Sense of Space: Mapping Physiological Emotion Response in Urban Space

Luluah Al-Husain
College of Computer and Information Sciences
King Saud University
Riyadh, Saudi Arabia
lalhusain@ksu.edu.sa

Eiman Kanjo
College of Computer and Information Sciences
King Saud University
Riyadh, Saudi Arabia
ekanjo.c@ksu.edu.sa

Alan Chamberlain
Mixed Reality Lab
Computer Science
University of Nottingham
United Kingdom
Alan.chamberlain@nottingham.ac.uk

UbiComp'13 Adjunct, September 8–12, 2013, Zurich, Switzerland.

http://dx.doi.org/10.1145/2494091.2499213

Abstract
Urban spaces have a great impact on how people feel and behave. There are number of factors that impact our emotional responses to a space. In this paper, we propose an objective way to measure people's emotional reactions in places by monitoring their physiological signals that are related to emotion. By integrating wearable biosensors with mobile phones, we can obtain geo-annotated data relating to emotional states in relation to our spatial surroundings. We are the able to visualize the emotional response data by creating an *emotional layer* over a geographical map. This can then help us to understand how individuals emotionally perceive urban spaces and help us to illustrate the interdependency between emotions and environmental surroundings.

Author Keywords
Mobile sensing; affective computing; urban space; location-based emotions; physiological monitoring.

ACM Classification Keywords
H.1.2 [Information Systems] User/Machine Systems – Human Information Processing.

General Terms
Design, Experimentation, Human Factors, Measurement.

Introduction

Emotions play an important part of our daily life, affecting our perception of the world around us. Emotion may be seen as a physiological response to stimuli, which is both mental and physical. Emotion can be interpreted in a variety of ways and relate to a variety of contexts. Within this paper we focus upon our emotional response to urban space. There is a complex interplay between emotion, mood, place and space; and while we may feel happy and secure in one place, we might feel worried and unhappy in another.

There are a number of factors that impact upon our emotional responses to a place. Observing each factor individually is complex, but it facilitates emotion analysis and detection. However, being able to acquire someone's feelings in real situation, and understanding the physical environmental factors (heat, light, taste, smell and so on) that make up context have been made possible with the advancement of context-aware mobile technologies and in particular wearable sensors. This technology means that we are able to detect emotional responses, understand the environmental context and represent this in a geographical manner. There is research about sensing emotions, in general, but few studies investigate the feelings of people in relation to place, especially as emotion is a critical aspect of understanding and interpreting place.

In this paper, we discuss the ways in which people feel and physically react in different places by monitoring their physiological state. This provides us with objective indicators that are related to human emotion. We can then understand and correlate these with the environmental factors in the specific setting, e.g. temperature, humidity, noisiness, traffic, smell and brightness.

Existing Works

There has been little research that has focused upon on the study of emotional response to place. Matei et al. [1] is one of the few studies that have attempted to map emotion to places, by visualizing feelings of fear and comfort in Los Angeles. This was done by adding digital, subjective, and collective layers to a map of Los Angeles. This mental map reported on the subjective emotional states of people in Los Angeles. The work focused upon people's perceived emotional response in the past, it did not report on the real-time emotional response of the people. In addition, Christian Nold [2] has explored emotional reactions to place in his art project BioMapping. Christian created an emotion map that visualized the points of high arousal and low arousal of participants in different places, by using GPS to indicate the participant's position to a geographical location and a galvanic skin response (GSR) to indicate the person's emotional arousal. This project considered that every arousal measured by physiological signal (GSR) indicated an emotional reaction. Although, this physiological data would need more manipulation and analysis in order to produce meaningful maps. In Shopmopia [3] the authors have used physiological sensors to rate shoppers emotions toward retail shops in mall environment.

Some systems such as such as Mappiness [4] and Glow [5] have proposed using smartphones to gather the self-reported affective states of users and linking them to the geographic location. Although these two applications geo-reference the emotional entries, it is not clear that the elicited emotions actually describe

the users' feelings about the place. Mody et al. [6] developed a prototype called WiMo, an application that allowed emotional-location tagging for mobile devices. Another interesting project is NeuroPlace [7], a pervasive experimental manipulation was carried out to analyze brain signals in order to label outdoor places according to how users perceive them with a focus on relaxing and stressful mental states.

Thus, in order to measure the affective feeling of people about places, it is necessarily to measure emotional responses in a more objective way, which could provide the affective feeling caused by the spatial surroundings in real-time.

Proposed Approach

Different urban places influence the emotional experience of individuals. This is important because how people feel has a huge impact on how people behave. In relation to this we investigate the use of physiological signals for location-based emotion recognition. Through this, we can explore the relation between the emotional response of people and different urban settings. This enables us to study how people experience place, the impact of place and the role that different environmental factors play on emotion. We would then identify how these emotions are distributed spatially and map the variability of emotional patterns for different places.

In urban scenarios, the deployment of wearable biosensors integrated with mobile phones can deliver geo-annotated data relating to emotional states that describe how different individuals perceive and experience space. As many factors can stimulate the emotional experiences of place such as noise level, illumination and population/building density, these factors can be geo-tagged. We can then analyze the physiological signal as a response that is affected by these factors. Consequently, we can identify common patterns arising from large groups of people and mapping the patterns of emotional variance on a place with its affective stimuli. As a result of this, we may be able to understand the way that an individual's different emotional responses change over time. Moreover, we can visualize the spatiality of emotions on three different levels: Individual Emotion (the emotion of one individual in same place - temporal), Accumulated Emotion (the emotion of one individual in many places - spatial), and Collective Emotion (the emotion of group of individuals in many places). An understanding of the emotions of the city might enable us to enhance the overall quality of living.

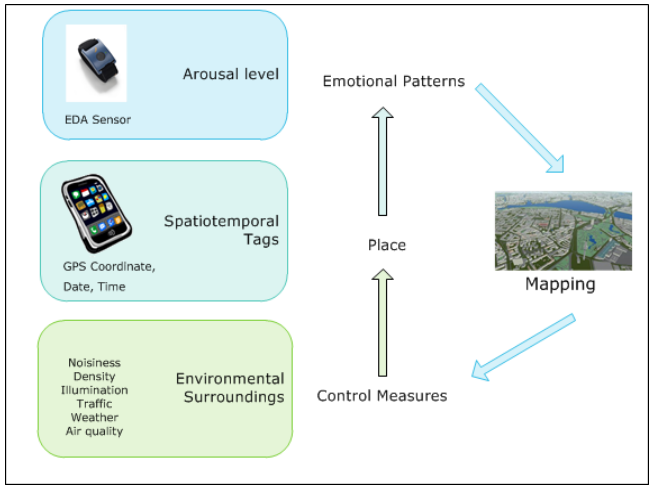

Figure 1 Sense of Space

To accomplish this, our approach will gather the required data using a wearable physiological sensor combined with smartphone in different locations at different times. By analyzing this data, we will be able to understand and track how a person feels and reacts to different places and to different environment factors. We will map and visualize the emotional response data by creating an emotional layer. This would help to illustrate the interdependency of the emotion and the environment, helping to find any influencing factors. We would also be able to use this system to quickly see the relations between environmental surroundings of place and the emotional states and behavior of people.

Conclusion

This research aims to model the way people feel and how they emotionally respond to urban space. In carrying out this research we are examine: how people feel in their surrounding environment, how their surroundings affect them? How can we use participatory sensing and mobile sensor technology in collecting data? And how the collected data might be analyzed and visualized in map-based fashion?

References

[1] S. Matei*, et al.*, "Fear and misperception of Los Angeles urban space: A spatial-Statistical study of communication-shaped mental maps.," *Communication Research,* vol. 28, pp. 429-463, 2001.

[2] C. Nold. (2006). *Bio Mapping* Available: http://biomapping.net/

[3] N. Alajmi, et al., "ShopMobia: Emotion based Shop Rating System," in Proceedings of the 5th International Workshop on Affective Interaction in Natural Environments (AFFINE): Interacting with Affective Artefacts in the Wild, Geneva,Switzerland, 2013.

[4] G. MacKerron, "mappiness. org. uk," 2011.

[5] *Glow* Available: http://glowapp.com

[6] R. N. Mody, et al., "WiMo: location-based emotion tagging," in Proceedings of the 8th International Conference on Mobile and Ubiquitous Multimedia, 2009, p. 14.

[7] L. Al-Barrak and E. Kanjo, "NeuroPlace: making sense of a place," presented at the Proceedings of the 4th Augmented Human International Conference, Stuttgart, Germany, 2013.