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Urban Emotions and Realtime Planning Methods

Peter Zeile

(Dr.-Ing. Peter Zeile, Karlsruhe Institute of Technology, Institute of Urban and Landscape Design | STQP, peter.zeil@kit.edu)

1 ABSTRACT

The Urban Emotions approach combines methods and technologies from Volunteered Geographic Information (VGI), Social Media, sensors and bio-statistical sensors to detect people's perception for a new perspective about urban environment. In short, it is a methodology for gaining and extracting contextual information of emotion by using technologies from real-time human sensing systems and crowdsourcing methods. "Real-time planning" describes a system in which planning disciplines get a toolset for a fast and simple creation of visualization or simulation from municipal geodata in a consistent workflow. This includes applications from Virtual Reality, Augmented Reality as well as the above mentioned combination of real-time humane sensors and urban sensing systems. Due to the fact, that a real existing city never corresponds with a laboratory situation, Virtual Reality can be one of the solutions to fill the gap for detecting people's perceptions concerning design, while filtering other unintended side effects. Insights and results from Urban Emotions project, granted by German Research Foundation and Austrian Science Fond, will be presented in this contribution. It is based on a German contribution, published earlier this year (Zeile 2017).

Keywords: walking, 360° cameras, people as sensors, virtual reality, cycling

2 REAL-TIME PLANNING

Real time planning and the development of simulation and visualization methods in urban planning was published in 2010 (Zeile 2010). This contribution gives a short overview, how new technologies support this approach contemporarily, and how they can be used in urban and spatial planning.

"Real-time planning is defined as a dynamic system, in which users be informed with an interactive experience concerning planning principles and issues" (Zeile 2013, p. 26). Urban planning should be improved through clearness, transparency and an easy understanding in a – if possible – three-dimensional environment (Zeile 2010, p. 106). A targeted and tailor-made data processing and data treatment especially build for use in urban and spatial context are the core elements of this method. „Not technology of presentation is the key, but technology has to support communication for a better understanding of planning goals and an implementation in urban areas. Urban planners need to have the skills to use this method and also must have an holistic knowledge in traditional planning methods and the use of technology for their daily work" (Zeile 2013, p. 26).

Another approach in this context is "Live Geography" (Resch et al. 2010b) with a "near real-time" (live) analysis of spatial data from sensor networks. All the essential components for a near real-time analysis were covered in this method: stationary sensors (Sagl et al. 2012), intelligent mobile sensors (Resch et al. 2010a) and sensor fusion mechanism for the integration of data (Resch 2012) as well as web data processing for real time decision support systems (Sagl et al. 2012). In conclusion, "Live Geography" is main core of "Urban Emotions-Approach" (Zeile et al. 2014). Previous studies, described as "emomaps", were also integrated in the "real-time-planning" approach (Zeile 2010, 216 pp.). Linking element is the so called "plan-communication" (Fürst and Scholles 2008, p. 198), an adopted method of the well-known "communication theory" (Shannon and Weaver 1949) for spatial planning. The contribution "Sich ein Bild machen" (Berchtold 2016) is one contemporary example of knowledge which workflows in using GIS are essential for planners today with a focus on applied urban GIS workaround.

To sum up, spatial analysis should visualise changes in spatial structures over time. Discussions concerning slow processes, but in case of urban environment, fast changes with their own dynamics, can be organized (better) with support of these tools.

3 DYNAMIC AND SPACE

In general, there is a simple difference in visualisation methods dealing with the aspect of "dynamics":

- Visualisation of dynamism of spatial processes

- Creating virtual environments

Dynamics of spatial processes work with data streams along a time axis – “gathering a (spatial) phenomena over time” (Streich 2011, p. 189) – also known as “spatial monitoring”. In virtual environments, users have the possibility to emerge immersive dynamic impression by using the so called “first person view” (FPV). Consequently, the following two chapters deal with these topics. A brief introduction to the theme field of Augmented Reality and Virtual Reality in urban planning and architecture can be found in Broschart (2013) and Höhl & Broschart (2015).

3.1 Virtual Reality

Well-known technology for representing dynamics from “ego perspective” is the Virtual Reality. Virtual reality methods (VR) represent models of real situations in a digital environment or even manipulate them for planning purposes. Origin VR concepts were – compared to today’s comprehension- not reduced to two senses “looking” and “listening”, but were more immersive seen in a more open context and integrated senses like “touching” via specially designed interfaces (Streich 2011, p. 229). In addition, former VR environments were characterised by high hardware requirements and special output devices (Wietzel 2007), whereas actual stereoscopic VR environments are using standard desktop computers and VR eyewear such as the Oculus Rift or HTC Vive, out of the box customer products. Even low budget systems, the so called card-boards, can turn a smartphone into a VR glass, which can be used in planning processes and in a multidirectional communication process with citizens (Dübner 2014). New optical systems such as 360° cameras as well as available 3D city models i.e. based on Google Earth can create a virtual, immersive environment in a fast workflow (Folz et al. 2016). Especially GoPro360° camera seems to be suitable for a quick setup of existing situations. Omni Rig is a synchronized, six camera array, which stitches the collected clips in an automatic post-processing to a virtual 360° movie.

The following combinations have proven to be successful and suitable for "real-time planning":

- Sketchup, Unity Engine, and Oculus Rift (Dübner 2014),
- Sketchup with Kubity (Folz et al. 2016)
- Standalone VR without glasses, creation with City Engine and visualisation via Lumion (Broschart 2013; Buschlinger et al. 2016)
- Youtube 360 ° -VR (Folz et al. 2016), which is a kind of precursor to virtual reality

Especially Unity3D-Game Engine offers a good to handle workflow to create virtual 3D-models for VR-glasses out of (municipal) geodata or out of architectural drawings.

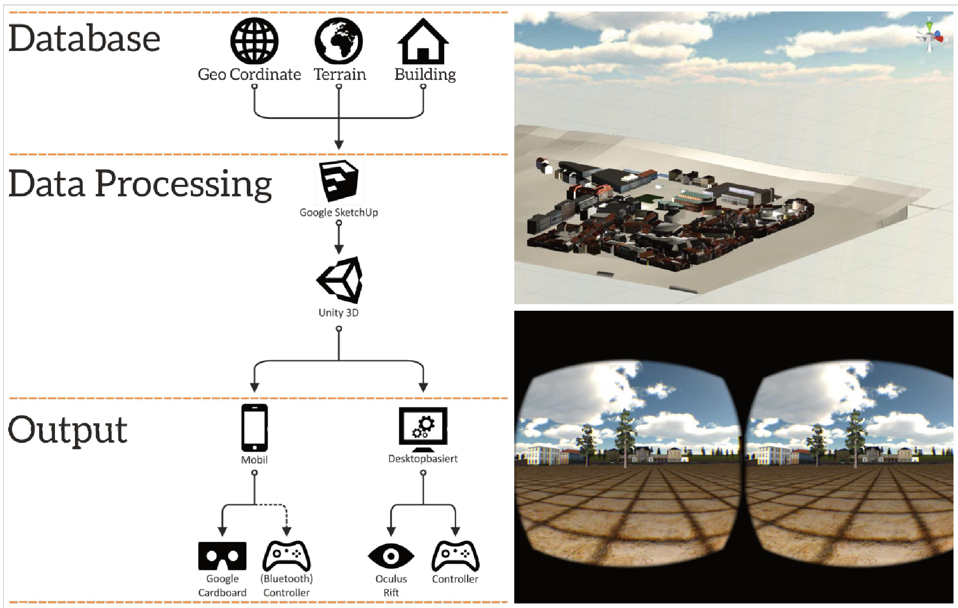

Fig. 1: Exemplary workflow via Unity3D (left) as well as the integration of the 3D model into Unity and as a binocular representation in Oculus Rift (Zeile 2017).

The engine processes almost all known 3D-formats, and also supports technologies like bump mapping, texture mapping and ambient occlusion (Unity Technologies 2017). A simplified workflow about integration of a 3D city model into Unity game engine as well as its output to a VR device is shown in figure 1.

A characteristic for planning processes is that there is usually not "one way" or the blueprint for an always perfect VR visualization. In many cases, a try-out of new techniques for new planning approaches is necessary. A mentionable example for this “adoptive approach” is the workflow of modelling with City Engine and Lumion (fig. 2). This workflow was tested in the "Urban Cable Cars" project, which deals with different visualisation tools for communication processes during the planning stages of integrating a cableway in urban areas. It started with the idea of a simple photomontage of the design impacts of the cableway to the city. Like always in iterative processes, new requests came up, requests like photorealistic films, virtual reality as well as mixed reality technologies seemed to be an adequate instrument (Fig.3). Thus, it was essential to develop a method which allows to implement all requirements with the same data and less additional processing steps quickly (fig. 2).

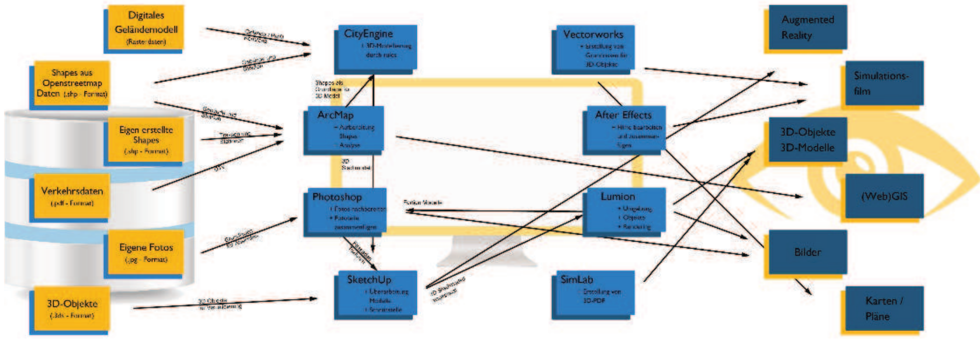

Figure 2: Processing of digital (geo-) data during the Urban Cable Cars project (BUSCHLINGER et al., 2016).

Figure 3: 3D city model of the city of Konstanz, generated in CityEngine (1) and visualized as a real-time model with planning-relevant content in Lumion (2), mixed reality film from a car (3) (BUSCHLINGER et al 2016).

3.2 Augmented Reality

In contrast to Virtual Reality methods, in which all content is captured and visualized digitally, Augmented Reality overlays digital content with reality. A complex modelling of the whole physical environment can be avoided in an ideal case. Real situations are equipped with additional digital information, so that all the objects can interact and communicate with CPU. So, a digital sketch of a new building can be overlaid in real time with a real situation through superimposition, like in a traditional photomontage (Streich 2011, p. 229).

The reality is thus "expanded" or "enriched". Milgram & Colquhoun refer to Augmented Reality as the "computer-assisted superposition of human sense perceptions in real time" (Milgram and Colquhoun 1999; Zeile 2010, p. 28). AR systems superimpose the reality with visual, acoustic and haptic information in real time (Höhl 2009, p. 10). "According to these methods, it is no longer necessary to model the complete environment, but it is theoretically conceivable to project only the virtual model of the project into the real existing reality. Through this interaction between virtual and real elements, the degree of abstraction of the representation for the interested viewer diminishes, so he can get quickly into the scenery " (Broschart et al. 2013).

A system for the representation of augmented content consists of four elements (Höhl 2009; Zeile 2010; Broschart 2013):

- render unit, i.e. a computer with software that processes and visualises the data,
- a tracking system that can locate the user/viewer in the virtual space. Depending on the system, this positioning can be done via satellites, a virtual coordinate or via an image comparison with the environment,
- recording sensor, usually a camera system as well as
- a display component.

Particularly in the dynamic market of display system, four systems have been developed which are suitable for real-time planning:

- Optical See Through (OST), with the well-known representatives such as Google Glasses or Microsoft HoloLens.
- Video See Through (VST), as in principle the HTC Vive or Oculus Rift, if the real situation is recorded with a camera and the possibility of overlaying with virtual content is given.
- Projected Augmented Reality (PAR), in which virtual information is projected onto a surface.
- Monitor AR (MAR), where either a monitor or a mobile display is used to display the virtual content, in example on a smartphone or tablet.

Due to the high availability of smartphones and tablets, a number of apps have emerged which can display these contents. However, the disadvantage every app needs its own programming environment, the mechanism of creation, georeferencing and display of information is quite different. One solution for this purpose is the RADAR platform, based on the ALOE environment (Memmel et al. 2010; Memmel 2015a, 2015b). Via a central backend, all information with geo-coordinates can be collected and exported to apps like Junaio, LayAR or Wikitude via a corresponding pipeline including the augmented model in L3D format (Fig. 4).

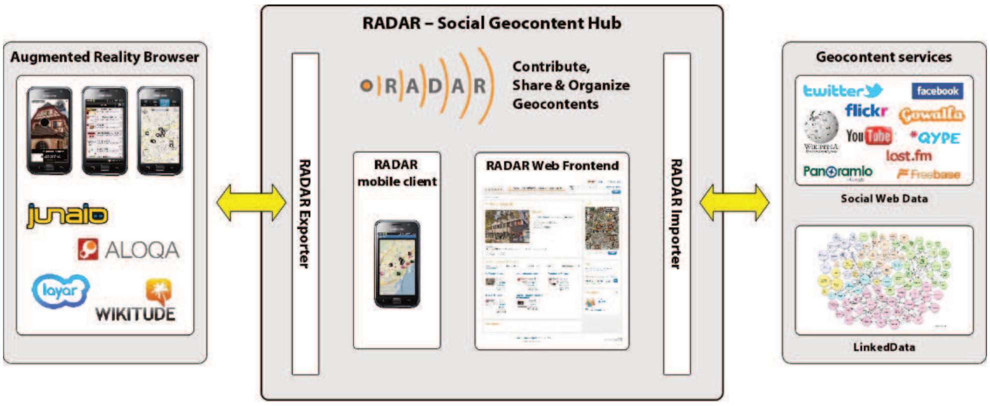

Fig. 4: Structure of the RADAR Social Geocontent Hub including an export option to Augmented Reality Browsers (Memmel and Groß 2011)

A short presentation of suitable software solutions for spatial planning and architecture, evaluated by Broschart (2013), follows up, including software like Layar POI, Layar Vision, AR Media and Sightspace3D.

Layar POI is something like the "classic" augmented reality app for smartphones, which detects the position of the viewer using GPS coordinates. It is possible to stream informations, audio and video files as well as 3D models from the server (Fig.5,1). On the other hand, Layar Vision works independently of GPS signal: the position of the viewer is detected solely by image recognition mechanisms (image markers). The app scans the environment via the camera sensor permanently and provides augmented content as soon as the marker is detected (Fig.5,2). A disadvantage is that this technique only works at predefined viewing angles and is also dependent on light intensity, contrast and season. Both versions can only stream the content, local storage is not possible. This gap fills AR Media, where a local storage on tablet or smartphone is possible. Almost all common 3D formats can be exported and visualised with the help of a QR code and marker representation (Fig. 5,4). Sightspace3D also saves 3D models locally, but users have to position the model on the screen manually. In principle, every model can be displayed at the desired location and moved in real-time on the tablet (Fig.5 (3)).

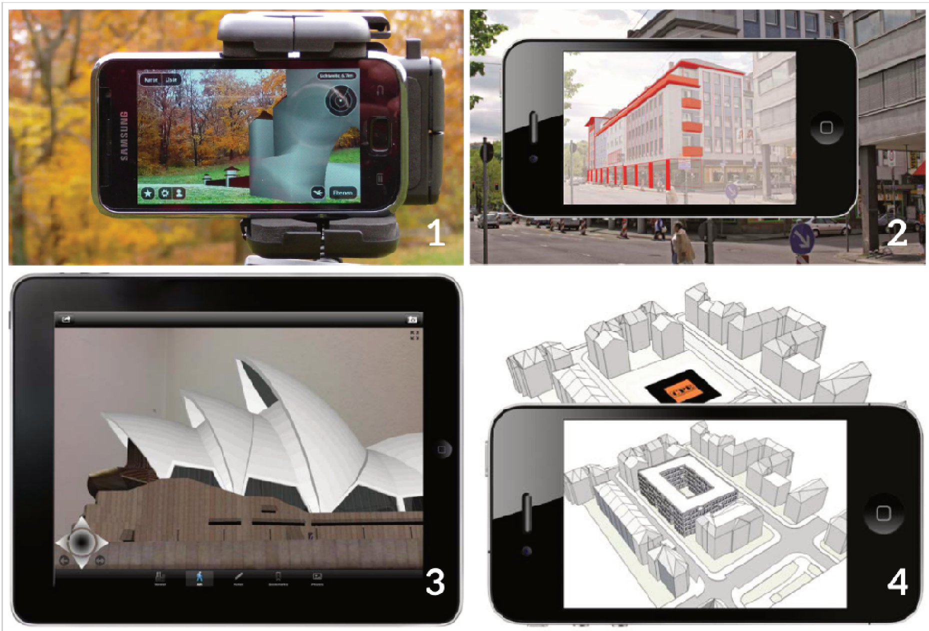

Fig. 5: AR-Software Solution: Layar POI (1) with GPS positioning, Layar Vision marker-based position recognition (2), Sightspace 3D with manual positioning via screen (3) and AR Media with local stored 3D files and marker based recognition (4). (Zeile 2017; with figures from Broschart 2013)

The most important issue using these technologies is, that planners need to think about the planning principles and targets before the decision of one visualisation method. Not the technologically “nice2have”, but a suitable and resource saving workflow is the key for a successful project. For textual information a simple GPS-based solution is sufficient. With increasing details and complexity the requirements for the visualisation methods arise also.

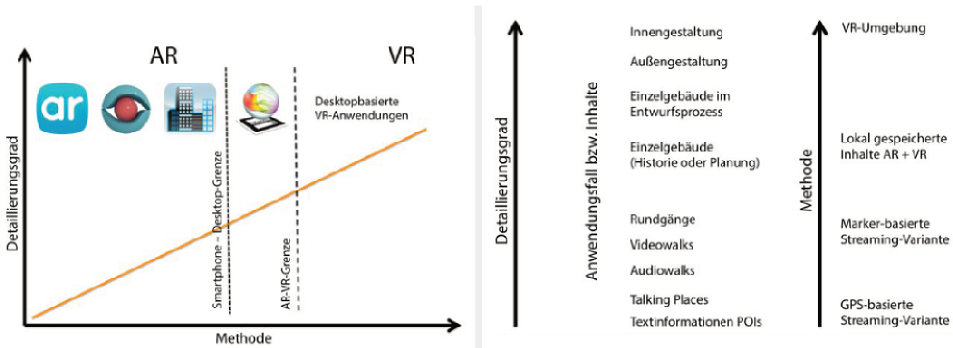

Fig. 6: Overview of the estimated workload of AR and VR technologies for the potential use in real-time planning (Broschart 2013, 62, 63)

However, all presented methods are examples of first-person-view. Laymen can interpret ambiance of new generated spaces and situations much better than on traditional 2D drawings or 3D stills. Translation of

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design and the immersive experience of city support communication processes in spatial planning (Petschek and Lange 2004).

3.3 Urban Emotions & Urban Sensing

Another option to visualise urban datasets in a dynamical way are "people centric urban sensing systems" (Campbell et al. 2006). In combination with Volunteered Geographic Information (VGI) (Goodchild 2007), it is possible to collect, analyse and to share data from users.

The project "Urban Emotions" (development of methods for production of contextual emotion information in spatial planning with the help of human sensory assessment and crowdsourcing technologies in social networks) takes up this approach precisely as well as the discussed topics in previous sections. To keep in mind: the objective is to do "real-time planning" and how to combine approaches of citizens as sensors with virtual environments.

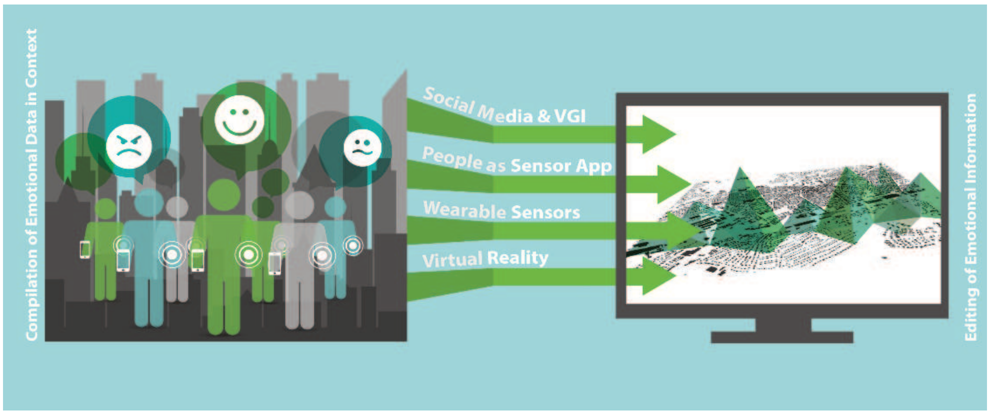

Fig. 7: Schematic overview of the Urban Emotions project, which will combine approaches from VGI, the use of wearables and VR approaches into a real-time planning system.

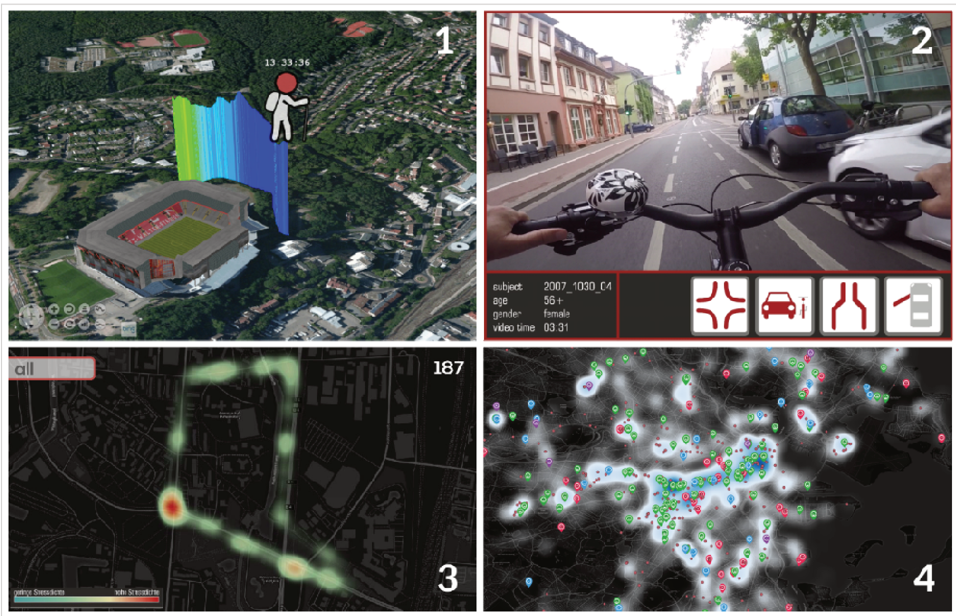

Fig. 8: Visualization of a test-run using skin conductivity in "Geovisualizer" (1); camera recording during a test-ride (2), aggregated datasets as a heatmap (3), labelled Twitter feeds of emotions (4) (Zeile 2017; Groß and Zeile 2016b; Resch et al. 2016)

If "people as sensors" are integrated into a project - as a measuring tool -, the question is: Which measuring system is the right one? The range spreads from simple survey to the evaluation of social media data as well as collecting and analysing biostatical data. An overview of technologies available for recording vital/ biostatistical data is provided by Kanjo et al. (2015). Kreibig (2010) gives an overview, how vital data correlate in detection of emotions. For use in public space, the approach to use simple data of the autonomous nervous system for the identification of negative excitation - defined as an emotional construct of anger and anxiety (Kreibig 2010) - the parameters "skin conductivity" and "skin temperature" are suitable (Rodrigues da Silva et al. 2014): If skin conductivity increases and the skin temperature decreases shortly after, people feel a negative arousal, well-known as “stress". After a geolocalisation of these “stress spots”, planners get maps which indicates potential locations in the city, which should be checked by planners in case of a "wicked problem" (Rittel 1973) (Figure 8 (1)). In combination with cameras, recording an “ego perspective”, individual runs of test persons can be examined for the stress-trigger (Fig. 8 (2)). A Kernel Density Calculation aggregates all data (Figure 8 (3)) and provides a first indication of hotspots of planning interventions (Zeile et al. 2016). In combination with an evaluation of social media like Twitter feeds (Summa 2015; Resch et al. 2016), additional information can enriched the planning process (Fig. 8 (4)). The topic of cycling, as a new / rediscovered concept of mobility is also suitable for "Urban Emotions" research (Höffken et al. 2014; Groß and Zeile 2016a). However, the intention is not to replace traditional planning methods but rather providing a new kind of indicator system for an “early warning system”.

4 CONCLUSION / OUTLOOK

The above-mentioned techniques are additional components for the detection and visualisation of spatial phenomena as well as design tasks within the context of urban planning. They can improve knowledge of spatial processes and make them intelligible during communication with citizen. As already pointed out, these workflows are not intended to replace formal processes, but can support context of informal procedures. Weighing has to take into account all available sources and information in planning process, so, according to the author’s opinion, even relevant social media data, if it can be easily processed, has to be one factor for consideration. Legal aspects like the question of using only clear names in digital communication in digital public panels or the issue if only residents have the right of an expression of opinion concerning a local task have to be discussed in the future.

In a broader sense, biostatistical data could also become relevant issue in the weighing process in the future. For example if all followers of “Quantify Self” movement provide their biostatistical data, this would be at least also a source of consideration within planning processes. With one limitation, that the provided data will be used for the detection of urban deficiencies. Anyway, there is no doubt that personal data have to be protected and all relevant privacy issues have to receive attention.

5 ACKNOWLEDGEMENT

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