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Towards Emotional and Opinion-Based Layers in City GIS

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1 ABSTRACT

Planning and building games, such as the popular SimCity series, allow the player to virtually manage and control their city. Although such models do not claim to represent a real-life city, they typically offer some capabilities found in modern GIS applications. For instance, thematic queries allow players to retrieve information on the current status of their virtual city. The results, e. g., information on the state of happiness of citizens, can provide valuable clues suitable for planning decisions. We argue that even these futuristic sounding functionalities, are on their way of becoming reality. Research has shown methods to capture (almost) real-time "mood data" via the Web. Also, recent developments in participatory GIS have made it possible to directly communicate people's perceptions of their environment to authorities. We point out how modern technologies could be utilized to extract information similar to the ones found in city building games for the benefit of a sustainable and more democratic urban development. We therefore draw the outline of two possible solutions for achieving such information layers.

2 INTRODUCTION

The planning process is generally structured into several phases: data gathering, data analysis, policy making, and maintenance. These are often carried out in a consecutive order, although they may also happen simultaneously (Kelly, 2000) Certainly all the latter build upon the very first, which therefore poses a crucial pillar of the planning dogma. We can assume that probably the most important factor for a planning process is the information gained about an area, since no decisions or actions can be seriously considered in absence of some sort of ground data. Consequently, planning decisions are to a great fraction determined by the information used as input and the interpretation of it.

Since in social systems like urban environments it is impossible to attain “complete” information, probably the biggest challenge is to attain the most relevant data. A planner can only hope that crucial pieces of information were not left out, in order to have the best possible foundation for further analysis. The data gathered and its survey methods are just as diverse as the environment itself. Common examples of information typically used in urban planning are demographic projections, statistical data, environmental measurements or public surveys.

In modern planning the notion of public participation has gained popularity and is widely accepted as a tool for problem solving and sustainable development, but also as a valuable resource of information. This is mainly due to the fact that planners became aware that their main purpose is to serve the residents of an area and, as such, to communicate and involve them into the decision taking process. Planners also recognized that the population can provide valuable “insider” information on a particular area, which they might lack. (Bischoff et al., 2007) The range of the methods used for such processes include working-groups, interviews and increasingly (Web Based) Participatory Geographic Information Systems (GIS) projects. In order to maintain, handle and analyze such comprehensive amounts of information, GIS-based tools are used, e.g. , spatial decision support systems (SDSS) or planning support systems (PSS) (Batty and Denshan, 1996). In GIS similar information, i.e., of the same geometric type, are usually grouped together in layers. This makes both the storage of information more efficient and the modeling of relationships between entities easier (Longley et al, 2011).

The idea of displaying and storing information in the form of layers is not new and certainly not limited to GIS. In fact, computer games implemented such ideas before the advent of commercial GIS. One example worth mentioning is the popular simulation game “SimCity”. The game enables the player to plan and build a city and simulates the development of it. The player is provided with different layers of information about the city and is supposed to act in response to it. Examples for such layers include information on population density and growth, land value, and many more. Some of these have become reality and are implemented in many city GIS providing valuable insight on the current state of a city. One particular layer, however, although available in Sim City is not yet implemented in commercial applications. This layer, called “Aura

Layer" provides information on the mood or emotions of people. We argue that spatial (geo-coded) emotional data on citizen can provide increased benefits to city planning. We propose ways how such a layer could be come reality. We also discuss recent efforts on emotional data mapping and discuss their potentials.

3 BACKGROUND

3.1 GIS and SIM CITY

Sim City, first introduced in 1989, enables the player to build and modify a city from the scratch. The game is a convincing simulation of an urban environment and was therefore even used as a tool for teaching urban geography (Adams, 1998). The game's interface consists of a bird's eye view and a tool bar allowing users to retrieve information (queries) on the status of their virtual city. Very interesting is the fact that the game enables the user to acquire map based information about the city by switching through layers, view plots, and charts. Examples include:

- Crime Data
- Zoning
- Electricity Grids
- Drain system
- Population density and grow
- Land value
- ...

These layers do strongly correspond to the spatial data currently available for most Western city councils, although in variable quality. Sim City and modern GIS resemble each other, both in terms of functionalities and looks (similar visualization). Consequently, one can argue that Sim City's first version, already gave an idea on how the information of a city might be used for planning in near future. Even the "real-time" nature of the views in the computer is close to become reality. Concepts such as "Live Geography"(Resch et al.,2009), are suggested to implement a real-time city information system utilizing a variety of sensor networks. While most of the layers available in the original Sim City are more or less available for city planning already, one of the most interesting is not.

In its third installment, "Sim City 3000", a layer displaying the emotional state of the city inhabitants was introduced. The so called Aura-layer, visualizing the happiness of your fellow virtual citizens, is not something a city council would call a main data set. In the game, however, this layer can give the player valuable information on where to act next. Particular unhappy areas may require additional investigation to identify potential problems meaning that emotional data has a geographic location. The computation of emotional information is based on several parameters within the game, e.g., pollution or crime levels. Sim City uses algorithms to calculate a happiness index, similar to typical statistical indexes. Unlike Sim City, where an emotional index is calculated we would like to emphasize ways how this can be done by means of data acquisition carried out by people.

Fig. 1: Similarities between Sim City 2000 (released 1994) and Google Earth (released 2005)

3.2 Public Participatory GIS (PPGIS) and WEB 2.0 as a means of emotional data acquisition?

A problem that arises when talking about spatial emotional data is how the actual data acquisition should look like, i.e., what technologies or tools can be utilized? Certainly, there need to be some way of reaching out to the public in order to retrieve and interpret their emotions or opinions towards a location. Probably the closest attempt to retrieve such information is surveys, as used by many planning authorities. Surveys, however, are rather costly and very time intensive and mostly focus on specific issues. There is no general way of retrieving emotional or opinion based data. The question is: Can new technologies carry the resources needed for the acquisition of such data?

PPGIS for example are an attempt to introduce spatial technologies in order to create a platform of communication between planners and the population (Craig et. al., 2002;Hudson-Smith et al., 2002 and Kingston et al., 2000). The main purpose of such systems lies "*...on giving the public a greater degree of engagement in planning issues and access to the relevant tools, data and information to enable more informed participation...*"(Kingston, 2007).

Similar approaches are nowadays applied by local governments in order gain data about problems or issues that need to be tackled. An example for such an application is the Manchester Council's Environmental Services. It allows citizens to report environmental issues via a Web site (Kingston, 2007). Another more recent but similar example is the "city sourced"[1] application. It enables citizens to report issues to their local government using mobile devices or directly through the Web (Demeritt, 2011). These applications have the potential to act as a direct connection between citizens and governments. These examples also introduce a new phenomena into the practice of PPGIS, called volunteered geographic information (VGI) (Goodchild, 2007). While traditional PPGIS projects are mainly project related and concerned only with a subset of the

[1]http://www.citysourced.com/default.aspx [2] http://www.biomapping.net

population, new approaches can have a more holistic view by engaging a potentially great proportion of people and acquire important information about the city, by using the citizens as sensors.

Another example of using new technologies to retrieve information from citizens for planning purposes, is the "Police Act Wiki"(Summer and Cullen, 2009). The project was an attempt of the New Zealand Police to start a discussion on the future of policing in New Zealand. As part of the process an online wiki was created giving the people the ability to forward their expectations and opinions to the institution. These processes are called Public Participation 2.0 and describe the utilization of new Web 2.0 technologies as a means to connect to the community and gain valuable information (Summer and Cullen, ibid.).

The above listed case studies show that mobile and Web 2.0 technologies are already deployed by authorities to gain valuable information from locals. We therefore argue that these technologies in combination with GIS can lead the way to the production of useful emotion- or opinion-based layer information for city GIS.

3.3 Related Work

The concept of mapping emotional information is relatively new, and became famous with the work on bio-mapping, done by Nold in 2007[2]. The idea was to combine a galvanic skin response (GSR) sensor with a GPS to track bodily responses according to its location. The sensor, which is based on a lie-detector, measures changes in the sweat level of the wearer. These measurements can give evidence about the protagonist's physiological arousals at certain points and therefore be interpreted as emotional intensive.

The outcome is interesting maps and visuals (See figure 2) highlighting the fact that people are extremely responsive to their environment. The raw data though is not very meaningful since these peaks of 'emotions' do not really give evidence about why or what was the reason for it, as well as it does not tell whether it was a positive or a negative arousal. Thus participants were asked to interpret the data collected on their walk. It was revealed that some of the peaks were due to very personal feelings, e.g., passing the home of an ex-partner. Although the project is a very interesting one and received a great deal of attention from various fields it is in its current state not particularly useful for the creation of meaningful data layers for city GIS.

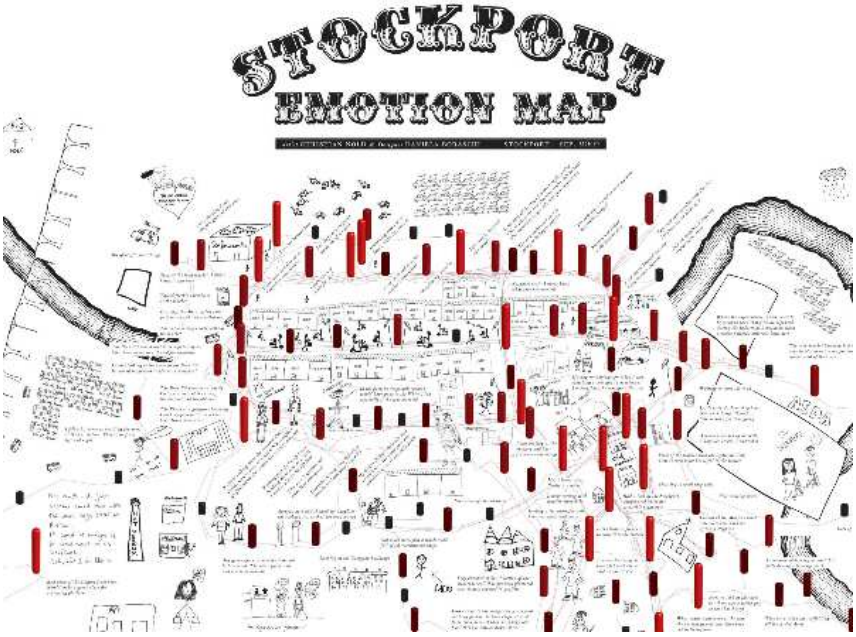

Fig. 2: Bio mapping example by Christian Nold (www.biomapping.net). The GPS-tracks of the participants are plotted, along with the arousals measured. Higher bars represent stronger arousals. Also textual descriptions and drawings are added by the participants.

A related Web application worth mentioning is Twittermood (www.twittermood.org), visualizing emotional information extracted from Twitter messages. Twitter is a micro-blogging service allowing users to publish messages (Tweets) limited to 140 characters via the Web. An interesting fact is that users can give their messages a geographic location (exact lat/long or geographic region such as Vienna, Austria). Twittermood processes about 1 800 000 messages a day and extracts emotional information from them. Each tweet is analysed based on the Affective Norms for English Words (ANEW) (Bradley et al., 1999). ANEW assigns 1034 English words an emotional meaning (e.g. love, spring, accident, war). The resulting dataset is based on a study carried out by the University of Florida. Participants were asked to grade certain words based on

their emotional weight on an integer scale of 1-9. Furthermore, Twittermood uses a methodology created by (Dodds et al., 2009) to calculate the overall mood in every tweet.

Locations of at least 5 tweets are visualized using different circle sizes (larger circles = more tweets). A colour code (from blue to yellow) indicates the mood at the centre of each circle. Yellow circles show areas with moods above average while blue circles indicate moods below the average (See figure 2). The number of tweets visualized this way is quite large and even allows for a recognition of patterns on a city (street) level in heavily populated areas.

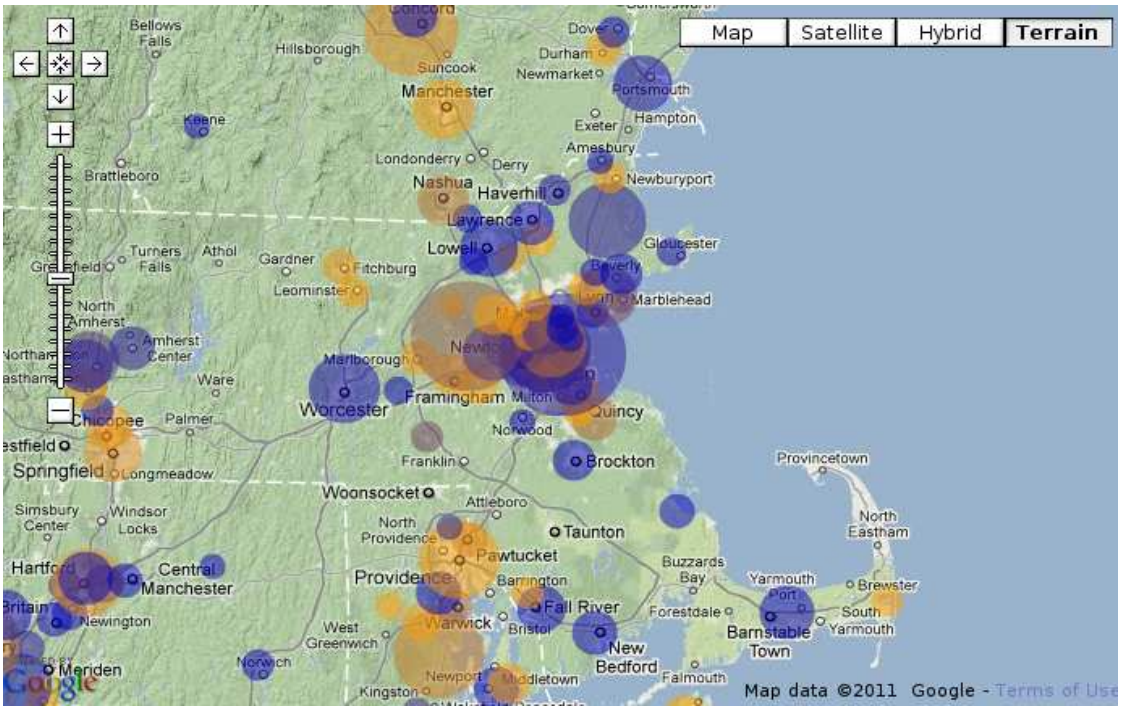

Fig. 3: Emotional Data Visualization based on Twitter Messages near the Boston Area, USA (www.twittermood.org)

4 APPLICATIONS FOR EMOTIONAL BASED DATA

4.1 Feedback maps for city councils

One possible solution for city councils to gain information about people's feelings or opinions is based on the idea of VGI and citizen engagement. By giving the people the possibility to report their opinion or feeling towards a specific location, authorities can retrieve almost real-time data of citizen's feelings or opinions towards locations.

Imagine walking along a highly frequented road. At some point you want to cross it but cannot find a safe spot. Obviously you get frustrated and want to express your anger about this planning mistake to somebody. Another possible case can be: you are walking down a poorly illuminated street at night time and you feel anxious about the situation. Again you might want to report your dislike of the location to the people responsible for the lighting and design of this place. To do so, the current situation forces you to write an email or letter, make a telephone call or visit the city council in person. Whether your complaints are taken seriously or not, is a matter of uncertainty.

So we suggest a reporting system allowing people to file their complaints or praises, if they feel the need. In this case we do not talk about comments, although it can be an additional feature. We suggest to provide people with an opportunity to give some sort of feedback about their feelings or opinions towards locations. It would give them a direct line to the institutions responsible for planning decisions.

To make this information usable they will be provided with templates, which can be made out of emotional descriptions:

- Anxious
- Angry
- Frustrated

- Relaxed
- Stressed
- etc...

or simply opinions:

- Bad
- Good

By looking at clustered negative reports, if they occur, the local council can gain hints about where in the city problems are evident. Heat maps can be created visualizing the hot-spots of similar feelings or opinions.

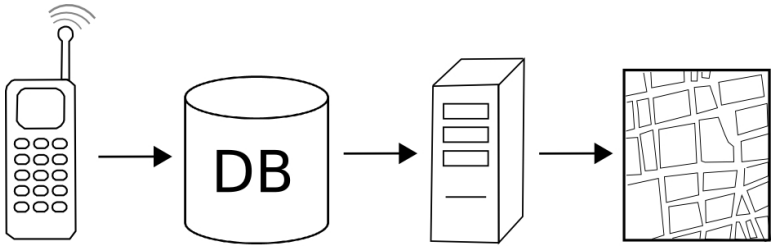

Fig. 4: A schematic representation of such a system. The data is stored in a Database, which will then be processed, analysed and finally rendered and published as an online map.

Publishing the map ensures the public can follow the developments and actually see whether the local government is acting at the right places. Technologically the implementation of such a system is proven to be manageable, as its concept does not diverge strongly from the "citizen report"-projects mentioned above.

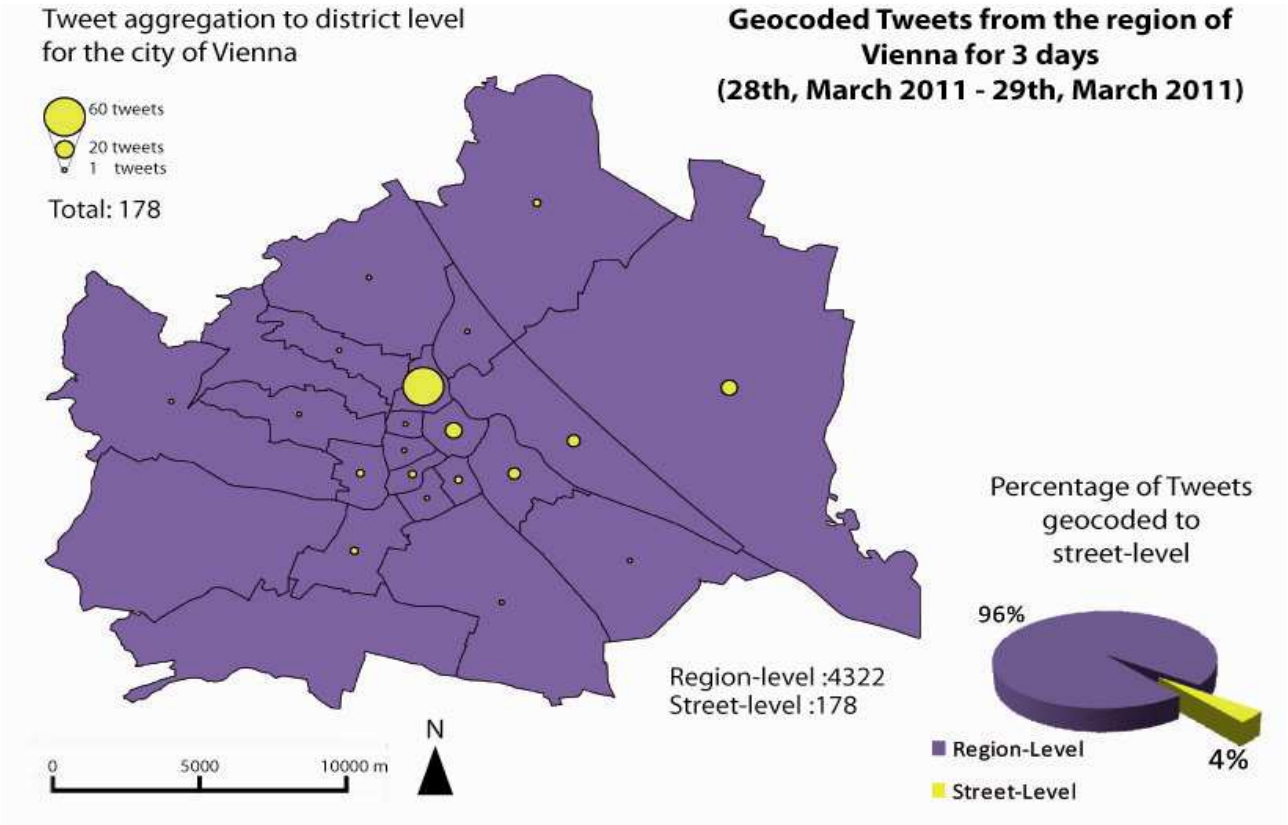

Fig. 5: A sample of 4500 geocoded tweets from the region of Vienna. Those with coordinates attached are aggregated to districts. Only about 4% of the tweets bring detailed location information, such that it can be used for on a city level.

4.2 Towards Mood Maps in City Planning

Based on the work of twittermood.org we think that such information can be aggregated to administrative units, like districts or boroughs. Since this type of data would be a completely new introduction into urban planning, its value is hardly predictable. Nevertheless, we assume that for example the analysis of the data over a long time period can reveal interesting information. A sort of "average" mood in areas can be utilized

as an indicator for living standard in a district. For example, it could be assumed that districts with lower living standards show more "negative" tweets than the average.

An increase of the average mood of an area in the long term may also be interpreted as a sign of improved living standards. This can give the planners confidence about their decisions taken for the area. The real time nature of the data, can also be used to see possible reactions to incidents happening in an area. Authorities can look at changes in the average mood in an area and try to connect it to important happenings in close proximity. The acceptance of city planning projects for example can be assessed by looking at mood changes. An unpopular project may result in an increased amount of negative tweets in the area affected by it, while a well received one can spark the opposite.

It is worth mentioning that current mood maps based on Twitter messages are mostly on country or city level. For a more meaningful analysis comprehensive data on a street level would be required.

In a sample of 4500 geocoded tweets gathered for three days from the Twitter Search Api[2], we found that only 4% of them had coordinates attached to them. The rest were simply marked as "Vienna,Austria", hence regional level. Considering the growth of Twitter and location based services, however, an increase in the ratio of street-level geocoded tweets, does not seem unlikely. Additionally, in future it may become possible to extract mood data from similar Web services that assign a geographic location to messages, e.g., Facebook[3] (status updates) or FourSquare[4] (check-ins).

Another issue we see in figure 4, is that some districts contain considerably more tweets than others, which is partially explained by one or several more active users, than average. But it can also point to the fact that there are differences in the usage of social media in the population, what thus can lead to an underrepresentation of certain parts of the population by this approach.

5 CONCLUSION

In this paper we tried to convey the idea of having emotional layers integrated into the city planning process. We also tried to suggest ideas of how to acquire such information. We therefore explored the current state of emotional mapping and suggested ways to utilize current technologies and applications to gather emotional spatial information. The great advantage of the suggested approaches is the relatively low costs of data acquisition and the fact that data are captured in almost real-time. The mentioned techniques propose a way to directly connect the mood and opinion of citizens to their local government. We hope that the idea will be received well and that further research on the nature of such data and possibilities to extract information from it will be sparked.

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[2] http://search.twitter.com/api/

[3] http://facebook.com

[4] http://foursquare.com

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