

# The Emotion-Aware City: Using Ambient Geographic Information (AGI) in order to understand emotion & stress within smart cities

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## Introduction

The relevance of cities in modern societies can be summed up with just four statistical indicators represented on figure 1, which depicts these challenges: urban coverage and population, consumed energy in cities, and CO<sub>2</sub> emissions.

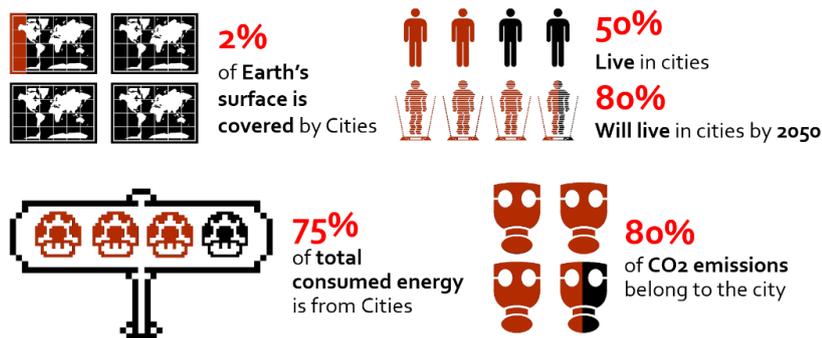


Fig. 1. Cities challenges Infographic (Author) (Source: UNdata, 2015) (S. Roche, 2014).

The idea and concept of smart city itself tries to address these challenges. A smart city's main goal is to increase the quality of life for its citizens and to make the city more attractive, lively and greener (Kehoe & Nesbitt, 2010). To achieve this goal, physical sensors are deployed throughout the city to monitor various aspects such as environmental parameters (weather, pollution, etc.), traffic and the consumption of resources (Caragliu, Del Bo, & Nijkamp, 2011). However, this concept does not directly reflect how humans actually perceive their environment and the city's services (Nam & Pardo, 2011), only includes measurable quantities and disregards how the citizens actually feel.

Since emotion is a central component of human behavior and, in order for a city to be truly "smart", it is important not only to assess what people are doing, but also, why they are behaving in a certain way (Dolan, 2002). Considering emotional states is essential for achieving real-time judgment and perceived life satisfaction (Guthier, Alharthi, Abaalkhail, & El Saddik, 2014).

This gives rise to the vision of an emotion-aware city with the ability to understand and utilize the emotional states of its citizens to enable improved planning and decision making (Guthier et al., 2014). Therefore, the use of geospatial user-generated content, including social media information (twitter, flickr, facebook, instagram), could truly lead to a better urban planning (Exner, Zeile, & Streich, 2011; Exner, 2014; Resch, Summa, Sagl, Zeile, & Exner, 2014), and engage city planners to detect positive or negative trends, managing to take early countermeasures.

## Research Goals

The main goals for this research are as following:

1. Develop a methodology towards emotion and stress mapping, in order to assess people's emotional responses to their environment, using Lisbon (Portugal) as a case study.
2. Produce alternative representations of space based on individuals' georeferenced experiences, thoughts and emotions by mapping stress and emotion, through geospatial user-generated content, including social media information.
3. Compare information retrieved from geospatial user-generated content (subjective observations) with objective measurements (such as biometric sensors – or socio-demographic statistics about a specific city), evaluating which can truly characterize and share the emotional dimension of the city.
4. Consider Lisbon as a “rich” and worthy candidate to analyze as an emotion-aware city, simultaneously assessing its potential as an (emerging) smart city.
5. Finally, to assess if there is a strong correlation between the main touristic sites in Lisbon and the “emotional landmarks” within the city, which can be defined as “emotional hot spots”.

Finally, there are two major research gaps/challenges in the new field of emotion-aware cities, which this research will address:

1. The detection and aggregation of affective data in an urban scenario (Guthier et al., 2014). These issues are related with the specific and personal effect of appraisal and enthusiasm, which differs from person to person (Zhang & Lin, 2011).
2. The need on developing smart urban solutions built on the vision of citizens as active sensors on one hand, and on the other hand on spatial enablement of citizens via social network (P. S. Roche, 2012). These kind of solutions have also to be built on the potentials offered both by embedded sensors to crowdsource the process of collecting geo-referenced information about places in the city.

## Regarding Ambient Geographic Information (AGI)

Nowadays we give a growing amount of location-based contents generated by connected – anytime and anywhere – producers, mainly equipped with smartphones. Social networks are vessels which millions of people use to share their current thoughts, observations and opinions, and have been shown to provide more reliable

and trustworthy information than traditional methods like questionnaires and other sources (Marwick & Boyd, 2010).

Such data conveys Ambient Geographic Information (AGI), capturing for example, people's references to locations that represent momentary social hotspots. Harvesting this ambient geospatial information provides a unique opportunity to gain valuable insight on information flow and social networking within a society, support a greater mapping, understand the human landscape and its evolution over time (Stefanidis, Crooks, & Radzikowski, 2013).

In this context, a methodology based on AGI and VGI, could produce alternative representations of space, based on individuals' georeferenced experiences, thoughts and emotions by mapping stress and emotion. The use of geospatial user-generated content, including social media information (twitter, flickr, facebook, instagram), could lead to a better urban planning, and how living in an urban area could relate to well-being.

## Methodological Approach

In a sense one could consider AGI to be addressing the fact that the human social system is a constantly evolving complex organism where people's roles and activities are adapting to changing conditions, and affect events in space and time.

To implement an AGI-based methodology this research will focus on creating tools and methods that can collect, analyze and share information, based on geospatial user-generated content linked with social networks and media. Any spatial information related with emotion, enthusiasm, memories and stress related with the people's perception about the urban space, will be georeferenced.

Figure 2 represents the methodological approach for this research. The emotional states of Lisbon citizens will be sensed through a variety of social media sources, by extracting features and applying machine learning techniques. Finally, this AGI-based data (subjective observations) can be compared with results from objective measurements, such as socio-demographic statistics, questionnaires and data retrieved from biometric sensors.

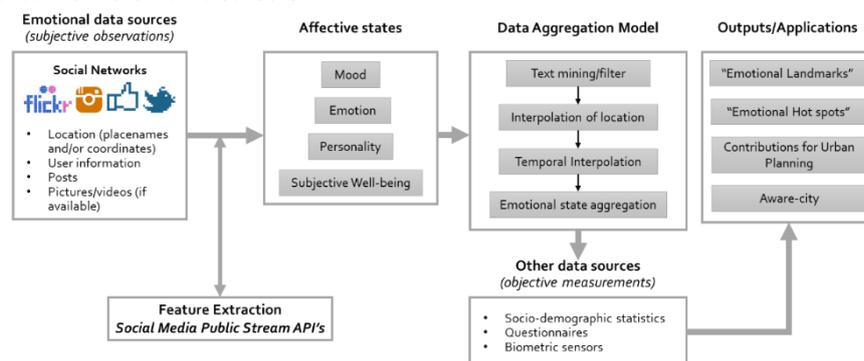


Fig.2 Research conceptual framework (own source).

In order to collect geo-tagged data to analyze Lisbon as an emotion-aware city, Twitter, Flickr, Instagram and Facebook public stream API's (Application Programming Interface) should be used, allowing interaction within the social network's ecosystem (users, communities, content, e.g.) (Iaconesi & Persico, 2013).

## Expected Results & Conclusions

With this approach it'll be possible to visually discern areas of strong feelings, either good or bad. These areas can be called as emotional clusters, which can be defined as the tendency shared by two or more participants in a particular place. The greater the number of people reporting a strong positive or negative feeling in the same location, the more pronounced the emotional cluster. These "hot spots", exhibit aggregations of positive ratings, negative ratings, or in some cases, a mixture of strong positive and negative ratings in the same place.

Other main goal will be to identify "emotional patterns" – those spaces where, at a specific or recurring time, a certain emotion is expressed powerfully and abundantly. If they exist: do emotional landmarks change over time? Do they change according to the observer? To language? To the time of day, week, month or year? Additionally, several groups of producers will be established, based upon social-demographic characteristics, such as: gender; age; education level; motive of trip (leisure, business, e.g.); "level of acquaintance" of the place (old-timer, newcomer, tourist); origin (country and/or city).

GISciences can truly support the development of the intelligent city (Daniel & Doran, 2013), due to crowdsourcing, VGI, AGI, including location-based social networks which stand out as key geospatial data sources indicative of the pulse of the city.

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