Urban Emotions – Tools of Integrating People's Perception into Urban Planning

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1 ABSTRACT

This paper introduces the research field "Urban Emotions" – an interdisciplinary approach combining not only spatial planning and (geo-) informatics, but also computer linguistics and sensor technology methods. A new set of methods will be formed for the area of urban and spatial planning, resulting in a fundamental change of the understanding of planning. One of the main objectives is the involvement of citizens into planning processes. Therefore, new techniques are developed to collect and analyse data on the emotional perception of space and provide it to the people and also planners. Not only the human perception in the context of the city, and the combination with human sensory processes are contents of this paper, but also the critical discussion of these effects to privacy issues. Based on the topics "mental maps" and psychogeography in combination with the field of digital emotional urban tagging, the potential of integrating objectively quantified emotions in the context of citizen participation will be explained. In the following, partly established and partly experimental methods for collecting and analysing "Urban Emotions" will be introduced. Based on two studies, the possibilities of transfering these methodsinto the planning praxis will be shown on the one hand and on the other hand the potential for further development for other disciplines will be more evident.

2 INTRODUCTION

Spatial Planing is a cross-section discipline that considers all spatial and social structures within in a city. In an ideal case, a good planning process weighs all public and private issues to minimize conflicts and to get a good planning result. Jane Jacobs, one of the pioneers of a bottom-up and people centric planning approach, concluded: „Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody" (Jacobs 1961, p. 238). The question is: How is it possible to integrate all of these issues into the planning process? Also how can citizens' perception of urban space be measured and how can new technological approaches help in this way?

The Urban Emotions approach figures out the use of new biostatistical and sensoring technology to develop a new method set, that creates a new point of view to the "city as a body" and can be used in in urban planning processes. A new understanding of planning, influenced by network society (Castells 1996; Benkler 2006) is described in the academic discourse (Streich 2012a), in which bottom-up participation processes with a proactive embedding of citizens is the core element. Also smart city concepts could be taken into consideration in these new planning approaches. The change from "digital cities" to "intelligent cities" was easy to follow, even the potential for spatial and urban planning. The possibility to collect geodata in near realtime and to generate information about spatial processes open up new possibilities in analysing cities. „Realtime cities" combine the physical world with virtual space over sensor networks and sensor technology. Forerunner in this scientific apporach is the SENSEable City Lab from Massachusetts Institute of Technology (MIT). They shaped the term „real-time-city" by creating dynamic visualisations, in which they presented the (body of) the city as a pulsing unit or organism. Projects like Real-Time Rome (Calabrese et al. 2010), LIVE-Singapore! (Kloeckl et al. 2011) and the Copenhagen Wheel (Outram, Ratti and Bidermann 2010) used ubiquitous senor technology (f.e. in Smartphones or over collected cellullar networ data sets) for a better understanding of humans interaction and mobility in cities. These spatial, temporal and spatial-temporal patterns help in research activities in identifiying urban processes and to characterize special social-cultural movements and developments. In all these cases, it is important to mention, that only citiziens can make a city really "intelligent" (Batty et al. 2012). This interaction between citizens and urban spaces in a digital society is worth to discover. „Urban Emotions aims to address this shortcoming by providing a human-centred approach for extracting contextual emotion information from technical sensor data

(measurements from calibrated bio-sensors) and human sensor data (subjective observations by citizens)" (Resch et al. 2015b, p. 200). The results should be used as a new kind of decision support system and can create a new perspective to ongoing planning processes (Zeile et al. 2014). „Like this, the realization of a Smart City is not only to be tackled from a technological viewpoint (as most previous research efforts did), but from a human-centred viewpoint that claims that a city requires "Smart Citizens" to be intelligent itself" (Resch et al. 2015b, p. 200).

3 STATE OF RESEARCH

The aspect of emotions in planning is a rather new approach even if planners and thinkers of 20th century had it always considered only using different wording. However, it was more closly linked with perception in planning, mental maps, psychogeography or even anthropocentric planning views. The mental maps studies, basically known from Kevin Lynch and the research of "The image of the City" analyse the „quality in a physical object which gives it a high probability of evoking a strong image in a given observer" (Lynch, 1960, S. 9). Lynch moves the observer in to the center of reflection and that gives his studies an anthropological perspective on the city. So Lynch sees the people moving in the city space to be as important as the structural and physical elements. „We are not simply observers of this spectacle, but are ourselves a part of it, on the stage with the other participants. […] Nearly every sense is in operation, and the image is the composite of them all" (Lynch, 1960, S. 2). The research on the city had a very visual perspective and did not consider – or sometimes only as side issue- other sensual aspects. Closly related to the mental maps is the psychogeography which came up during an urban transformation process in Paris in the 50s. In addition to lots of political groups which fought against the urban plans and the capitalism in this time (Castells 1975/2012 p 45ff.), the group of "Situationist International" was established, which had largely influenced the concept of psychogeography. Hart defines it as „a slightly stuffy term that's been applied to a whole toy box full of playful, inventive strategies for exploring cities. Psychogeography includes just about anything that takes pedestrians off their predictable paths and jolts them into a new awareness of the urban landscape" (Hart, 2004). The ideas of mental maps and methods of the Situationists have influenced a lot of research studies in the present time, using modern, innovative tools (mobile devices, Social Media, etc.) to explore the city space, e.g. the "Blake Walk" in London (Whitson & Whittaker, 2013, S. 2-3) or „Forschungsreisen International" in Vienna (dérive-Zeitschrift für Stadtforschung, 2015).

Topics like sensor-driven data gathering and human sensory assessment are, from a planning point of view, closely linked with spatial monitoring approaches. A distinction is made between inductive and deductive monitoring. Deductive monitoring is described as the observation of phenomena over a time span, integrated in a Geoweb-supported planning processes and organized by planning institutions who are interested in the gathered topic (Streich 2011, p. 235). "Opportunistic Sensing" (Andrew T. Campbell et al. 2006; Lane et al. 2008) is an example for deductive monitoring: Data from the direct spatial environment of the users is collected, analyzed and divided again instantly on the Internet. Sensor technology is "in situ" (Wetter 2009). Also, participatory sensing concept (Burke et al. 2006) describes a type of deductive, user centric, monitoring. It is based on the "crowdsourcing" phenomenon (Howe 2006; McConnon 2006; O'Reilly 2007), a predecessor of Goodchild's concept of "Citizens as Sensors" (Goodchild 2007) and his "Volunteered Geographic Information" (VGI). With these types of sensor networks, both, citizens and experts can share information and local knowledge about (spatial) phenomena.

The repertoire of methods for urban planning is significantly enriched by the use of such "sensor" technology; traditional deductive planning approaches are enriched by inductive ones, which are an expression of crowdsourcing processes in bottom-up planning mode (Streich 2014). "Most important, however, humans themselves have turned out to be excellent sensors. Many provide information without any extra effort, just by carrying around a mobile phone" (Siegele 2010, p. 6). Further, "they provide local information and site-based knowledge available [...] and users are thus equally to consumers and producers of information" (Roche et al. 2012). Traditional, deductive planning approaches are enriched by inductive and bottom methods, supported with sensor technology (Streich 2012b). A similar approach, close to Goodchild's "citizens as a sensor" is the "people as sensor" definition (Resch 2013). People as sensor represents a model in which not only electronic devices produce data sets, but people generate subjective measurements by recording their subjective, individual perceiption or observation. These "human sensors" can supplement or sometimes replace expensive and specalized sensor technology and sensor networks.

"This revolution in tracking human and other motion in digital form enables the collection of multiple attributes at the finest of scales of urban observation (…). This extends well beyond geography, however, to the collection of much non-geographic information which is nevertheless tagged to place and hence understandable in both spatial and temporal terms" (Batty 2010, p. 575). Some academic and economic projects are for example Nokia's "Wearable Eco-Sensor" concept (The Future of Things 2007), "On Line Disaster Response Community" (Laituri and Kodrich 2008), or "Lift Lab" (Girardin et al. 2008).

Affective perception of people's environment in combination with crowsourcing approaches was investigated by Klettner (2013). Though, in this approach, there is no realtime sensor technology. Realtime visualisations of geo-social networks or social media like Flickr, Twitter, Foursquare, Facebook, etc. was made by Neuhaus (Neuhaus 2011). A systematical evaluation of spatial or planning relevant issues was not realised. The use of psycho-physiological measurements in urban space, for instance, to map emotions was made by Zeile et al. (2009), or with the help of smartphone data and social media data to get collective human behaviour patterns by Sagl et al. (2012). „These new data and information layers can provide additional insights into the development of both the physical and social structures of inherently complex and dynamic urban environments" (Resch et al. 2015b, p. 200). In research fields of security, aspects of perception of urban spaces and subjectiv felt security is getting more and more important. Salesses et al. (2013) examine, how the perception of safety of test persons changes during watching randomised Google Street View image pairs. The ratings were aggregated in a city map and compared with criminal statistics. The result was a large-scale image of perceived safety into four cities (Boston, NYC, Linz, Salzburg). The methods based on a subjective rating of a statistical situation and the test persons were not in situ. There was no embedding of people, the situative urban context was also not considered.

Despite of all advantages to embed actively "human sensors" into planning processes, privacy issues in combination with spatial planning are very important. There were only general statements concerning privacy, f.e. by Roßnagel (2007) and Gaycken (2013). How the planning discipline should handle these problems is still only posed as a question (Streich 2011, p. 147).

4 METHODOLOGY

Urban Emotions is providing a human-centred approach to extract contextual emotion information from technical sensor data (measurements from calibrated bio-sensors) and human sensor data (subjective observations by citizens). The results can be used in urban planning for decision support and the evaluation of ongoing planning processes (Zeile et al. 2014). It is a human-centred viewpoint based on the insight, that Smart Cities need "Smart Citizens", and technology should only support them.

Figure 1 illustrates the Urban Emotions approach, combining four steps: 1) detecting emotions using wearables, 2) "ground-truthing" these measurements using a smartphone-based the People as Sensors Smartphone App in near real time, 3) extracting emotion information from crowdsourced data like Twitter (detecting the type of emotion), and 4) correlating the measured and extracted emotions. The mapped information can then be used in urban planning processes (Resch et al. 2015b).

The Urban Emotions concept is of a trans-disciplinary nature. It consolidates the know-how and perspectives of at least five additional scientific disciplines, namely GIScience, computational linguistics, sociology psychology and computer science. The result is a tool with a direct feedback of citizens in ongoing planning and design processes, and represents a new form of a decision support system.

5 MODES OF MEASURING PERCEPTIONS AND EMOTIONS

5.1 Tagging

Tagging is an easy way to get information from users concerning urban phenoma of a city. An evaluated approach is the RADAR Sensing concept (Zeile, Memmel and Exner 2012). Based on the RADAR Infrastructure (Resource Annotation and Delivery for Mobile Augmented Reality Services), the user can contribute and manage arbitrary types of geocontents. With RADAR, it is possible to process very simple representations of geocontents and to use complex and multidimensional objects. One result of this open and flexible structure is the RADAR SENSING App. A detailed description of the system architecture and system features is available online (Memmel 2015), the use in urban planning is described by Zeile et al. (2012). The RADAR SENSING app was developed for AndroidOS and JSON allows efficient processing of

information to exchange arbitrary data types. The users only have to register using the RADAR-SENSING Web frontend and install the RADAR SENSING app. There , they can rate positive and negative votes by using predefined categories. If there is one category missing, a free one is also possible. After the vote, the app detects the user's position using multiple sensors (preferably GPS) and displays the position on a map. If the sensor did not locate a precise position, the user can still do a manual correction of the position. By switching back to the RADAR Web Interface, a nearly realtime visualisation of the tagged point is possible. It is free to chose between a presentation of all points or a density map of the tagged attributes (Zeile, Memmel and Exner 2012).

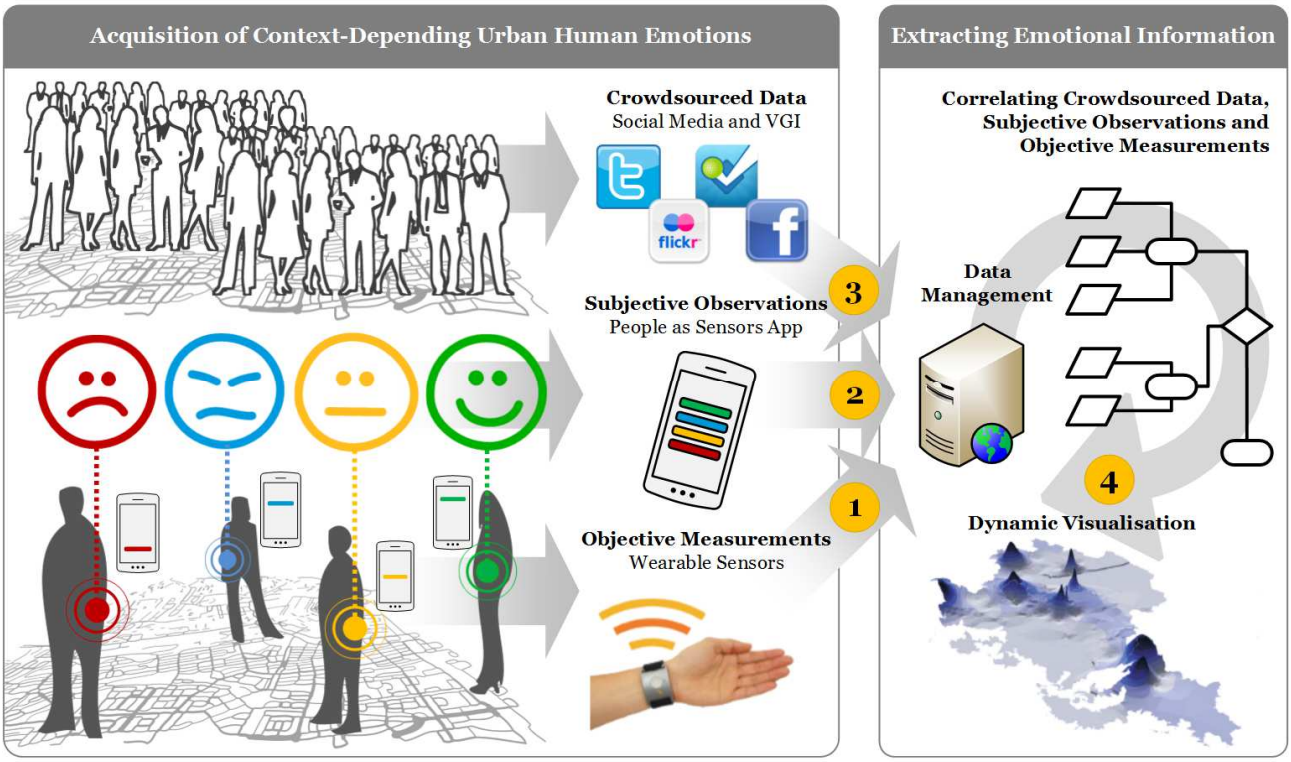

Figure 1: Urban Emotions concept: 1) emotion sensing, 2) ground-truthing using People as Sensors, 3) extraction of emotion information from VGI, 4) correlating measured and extracted emotions; plus visualisation and enrichment of urban planning processes (Resch et al. 2015b)

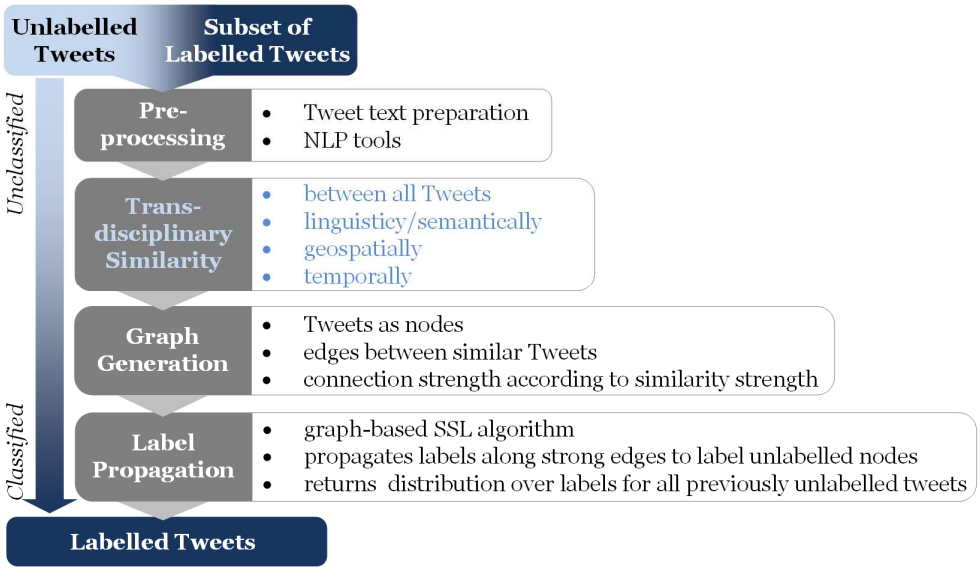

Figure 2: Label propagation algorithms for unlabelled tweets to identify classified emotions in tweets (Resch et al. 2015b)

5.2 Extracting Social Media

The basic concept of extracting emotions from VGI was introduced by Resch, Summa et al. (2015b). The extraction of emotion information from user-generated information, such as Twitter, Flickr or Facebook posts is a promising research direction. In particular, the development of interdisciplinary methods as a link between Geoinformatics and Computational Linguistics is the main focus. Figure 3 shows a recently developed method to assign emotion categories automatically from Twitter Tweets (Resch et al. 2015b).

In Figure 2, a method is presented using a label propagation algorithm to identify emotions in tweets and classify these into appropriate categories. An integrated algorithm was created using methods of geoinformatics and computational linguistics. This integrated approach based on the concepts of distances, clusters and similarities exist in both domains and can be combined natively in a graph-based algorithm.

5.3 Groundtruthing – People as sensors app

The Operation mode of the groundtruthing app is explained in detail by Resch, Sudmanns et al (Resch et al. 2015a): Similar to the tagging approach, users have the possibility to submit their personal impression of a situation. The new aspect in this app is, that also physiological sensor data can be gathered and combined after submitting them via Sensor Observation Service (SOS) to a central server. Because of the modular architecture of the app, it is possible to use it as standalone, “only impression submitting” mode, or to link new technical (environmental) sensors. If the user wants to be instantly informed about the measurements, the collected datasets have to preprocessed, harmonised and checked continuously. At the same time, the biostatistical data have to be set in relation to the collected subjective feelings, to get qualitativ information about the sensor detected arousal or perceiption of the test person. With the combination of theses datasets, the “type of emotion” can better be classified, the trigger of an emotion can be idenitified (better) and even the intensity of emotion can be analysed (Resch et al. 2015a, pp. pending).

Simply summarized, the workflow of the app follows these five steps:

(1) Notification (time based, location based, trigger based) to give a rating of the personal perception or emotion

(2) Statement of Emotion, detecting the potential spatial context and rating the intensity of emotion

(3) Automatical tagging of place and time

(4) Transmission to the server

(5) Visualisation (in near real time) to get a visual feedback

The app works like a link between digital, automatical physiological sensor data and the personal rating of the situation.

5.4 Biostatistical Data

Like mentioned in the above section, gathering of bio-sensor data is / could be the core element of urban emotions. This is called psychophysiological monitoring, and measures the arousal of a person over the change in body reactions (body physiology). A variety of assesment methods for measuring emotions is available (Schumacher 2014). Identifying “emotional stimuli” with a picture database , the so called IAPS (International Affective Picture System), in which a collection of pictures shows different human experiences and the users can rate them with the attributes ‘positive’, ‘negative’ or ‘neutral’ (Bradley and Lang 2007). The ‘startle reflex’, a peripheral physiological parameter is another measurement method. The idea is, that negative stimuli can be detected by a reflex of the neck or the eye (eyeblink). This reaction can be measured by two electrodes, placed under the eye. This setup can measure minimal muscle tensions which are an indicator of negative stimuli (Geyer and Swerdlow 2001). Like the IAPS, the startle is not suitable for the use in “real world”, outside a laboratory. Therefore, only the following psychophysiological methods are proposed at the moment: Measuring a combination of body temperature and skin conductance (Stern, Ray and Quigley 2001; Boucsein 2012) or using the additional heart rate (Fahrenberg and Myrtek 2001; Schächinger 2003; Myrtek, Aschenbrenner and Brügner 2005). A lack of these methods is (still) that only negative emotions can clearly be identified as “stress”. „According to emotion researchers, when a negative experience occurs, the skin conductivity increases and the measured skin temperature decreases” A well-known example in extreme mental stress situations is known as ‘cold sweat’ (Bergner and Zeile 2012).

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6 CRITICAL ASPECTS ON DATA COLLECTION

Dealing with such sensitive data is a huge challenge for the research. The user is permanently in a kind of conflict between participative motivation and concern for privacy. The postulated freedom in the network is equally exposed by commercial companies who use the data for their own purposes (Caesar, 2012). This dilemma can also be found in the use of Internet, Smartphone and related devices where "lack of clarity, commercialization and information overload have to continiously and critically observed. Nevertheless, it can be stated that the benefits of using social media in terms of legitimacy, transparency and democratization through citizen participation outweigh "(Caesar, 2012 p 84).

In an empirical study on the use of sensing applications and active involvement in research of mobile users, conducted by Ludwig and Scholl, it was outlined that the fear of the user that data is accessed by other users or even companies is a huge barrier. Thus, it is necessary to use „appropriate communication tools to inform about the intention of required access. Otherwise, the danger is that users do not begin or end participation "(Ludwig & Scholl, 2014: 148). The Chaos Computer Club called the Smartphone one " a location bugging device". What Smartphone data can show and especially tell about us and our behaviour, has been demonstated already by several research studies. It is obvisous that the user becomes more and more sceptical – and this "only" considering location data. As a mobile user, he probably produces the most sensitive data that may be collected in real time. Adding other parameters such as private messages or biostatistical data, even more data protection is requiered.

The concerns about data protection and privacy require a more detailed analysis of the challenges and possible solutions. It is less about technical hurdles, but rather to raise awareness of the user of the dangers, but also the potentials for the participation in city and urban planning. The benefits of sensor data for urban planning have to be shown to the users. How Shilton describes: "Participant engagement in privacy decision making must also be fortified by supporting social structures" (Shilton, 2009). It should therefore be noted that apart from technical protection mechanisms rather the people and transparency, openness and awareness towards the user should be addressed. Campaigns, public debates and blogs can contribute to social acceptance, as well as accountable consent forms (Shilton, 2009).

7 CONCLUSION

The research of Urban Emotions will contribute to the involvement and participation of citizens in the spatial planning. Already in the 1960s, researchers elaborated the question of how the perception of urban space could be used in the planning process. The toolset of methods for planners at these times was mainly limited to questionnaires, interviews etc., but all-embracings tools for geostatistical analysis were missing. This situation has changed radically nowadays. New technologies such as smartphones and biostatisical devices now offer ways to cope with participatory processes in a more effective and human-centered way. The objective and subjective measurements of human feelings and perceptions in terms of urban circumstances like architecture or traffic represent the basis for the extraction of contextual emotion information in a fine-grained spatial and temporal resolution. Technological advances in sensor technology, smartphones and networks as well as the evolution of web 2.0 and social media enable new opportunities for networking and the collaboration of different research domains - these possibilities are not limited to geoinformatics and spatial planning. The potential applications for urban planners are manifold and lie especially in urban design processes, but also in safety issues in traffic planning for example. A vision, from a planning perspective, is, that the results of these measurements will be part of weighing process in public decission processes in the future. Contextual emotion information can be a new type of validation in urban monitoring processes, if the stakeholders and the government are open for this innovative planning approach (Resch et al. 2015a). Though, privacy issues have to be discussed in an open and transparent way to inform and clarify the methods. Furthermore, questions concerning the technical implementation are as important as the ethical or privacy rights. Spatial planning should recognize these potentials and the potential risks in order to create an embracing participation process.

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