoMap project.

2. CHARACTERISTICS OF AFFECTIVE RESPONSES

Current research on modelling people's affective responses towards environments is still on an early stage. In the following, we explore the characteristics of affective responses, and investigate their differences with the conventional objective geospatial data (e.g., OpenStreetMap).

1) People's affective responses reflect people’s personal interpretations of an environment. These interpretations are shaped by people’s experiences at the environment. Different people might have different interpretations and perceptions about the environment. Therefore, these data are subjective in nature. In contrast, objective geospatial data are abstractions of the real world, and try to precisely model the physical features or objects existing in the environment. Precision is one of the main quality measures of objective data. These abstractions are often scale-dependent, but should be (in theory) the same for all the people regardless of their culture, background and perspectives.

2) People's affective responses towards environments are often context-dependent and dynamic. A same person might have different interpretations of an environment in different situations. For example, a same place might be perceived as safe in the daytime, while as unsafe in the night-time. In the same sense, with more exposures to the environment, people’s interpretations and perceptions towards the environment might change. In contrast, objective geospatial data are often context-

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independent, and remain the same for different time as long as the physical environment does not change.

3) Due to their different natures, the ways of modelling affective responses and objective geospatial data are very different. For modelling objective geospatial data, data models like field-based (raster) or object-based (vector) are often employed. For example, in the object-based models, the real world is abstracted as different spatial objects, which can be of the types of point, line and polygon (Shekhar et al., 1997). However, these kinds of models might not be suitable for representing people's affective responses. Currently, there is not agreed-on approach on modelling these affective data.

4) In terms of collecting methods, objective geospatial data can be easily collected via many surveying equipments and tools, such as Global Positioning System (GPS) devices, surveying prisms, laser rangefinders, and satellites. In contrast, collecting people's affective responses requires not only surveying tools, additional sensors (e.g., physiological sensors like electrocardiogram) or techniques (e.g., self-report) are often needed to capture people’s subjective interpretations of the environments (Klettner et al., 2013).

3. ACQUIRING PEOPLE'S AFFECTIVE RESPONSES TOWARDS ENVIRONMENT: A CROWDSOURCING APPROACH

People's affective responses towards environments can be collected through various approaches, such as self-report, physiological recordings via sensors, and social media analysis (see Griffin and McQuoid (2012) and Klettner et al. (2013) for extended reviews). In the EmoMap project, we use a crowdsourcing approach (humans as sensors; Goodchild, 2007) to collect people's affective responses. Specifically, we develop a mobile application to collect people's self-report affective responses. This approach is very promising with the increasing use of smartphones.

Firstly, in order to make these affective responses easily reportable, an Affect-Space-Model was developed. In this model, a two-level structure was adopted. On the first level, people’s level of comfort in space is gathered, whereas on the second level, users can optionally report more specific information regarding their affective experiences in space, specifically in the aspects of safety (unsafe/safe), attractiveness (unattractive/appealing), diversity (monotonous/diverse), and relaxation (hectic/calm). Due to the fact that people's affective responses are context-dependent, some contextual information is also asked/collected, such as company ("with whom"), familiarity with the place, and time. Affective responses are automatically annotated with GPS locations to free the user from manually reporting her/his location and thus facilitate the way of contributing. Based on the model, a mobile application prototype (working on smartphones with Android 2.1 or above) was developed to enable people to report their affective responses towards space anytime and anywhere. Figure 1 provides a screenshot of the mobile application.

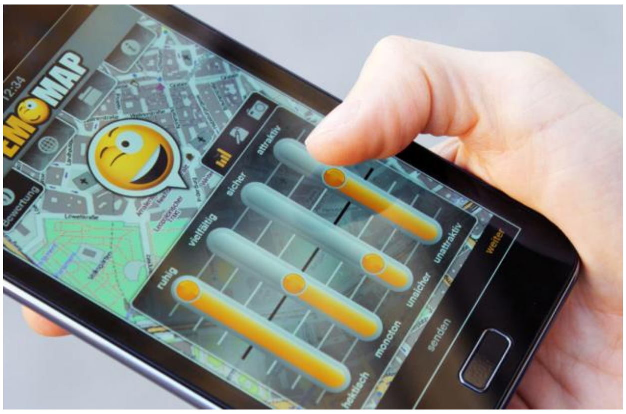

Figure 1. Screenshot of the Android application for collecting affective responses in space

Until December 2013, more than 3200 contributions from 193 people were collected with this approach. The number of affective contributions is still steadily growing. Experiences from this data collection show that crowdsourcing approach is very useful for collecting people’s affective responses towards space. More importantly, the crowdsourcing approach enables a direct, efficient, real-time collection of data, evoked by realistic scenarios, leading to highly valid results.

4. ENHANCING LOCATION BASED SERVICES

The affective data collected enable many interesting applications, for example, a better understanding on how people perceive the environment (see Klettner et al. (2013) for an example on the impact of environmental characteristics on people's affective responses in the environment), and smart geospatial applications. In this paper, we focus on incorporating these affective data into LBS. As an illustration, we study how these affective data can be used in mobile navigation systems, which are one of the most popular LBS, to provide more satisfying routing results.

Current routing algorithms often fail to provide other routes aside from time-optimized and distance-optimized routes. However, research has shown that humans may favour different route qualities in their path selection over shortness, such as safety, attractiveness and convenience (Golledge, 1995; Zacharias, 2001; Gallimore et al., 2011). We addressed this problem by incorporating people’s affective responses. The basic idea is to aggregate affective ratings of similar users to model/approximate the current user’s perception of different street segments. With this, a street network, in which each segment is encoded with a collective rating, can be generated. Based on this kind of street networks, we can compute routes with different qualities, such as the most comfortable route and the safest route.

Figure 2 shows an example of the route (green one) computed by considering affective responses (mainly the 'comfort' ratings), comparing to its shortest counterpart.

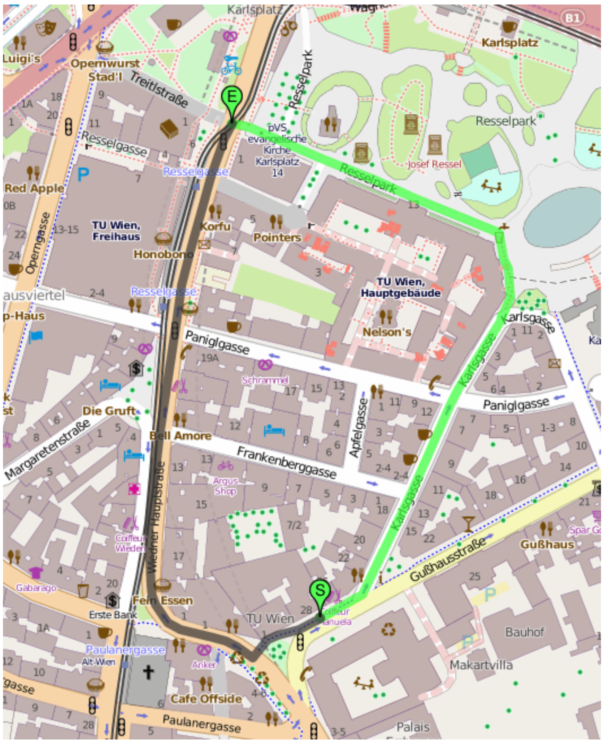

Figure 2. The most comfortable route (green one) computed by considering people's affective responses, comparing to its shortest counterpart (gray one)

Results from an empirical study (with 64 participants) show that the routes generated by considering people's affective responses towards environments are significantly preferred over the conventional shortest ones, which are employed in car navigation systems and many online route planners. In conclusion, considering people's affective responses towards environments leads to more satisfying routing results.

The collected affective data can be also used to enhance other types of LBS applications, such as mobile guides. For example, one of the key functions of mobile guides is to recommend tourists places or points of interest (POIs) to visit. The collected affective data can be used to provide tourists with more appropriate location recommendations, e.g., by avoiding unsafe or unpleasant places.

5. SUMMARY AND OUTLOOK

This paper reported on the results of a research project, which investigates how people's affective responses towards the environments can be crowdsourced via smartphones, and how the collected affective data can be used for enhancing LBS. As one of the most popular LBS applications, mobile pedestrian navigation systems are used as an example for illustration. Results of the evaluation showed that considering people's affective responses leads to more satisfying routing results.

In order to differentiate and tailor such services even more according to different user groups, more data from heterogeneous groups of people should be collected. On the basis of data from diverse user groups, collaborative filtering (CF) will be a promising approach to filter contributions according to similarities, and thus provide more personalized services. This aspect will be the future work.

Applications of affective data will not be restricted to the aspects mentioned above. We expect the inclusion of affective data will bring benefits to different disciplines, not only information and communication technology (ICT), but also urban planning, architecture, and policy making.

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