# Integration of Emotional Behavioural Layer "EmoBeL" in City Planning

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## 1 ABSTRACT

The link between the built environment as a geometrical dimension with the human behaviour and emotional aspects in recent planning research field has got a growing interest in the field of city planning. The emotional dimension in particular has become an essential part in city planning field where the emotional relation and the degree of emotional response are structuring spaces followed by behaviours and can therefore be relevant for human interactive in urban spaces. The theoretical, empirical, and practical work in this field has generally aimed to enhance the quality of life through the creation of new layers for our cities considering these behaioural and emotional aspects.

This paper is an analytical part of a research work on the micro level of city planning focusing on the growing importance of computing and mobile technologies. It creates a linkage between cities, people and technologies through integrating quantitative limits and qualitative criteria. It investigates a new layer presenting the citizens' behaviours and emotions "EmoBeL", which could be added to the geometrical layer and create a city analysis to improve decision making process as well as physical planning in our cities, which is the main goal of planners, developers and even politicians.

## 2 INTRODUCTION

In the field of city planning, there has been a considerable attention to connect the geometrical dimension of mapping for the built environment with the citizens' behavioural and emotional aspects. The theoretical, empirical and practical work in this field has generally aimed at the goal of life quality enhancement (Handy et al., 2002). Otherwise, nowadays the physical city is covered with an increasing number of digital information through several social and telecommunication networks on handheld devices with global positioning and navigation systems. These rich sets of information are of increasing importance for researchers in the city planning field that open the possibility to a wide range of future applications and services, which are the subject of intensified research efforts (Kloeckl et al., 2011; Robinson, et al., 2012).

Over the past decades, computing, social media and mobile technologies have become integral parts of our social lives and work practices, as well as shaping the way we make sense of our cultures and engage us as citizens (Marcus et al., 2011). This is not only transforming how we study, design and manage cities but opens up new possibilities for researches and new approaches that give decision makers and researchers access to more qualitative and quantitative data about cities and their dynamics (Kloeckl et al., 2011).

The objective of this research is how to find a way for better understanding of our cities by initiating a new approach of merging the behavioural and the emotional dimensions as the most recent planning layers with the geometrical one as a base. This is an ongoing leading work of a new classification called "EmoBeL" analysis that depends on all the theories of emotions and a number of tested smart phone applications.

## 3 STATE OF RESEARCH

This work is an induction analysis research to end up with a new analysis approach in city planning. This approach will consider the integration of geometrical dimension of mapping with an Emotional Behavioural Layer "EmoBeL" for more experiencing of our cities, Fig.1. This integration is getting more reliable with the help of various techniques such as Global Positioning System (GPS) for collecting data through citizens' movements in cities. Otherwise, might use in the future more technological tools, devices and programs such as SMART bands, biometric sensor measuring, Galvanic Skin and other recording data devices that is eliminated by this research for present (Nold, 2009; Zeile et al., 2009; Rania et al., 2011; Taha et al., 2012; Bergner et al., 2013).

To tackle previously mentioned analysis method there are several considerable steps: a literature review illustrating the cognitive mapping dimensions in city planning; geometrical, behavioural, and emotional dimensions as well as the proposed "EmoBeL" analysis approach with the theoretical base relation.
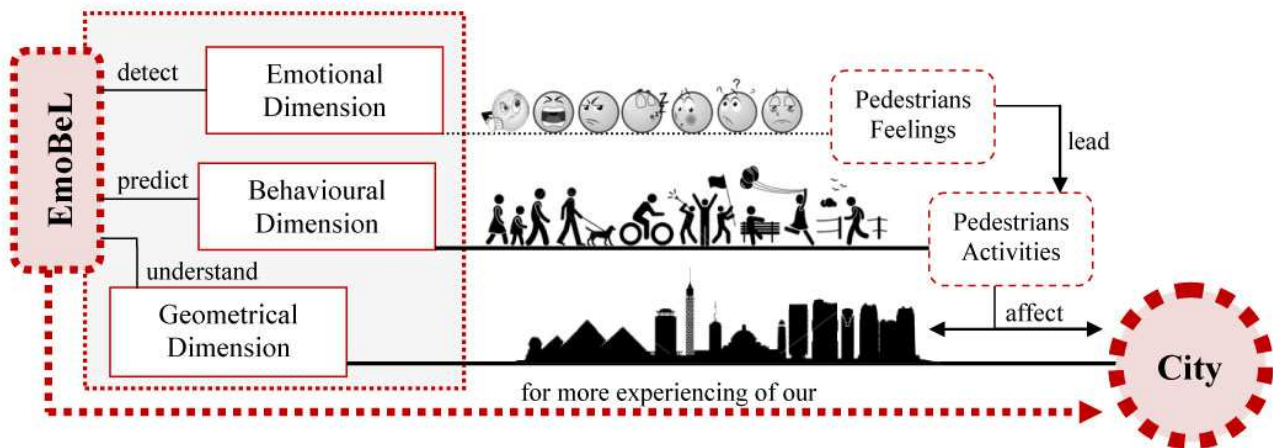


Fig. 1: The state of research for the EmoBeL analysis approach.

## 4 COGNITIVE MAPPING DIMENSIONS

The conventional cognitive mapping dimensions are usually the geometrical dimension one and the behavioural layer. Regarding the geometrical part, there are a variety of terms that have been used by city planners when referring to the built environment in recent city planning mapping process. Although these terms often seem changeable, the distinctions among them are important. According to urban planning theories and practices, "Urban design" usually refers to the design of the city and the physical elements within it. This includes both their arrangement and their appearance. In addition to, it is concerned with the function and appeal of public spaces. While, "Land use" typically refers to the distribution of activities across space, including the location and density of different activities, where activities are grouped into relatively categories, such as residential, commercial, industrial and others (Handy et al., 2002). All these terms exemplified our conventional approach of mapping in geometrical level of city planning.

By considering the problem of city mobility nowadays and the growing interest of pedestrians' behaviours in urban spaces, there is an increasing interest in determining the behavioural layer. Robinson (2012) argued on how people currently make decisions concerning their daily travel plans and how their in situ decision-making might be improved by streamer conditions and any other information deemed relevant by that individual.

According to Reeve (2009) there have been perennial questions regarding the behavioural layer:

1) What causes behaviour? And why do people do what they do? 2) Why does behaviour vary in its intensity? Why does a person behave one way in a particular situation at one time yet behave in a different way at another time? What are the motivational differences among individuals and how do such differences arise? 3) By answering previous questions a new one arises about how can we predict and expect peoples' behaviours in urban spaces?

Depending on previous studies on the behavioural layer it has been identified and discussed that all citizens' behaviours should be that way depending on the stress as one of the key motivators in the emotional layer in experiencing the city (Zeile et al., 2009; Rania et al., 2011; Taha et al., 2012; Bergner et al., 2013).

## 5 EMOTIONAL DIMENSION OF MAPPING IN CITY PLANNING

Various methodologies have been tested and developed for detecting emotions in urban spaces. One of the most promising approaches through emotional maps is the Christian Nold maps of cities where he mapped peoples' emotional geography instead of mapping their physical layout. He invented a technique called biomapping where participants walk the area connected to a system that measures galvanic skin response, a measure of the electrical resistance of the skin, which is known to give a rating of arousal and stress (Nold et al., 2008). His maps described an area in terms of how stressful it is, and so far, he mapped Greenwich in London, San Francisco, Stockport and the sensory experiences of Newham.

## 5.1 Emotion within city planning

A major problem in the field of emotion is the wide range of definitions that have been proposed for a long time. James (1884) illustrated that our mental way of thinking and mental perception of some fact excites the mental affection and that what called emotion and gives rise to the bodily expression. Kleinginna Jr & Kleinginna (1981) identified ninety two definitions and nine skeptical statements that were compiled from a variety of sources in the literature of emotion drawn mainly from psychological dictionaries and well-known texts on emotion, motivation, physiological psychology and introductory psychology. While Gartner (2012) mentioned the emotion as one of the psychological processes such as: perception, cognition, memory, emotion, behaviour, and physiology that devices and sensors can experience.

That meets Reeve (2009) where emotions are one type of motive power, which energizes and directs behaviour. Emotions are feeling states with physiological, cognitive and behavioural components. Emotions are usually intense and short-lived. According to that the bodily changes which behaviour follow directly the perception of the exciting fact and our feeling of the same changes as they occur is the emotion (James, 1884). On the other hand, moods are more pervasive and can last for longer period of time (Kleinginna Jr & Kleinginna, 1981).

By this work it has been considered to the explanation of Reeve (2009) that has been proposed the word emotion as a complex set of interactions among subjective and objective factors, mediated by neural-hormonal systems, as shown in Fig.2, which can:

(1) give rise to affective experiences such as feelings of arousal, pleasure/displeasure;

(2) generate cognitive processes such as emotionally relevant perceptual effects, appraisals, labeling processes;

(3) activate widespread physiological adjustments to the arousing conditions; and

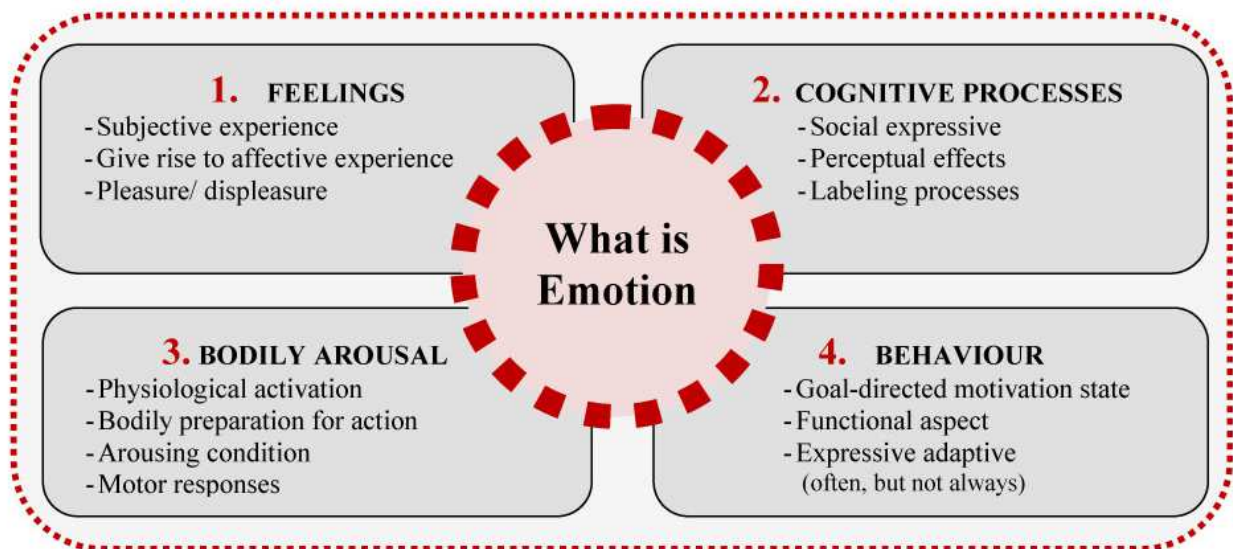(4) lead to behaviour that is often, but not always, expressive, goal-directed and adaptive.



Fig. 2: The four components of emotion definition. Source: after Reeve, 2009.

## 5.2 Emotion Classifications and Theories

Different emotional expressions and states have been identified in the context of detecting emotions. Plutchik's multidimensional model and his wheel of emotions (1962, 1980) addressed basic emotions, their dimensions and how those can be arranged into hierarchies around prototypes as shown in Fig.3 (a,b). This was and still the best known perspective of emotion and its structural model. Plutchik postulated eight primary emotions, which all other emotions are derived from (Andersen & Guerrero, 1997). His wheel of emotion was well classified because it filtered the emotions types and intensity in eight different colors with four degrees of strength.
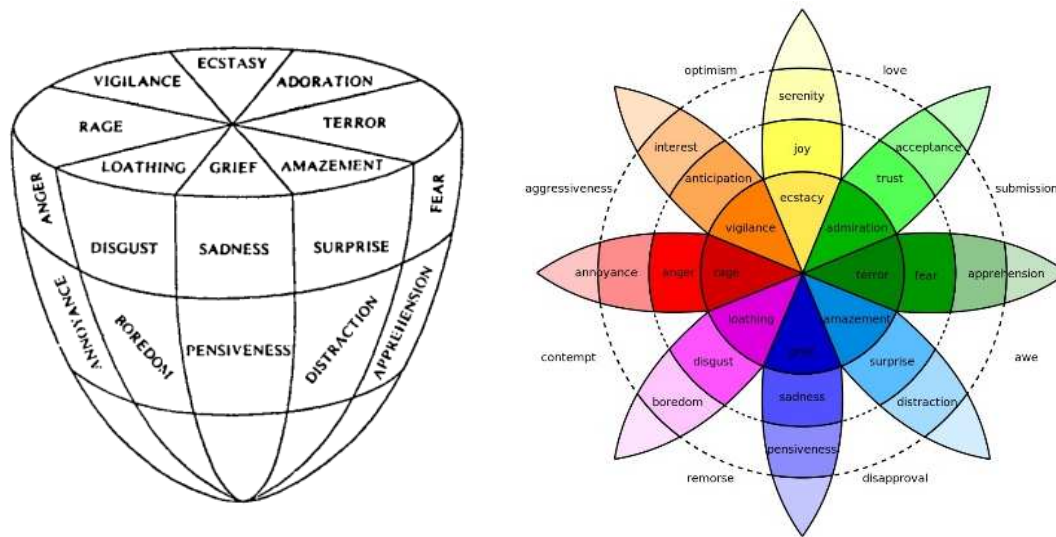
Fig.3: (a,b) Plutchik's three- dimensional emotion cone and his wheel of emotions 1962,1980. (Source: Andersen & Guerrero, 1997)

Gartner (2012) categorized emotions to anger, sadness, happiness, cheerfulness, neutral, joy, boredom, fear, annoyance and disgust. While Nummenmaa et al. (2013) added surprise, anxiety, love, depression, contempt, pride, shame and envy. Otherwise, there are much more researches in this field that enables communities to track and act on their feelings about their local environment. The most common emotions recognized are the standard emotions: anger, happiness, sadness, fear, disgust, surprise, anxiety, and interest (Klettner et al., 2011). However, people are more likely to have mixed emotions than pure forms of any single emotion.

According to that the research expect this inclusion of a subjective layer will bring benefits to different disciplines regarding city planning, architecture and decision making depending on the next four theories of emotion that Reeve (2009) summarized them as shown in Fig.4 to:

1) The James-Lange Theory of Emotion (1834-1900): where it has been suggested that bodily changes are the results of emotion.

2) The Cannon-Bard Theory of Emotion (1898-1977): where the physical changes and emotional experiences happen at the same time.

3) The Two-Factor Theory of Emotion: that proposed emotion as a result of the interaction between physiological arousal and the cognitive label we attach to.

4) The Cognitive-Mediational Theory of Emotion: that classified emotions in two ways: pleasant or unpleasant, and how much arousal is present. It is mostly concerned with the interpretation of the environment and work on how it affects a pedestrian.

This last theory of emotion, as shown in Fig.5, has been proven to be the most "accurate" one. While its way of classification has been used nowadays through several handheld and telecommunication devices by smart-phones to detect pedestrians' emotions through cities (James, 1884; Titchener, 1914; Ecedents, 2001; Reeve, 2009).
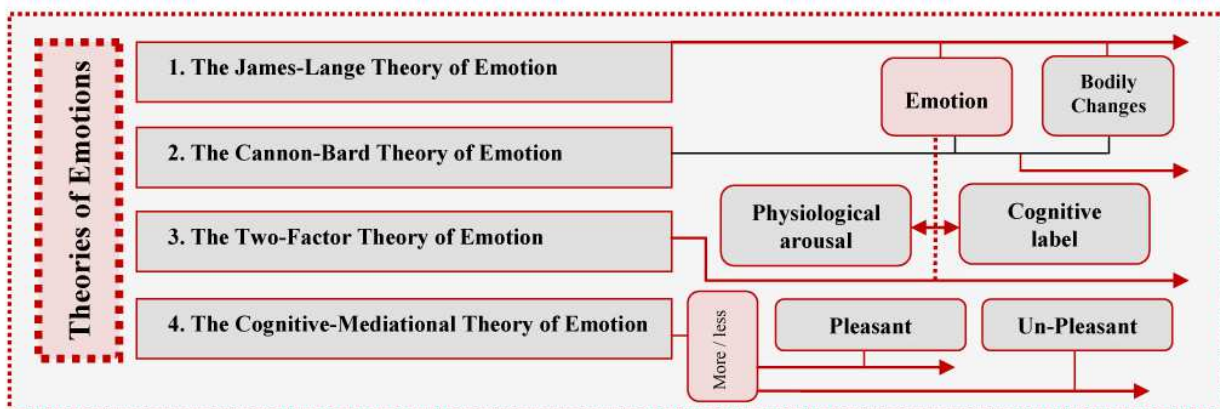
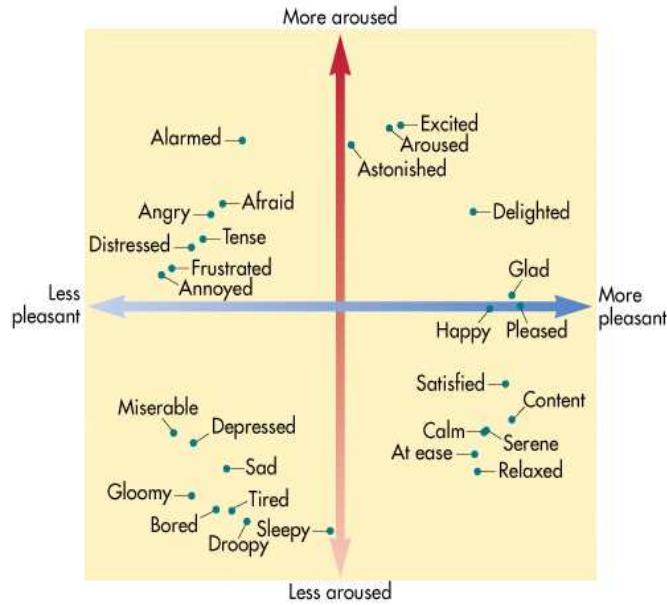Fig.4: A schematic diagram illustrates the four theories of emotions.



Fig.5: The Cognitive-Mediational Theory of Emotion (Source: Reeve, 2009

## 5.3 Emotional Applications in City Planning

There are several applications that benefit from smart phones using numerous methodologies for citizens' emotional detection and behavioural monitor. There are many projects about this development of hand held technologies for behavioural interventions that address several problems regarding cities quality of life. This research is using the advantages of two promising applications. One of them is the Emomap application that gathers qualitative data about peoples' affective experiences in urban spaces for building a subjective layer to modify the route calculation in pedestrian navigation systems (Klettner et al., 2011). This application focuses on testing the hereby developed methods and algorithms by collecting pedestrians' feelings in their surrounding spaces for the hypothesis that the inclusion of emotional data can improve user satisfaction (Gartner & Ortag, 2011). As shown in Fig.6, users submit their feelings through a number of indicators positively or negatively about the degree of feeling comfort, calm, diverse, safe, and appealing. These emotions then are sent to the system that automatically uploads the average feelings into a geometrical map. These indicators then have been re- classified by our research and added into the EmoBeL analysis method.



Fig.6: Measuring the citizens' emotions by Emomap application where users identify their feelings about the surrounding spaces.
(Source: Klettner et al., 2011)

Another application that has been used is the Emotion Sense application that combines systematically gathered data from a wide range of sensors with the user's own report about their feelings, which is entered

through a system designed by psychologists. Based on their response, the phone then conducts a brief survey to clarify their emotional state (Lathia, et al., 2013). As shown in Fig.7, the users are asked to mark how they feel using an on-screen matrix called an "emotion grid" based on the previous mentioned theories of emotions. Users have been asked ten questions about the degree of feeling calm, anxious, angry, alert, enthusiastic, sad, lonely, relaxed, their companionship, their activities, and their daily social life.

These parameters furthermore have been added into the EmoBeL analysis method. With further modification, this type of mobile phone technology could be a very accurate means of tracking the factors influencing people's emotions, but until now, these technologies have been designed for sensing information from single users or small groups.
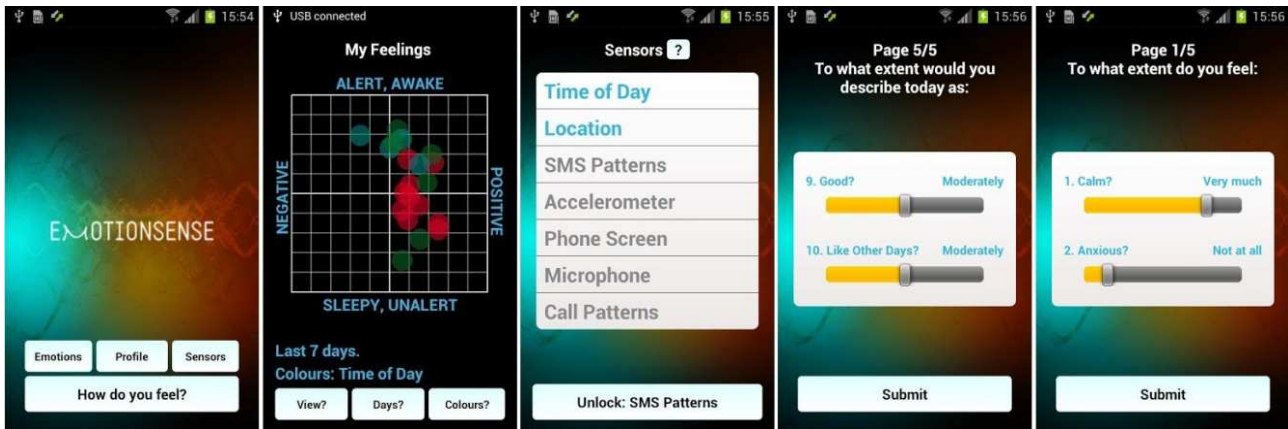


Fig.7: Measuring the citizens' emotions by Emotion Sense application. (Source: Lathia, et al., 2013)

## 6 EMOBEL FOR CITIES

This is an ongoing research of work leading to a new classification called "EmoBeL" analysis. This analysis depends on the theories of emotions particularly the Cognitive Mediational Theory as mentioned before as well as some of the most recent smart-phone applications for measuring how citizens feel in their environment such as Emomap app that depends on the GPS system (Klettner et al., 2011) and the other more psychological one, Emotion Sense application (Lathia et al., 2013).

The research proposes that citizen's emotions would be sorted into two main categories: Positive and Negative emotions as shown in Fig.8 (left). The positive emotions are at the upper side while the negative emotions are located at the lower side. Each part has been classified into four main zones differentiated in colors and ranged chromatically according to the emotion intensity depending on the emotions' colors of Plutchik emotions wheel. By that we got eight primary zones of emotions consists of twenty seven positive and twenty seven negative emotions that have selected from all the theories of emotions and the tested smart phone applications as shown in Fig.8 (right).
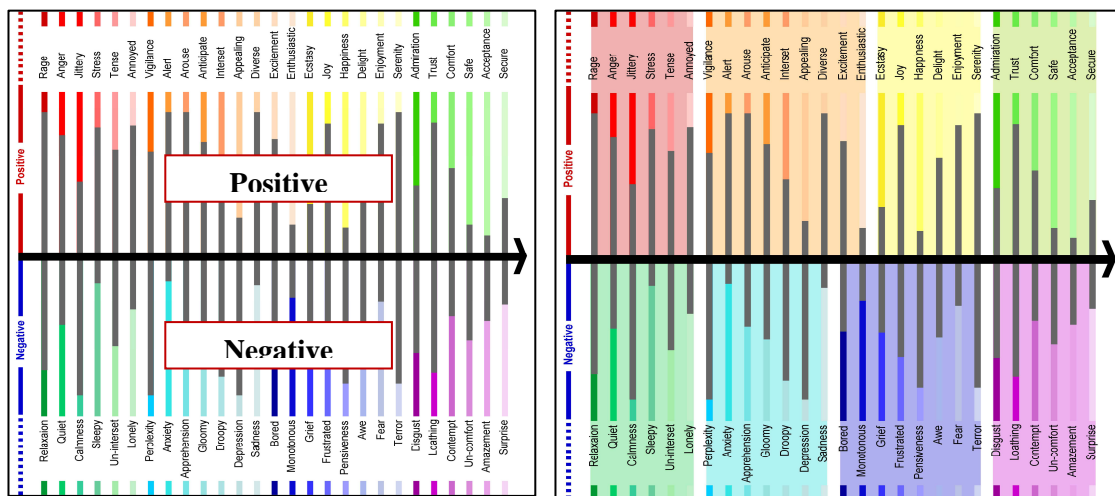


Fig.8: The EmoBeL graph classification of emotion (left) and the EmoBeL graph zoning of emotion (right).

This part of work is a new proposed approach that would be helpful for city planning field. This proposed work that shown in Fig.9 is an induction analysis of pedestrians' behaviours through urban spaces depending on the analyzed part of the emotional layer on EmoBeL analysis methodology.

For example, the red zone represents the feelings of rage, anger, stress and annoyed where city planners would expect that pedestrians in this zone might behave in a nervous way and walking with a high speed causing accidents. Otherwise, the yellow zone represents the happiness emotions with raising expectation of interest from pedestrians and that might cause a better environment for shopping and a highly use of spaces and activities. Feeling safe and comfort through the upper green zone might expect highly motivated activities such as cycling. On the other hand, the cyan zone corresponds to the feelings of depression and sadness causing negative responses on the urban activities. Getting into the blue zone means getting bored and feeling monotonous through spaces and this should get more effort to re-join pedestrians within the urban activities. In this zone also the feelings of fear and terror should get more concerns from city planners or it will turn to be defects areas within the city. The magenta zone reflects the un-comfort emotions that could be affected by the urban fabric and features and this would change the behaviour in the surrounding spaces.
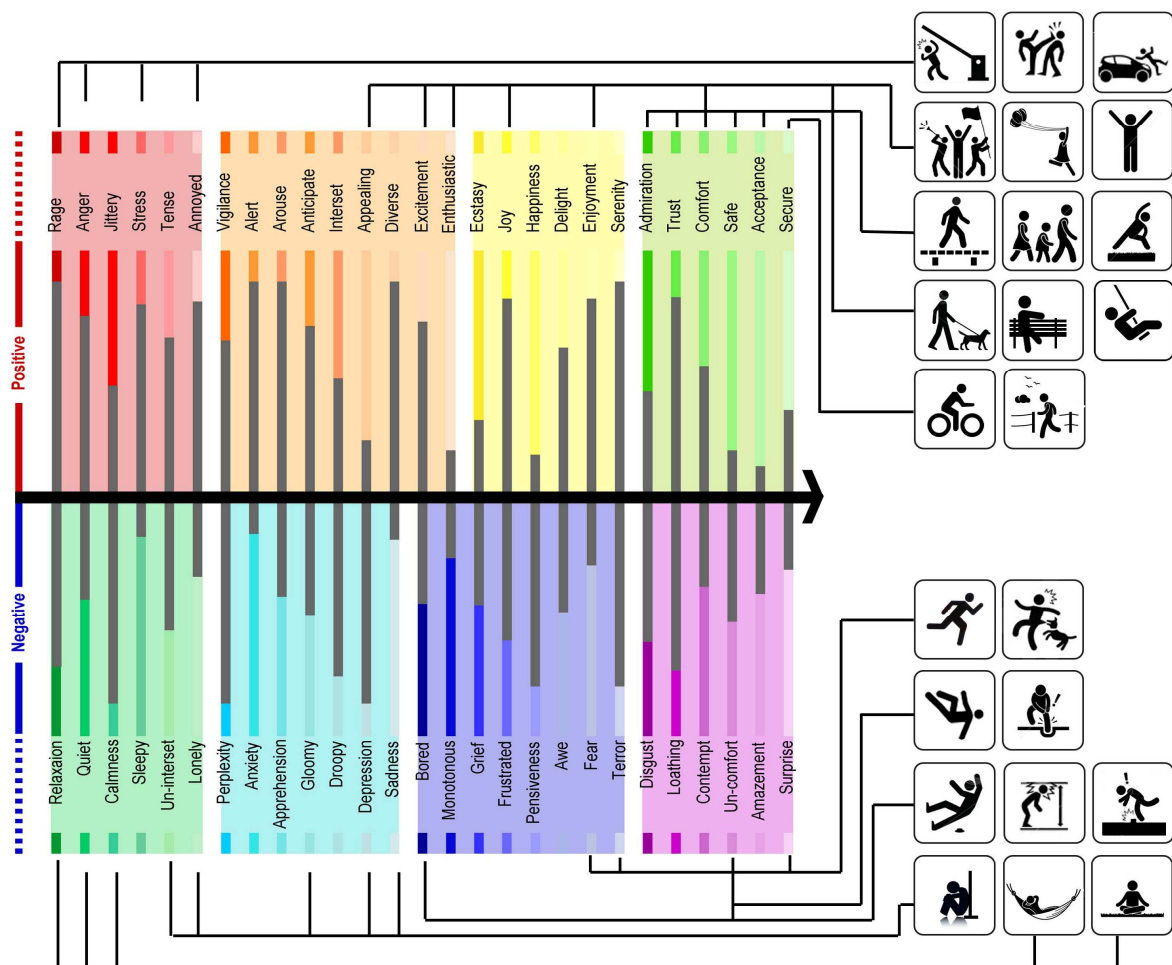


Fig.9: The EmoBeL analysis approach of emotions and its' expectations of behaviours.

## 7 EMOBEL MAP

Applying the previously mentioned analysis approach on part of Alexandria city map causes a prospective EmoBeL map as shown in Fig.10. This is just a visionary output analysis for the old town of the city. According to that the research proposed a new transparent and colored layer. This new layer depends on the EmoBeL analysis approach as a legend where it could be recognized that the city will get into the proposed colored zones. For instance, the yellow parts of the city are along the sea front of the Eastern Harbor of Alexandria where pedestrians feel joy and happiness walking along the beaches (refer to Taha et al., 2012). Under the red zones there are highly traffic arteries where pedestrians suppose to feel anger and annoyed

with more polluted environment. The blue zone gives indicators for the feelings of bored and fear so as to give more attention for these areas in the city.

This part of work is still in progress with a promising effort for more reliable work with the help of a number of participants for site experience of Alexandria city.
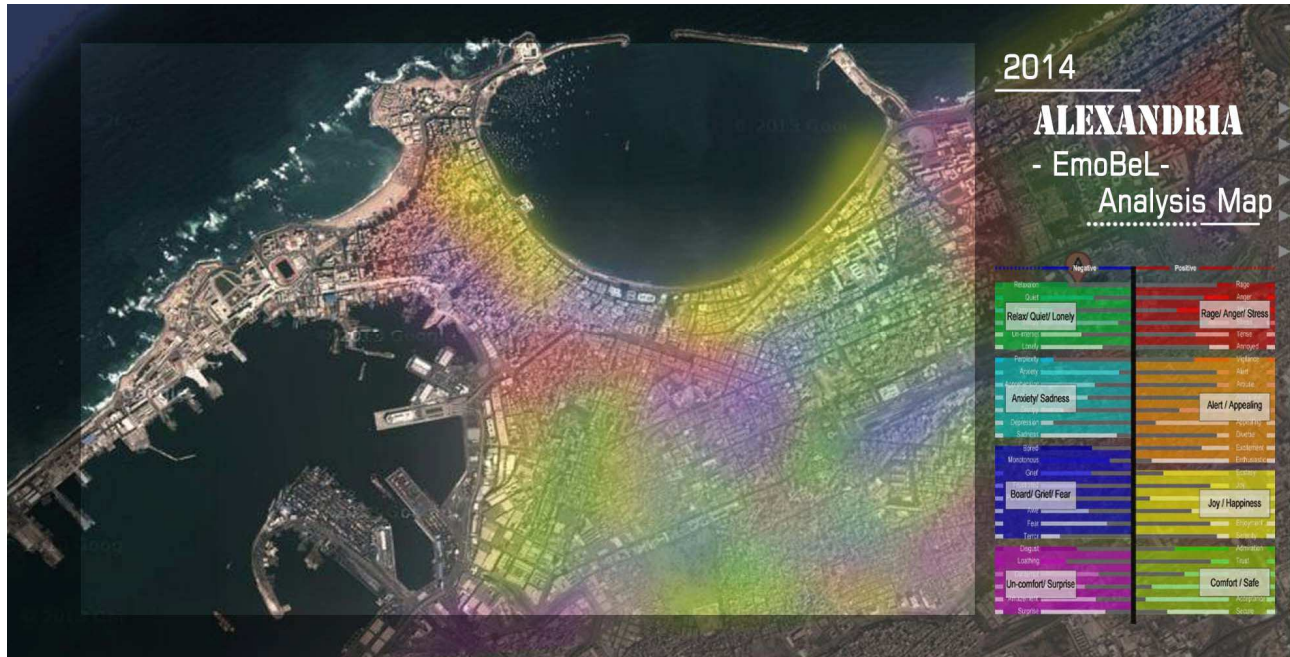


Fig.10: A prospective map of Alexandria city after applying the EmoBeL analysis approach.

## 8 RESEARCH POTENTIAL

This work is just a new start point on a micro scale level of research that could give more potential to decision makers in other disciplines by analyzing such maps and connecting them with the expectations activities for better understanding of our cities. This pilot study also threw up some interesting suggestions about how circumstances may affect our emotional condition, but still lakes a certain qualitative data collection that might be a stage forward.

## 9 CONCLUSION AND ONGOING WORK

Such research could be more supportive to decision making process in cities if it includes indicators and parameters to improve urban living conditions by answering the following questions: how do people perceive their environment? How people react on surrounding impacts either positively or negatively? How is it possible to collect all of the citizens' impressions in a centralized way; and how could these impressions be visualized in mapping process?

This work contributes to better understanding of the opportunities and challenges provided by a proposed EmoBeL analysis approach that could followed up with more tools and programs to bring benefits to different disciplines regarding city planning, architecture and decision making in cities.

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