# Emotional Geography of St. Petersburg: Detecting Emotional Perception of the City Space

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**Abstract.** Emotional perception of the city space has a great share in subjective well-being and is one of the core subjective indicators of the quality of urban environment. Studies of emotional response towards the city space has recently gained popularity within digital humanities. In this methodological paper we consider a new tool to collect data on urban emotions - an interactive platform called *Imprecity*, which has been recently developed at ITMO University and integrated into a wider framework of Smart City St. Petersburg project supported by St. Petersburg city administration. When authorized through social networks Imprecity user receives a possibility to place emoji on St.Petersburg map as well as write comments on each emotion. Emotions are divided into 5 groups of the basic emotions defined by Paul Ekman - joy, sadness, anger, disgust, and fear. Imprecity functions as a mobile and desktop version of a website, the mobile application is being developed. The emotions and comments are processed to form recommendations for placemaking, moreover, active users of Imprecity have a possibility to unite together and propose projects for renovation of specific urban places with the help of experts. We argue methodological difference between study of emotional perception by processing spontaneous data generated by users online and study of 'emotional' data created on purpose via Imprecity. We show visual analytical tools to process a test sample of data collected via Imprecity, such as emotional heatmaps, emotional ratings and word clouds. In general, people tend to express more 'joy' than negative emotions; positive emotions tend to cluster close to the main points of attraction and major touristic routes. All types of emotions tend to cluster along the major mobility routes, in the city centre and in the sleeping quarters.

**Keywords:** Emotional Perception, Social Media, Urban Environment, Interactive Digital Interface

## 1. Emotional Geography: Localization of Emotions

Louis Wirth has noted that urbanism is a way of life and that the city is an environment where a human being is immersed into a continuity of intensive and diverse encounters [1]. Since Wirth and his companions at Chicago School have elaborated an emphasis on human ecology, the main object of the urban studies is the human-environment interaction and emotions are the most visible marker of this relationship.

It has been long renowned that impressiveness of material forms, lines and planes, space and volume provoke emotional response in a human being. The city is a phenomenological experience being a constellation of visual signs, sounds, scents, tactile senses. Maurice Merleau-Ponty has proved the impact of architecture and

material design on the state of the human body and soul [2].I n Lynch's *Image of the City* emotions are demonstrated as an invaluable constituent of a mental map of a citizen which eventually becomes the actual basis for her urban identity [3]. Emotions are provoked not only by architecture and material forms, but also by almost irrational substance - atmosphere of the place. This atmosphere to big extent is ruled by violent powers of modernized cities which suppress and pervert natural feelings of people as G. Simmel showed in "The Metropolis and Mental Life", written in 1903 and still relevant for our times [4]. Environmental psychologists of today consider emotions and moods felt everyday in urban environment as prerequisites of the quality of life in the city. Dynamics of urban life, never-ending interactions with human and non-human actors in the city lead to abundance of feeling. Coping mechanisms lead to alienation of the 'urbanized' body from surrounding urban processes, as was depicted vividly in Simmel's term of 'alienated gaze'. Normalizing urban-human interaction and returning human scale back into urban development has become the biggest endeavour of the new urbanism school, while megapolis with its skyscrapers and highways leaves a person without intimacy important for the human life - cosiness, unconstrained tight interaction, cultural entertainment [5]. 'Urban' emotions burst out in the intensive dynamics of the contemporary city - informational turnover, transport and pedestrian movements, circulation of goods and services, communication processes and technological progress forward challenges for human perception. Intensity of the city provokes emotional intensity in a human being. After John Urry, who has proclaimed mobility as a paradigm of the contemporary city [6], we argue that the paradigm of the modern citizen is feeling.

However the city is not a unity of one emotion or feeling only. Its different units have its own atmospheres, which was remarkably proved by situationist movement in Paris in 1960s. Pioneers of psychogeography Guy Debord and his fellows explored urban environments in a playful *drifting (dérive)*. Psychogeography was defined in 1955 by Debord as "the study of the precise laws and specific effects of the geographical environment, consciously organized or not, on the emotions and behavior of individuals"[7], and as "a whole toy box full of playful, inventive strategies for exploring cities... just about anything that takes pedestrians off their predictable paths and jolts them into a new awareness of the urban landscape [8]. In Debord's *Psychogeographic Guide of Paris* (1957) the city is presented through a new partition formed out of spontaneity of the dérive [9]. The map of Paris is cut up in different areas that are experienced by some people as distinct unities (neighbourhoods). By wandering, letting oneself float or drift each person can discover his or her own ambient unities of a specific city. The mentally felt distance between these areas are visualized by spreading out the pieces of the cut up map.

Sustainable human-urban development requires from researchers to investigate the urban emotions in more detail. The frontier for this research nowadays is urban data analysis: each day users of social media, information sharing platforms, micro-blogging create enormous volume of geolocated data loaded with their evaluations of and emotions about the city space. Another line of cutting edge research and development is online services and mobile applications for emotional analysis and sharing.

## 2. Emotional Ambiguity of Social Media Data

Social media universe is already enormous and is constantly growing and evolving taking on different shapes of human behaviour. Globally, more than 2.8 billion

people or 37% of the world's population use social media on everyday life basis [10]. Personal profile in social media is becoming a digital avatar of a person, and her movements through the city space tracked through check-ins and geolocated posts become her digital footprint. According to Brand Analytics, on May 2017 the number of social media users was 38 million person, together have generated 670 million messages. In May 7 143 thousand new users have registered in Instagram, 1 171 thousand new authors have published 78 372 thousand tweets in Twitter, 1 953 thousand new authors have sent 53 413 thousand public messages in Facebook. For the same time period 25 722 thousand users of the most popular Russian social network VKontakte have sent more than 310 795 thousand messages [11]. The growing trend is "mobilization" of the social media, i.e. active users prefer to use applications for smartphones not their desktop versions.

Spontaneous user-generated data provides a number of advantageous features for the study of emotions in the city space:

1. *Coverage and volume*. Social media data is fastly growing while more and more users become active with their personal computers and smartphones, and more and more people share their emotions online [12].

2. *Details*. User-generated data provides an account on urban behaviour and its emotional aspects on individual level. For example, urban data allows to track routes of individual mobility in the city, use of different urban facilities, attitudes and preferences towards city space as well as social and demographic details of a certain user.

3. *Expressivity*. Almost every behaviour in social media is emotionally loaded while likes, check-ins, shares, recommendations, comments, emoticons reflect certain emotions and moods expressed towards urban space as such or specific places and venues.

4. *Richness*. Social media provides extensive information on different aspects of urban behaviours: mobility, space use (types of on-site activity), attitudes towards space. The range of different spaces is not limited and covers formal and informal environments, venues for work and leisure, third places and transit spaces, etc.

5. *Availability*. Social media data is stored on servers and in online archives and is often available for researchers [12].

Thanks to these advantages, emotional analysis of big urban data is rapidly developing along several methodological lines:

1. Analysis of semantic data

   a. Analysis of texts of commentaries. Tonal and sentimental analysis of text is used to define emotional load, which combine tasks of identifying sentiment expressions and determining the polarity or *valence* of the expressed sentiment [13]. One of the main drawbacks of sentiment analysis is low sensitivity to detecting different emotions, in the majority of cases analysis results in defining positive, negative or neutral emotional load of the text. Some of the authors identify a broader range of sentiment classes expressing various emotions such as happiness, sadness, boredom, fear, in addition to positive or negative evaluations [14]. Works on sentiment analysis focus both on full text as well as phrasal and sentence level [15], [16]. Analysis of semantic data can be upgraded with the help of machine learning, which can create a more finely tuned tool to recognize emotions in a specific dataset. Another way to elaborate textual analysis is multi-layer analysis of the

texts: quantitative analysis through sentimental analysis and qualitative analysis through discourse analysis of emotional expressions.

   b. Analysis of hashtags. Hashtags as highly suggestive and expressive bits of information can be parsed and considered separately along with other informational layers of the posts. Hashtags created by users themselves strongly vary, so it is recommended to use only frequent hashtags which appear in a significant dataset of different posts. Sentimental load for hashtags and smileys can be manually annotated by human judges, in particular, by Amazon Mechanical Turk service subjects. Analysis of hashtags is quite "noisy" and should be compared with other items, for example, Davidov et al. (2010) present multi-class analysis of hashtags together with analysis of smileys retrieved from Twitter [17].

2. Analysis of visual data

   a. Analysis of facial expressions. Widescale analysis of selfies taken with Instagram was conducted in frames of the *Selfiecity* project which resulted in development of an interactive interface for navigating in New York [18]. While moving through the streets the user can see a set of photographs of the local popular and unique places taken by other users. Analysis of facial expressions is helpful for preventing violence and aggression at certain urban settings, such as stadiums or during certain events, such as Olympic games [19].

   b. Analysis of smileys, emoticons and emoji. Another set of data is provided by icons expressing emotions in the text. These icons are much used in social media to eliminate the gap between online and offline communication and enhance understanding and interpretation of the text by the communication counterparts. Smileys might provide better results than semantic analysis or analysis of hashtags while they are originally limited and assigned particular meanings beforehand [17].

Though social media have become a powerful data generator for studying subjective perception of the city, analysis of urban emotions based on this data has certain drawbacks:

1.    *Loss of depth due to online anonymity*. Online communication is different from face-to-face since non-verbal communication is absent. Emotions are a major part of nonverbal communication and are most effectively translated through its mechanisms, such as the vocal tonality, intensity and volume, facial expressions, tactile feelings, etc. While emotions are expressed online in different ways - semantically through specific words or hashtags and visually through emoticons and photographs, detection of emotions through procession of the texts, photos or emoticons does not give the precise picture of face-to-face interviews, observations or other experiential methods.

2.    *Loss of truth due to conspicuous behaviour*. Alike T. Weblen's famous notion on "conspicuous consumption" [20] behaviours online could be named conspicuous or demonstrative, oriented towards visibility of the social status, political or cultural attitudes, fascination with fashion. The perfect framing of the social media of all types leads to concentrated visibility and specific rules of online conspicuous behaviour (considerate, socially conformal, goal and success-oriented).

3.    *Loss of representation due to lower scope*. The major age of the Internet audience as for now is below 50 years, the average age has not yet reached 45 years. Different social media are specific for different age groups, for example, Facebook is more popular within older people than other social media, age group of 45-55

years old makes up 15% of its users, 55 and above - 9% [11].

4.      *Loss of interpretative power due to fuzziness of subjective indicators*. Concentration of the emotions of a specific kind in a certain location might not have a direct connection to the place and its environmental features due to a multitude of other reasons, such as personal psychological state of a user, so they can't be regarded as firm explanatory variables or predictors of the emotions expressed in social media.

These considerations lead to an understanding that though social media is a fine resource for emotional analysis of the city, there are considerable drawbacks. The latter might be reduced if analysis of spontaneous social media data is conducted alongside with analysis of deliberately expressed emotions. Luckily emotions are the hot topic for many users and researchers, hence emotional sharing has become the core of many specialized online platforms and mobile-based applications. Emotional data generated in them is framed for emotional mapping, emotional sharing and even creating connections with people experiencing similar emotions. These data can be used together with emotional analysis of social media data for comparative analysis, which gives more reliable results.

**Digital Solutions for Urban Emotions**

Regarding viability of emotions many online services and apps focus on creating opportunity for people to share emotions which emerge in the course of their everyday life, in particular, while interacting with the city space. Such services, as foursquare[1], flamp[2], 2 GIS[3], Local experts by Google maps[4] give possibility to check-in, leave impressions and rate venues and places. Online tools and apps create different engaging mechanisms to keep users connected with the app, for example, customized suggestions on the places to visit formed by built-in algorithms along with the user estimated preferences in price, quality and type of products and services. The multitude of online platforms and mobile-based apps prioritizing emotional perception of the city constitute more or less definitive groups.

*Services with diagnostics of personal emotions*. Great share of existing applications are focused on measurement of emotional state of human body based on physical parameters and opt for elimination of risk of psychological disease, in particular, during the process of movement through the city. One of the examples is *Emotionsense* is a platform created by Cambridge University scholars to trace the emotional state of the person by processing audio data collected by personal smartphone, in particular, phone calls and audio chats [21]. To detect emotions - happiness, sadness, fear, anger or neutral reaction - the application analyzes laughter, pauses and voice timbre of the speech. *Spatial emotional awareness[5] (SEA)* provides a portable electronic wearable which allows a person to move throughout space based on locational proximity of people who can elicit good feelings [22]. As users navigates through the city space, portable device shows them the warmth coming from friends or supportive people and cold coming from people better to

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[1] https://foursquare.com/
[2] https://spb.flamp.ru/
[3] https://2gis.ru/
[4] https://maps.google.com/localguides
[5] http://emotionsense.org/

avoid.

*Services creating emotional maps.* Some of the services are more oriented towards mapping emotions in connection to certain locations and routes a person chooses in the city. These services are valuable for place-making, geo-marketing and tourism spheres because they help attracting people to certain places in the city. One of the examples, *Emotion Map* is a multifunctional application which gives users an opportunity to record and monitor emotions in relation to their activities and locations. In the app users place marks at locations they visit, choose their emotional label and label of their activities in that places. Marks can be shared with friends or with all app users. While travelling through the city users can check the location for interesting emotional marks created by their friends, all app users or themselves. Users can chat with each other and also receive daily reports showing personal emotional statistics [23]. *Bio-mapping* project by artist Christopher Nold (also see his book *Emotional Cartography*), though not an app, is a catchy example of emotional maps creation with the help of volunteers wired up with GPS and polygraph technology who wander around a neighbourhood area, noting feelings and reactions to their surroundings [24], [25]. Querias et. al. have created a crowd-sourcing platform to prove that there is more variability in ways which people prefer to take than just the shortest one, such as beautiful, silent and happy ones.

*Services creating emotional communities.* *WiMo* is a mobile app that allows people to share their emotions about specific places and store their emotional feelings about places. *WiMo* also creates a social network based on common interests and enables users to share opinions, experiences and passions about urban places [26]. *Tillbaka* app is a location-based storytelling and story experiencing system for web-enabled mobile phones. The system is based on a novel concept of pervasive play where stories emerge and develop on several dimensions, in particular, geographic one. The app was created to empower youth in a largely immigrant and lower-income neighborhood to share memories, feelings, and attitudes and engage in civic discussions about the neighborhood.

## Imprecity: Interactive Platform for Mapping Emotions

Imprecity interactive platform was developed for analysis of subjective perception of the urban environment (the name combines words "impression" and "city")[6]. Imprecity is designed to combine focuses and advantages of platforms and apps described above. On Imprecity map its authorized users - citizens or city guests - can leave emoji which symbolize 5 basic emotions about urban places and comments explaining these feelings. 5 basic emotions are defined along with Paul Ekman's theory and are namely joy, sadness, anger, disgust, and fear [27]. Collected 'soft' data is integrated into a coherent algorithm of expert-citizen interaction. Imprecity is one of the projects in frames of St.Petersburg Smart City programme supported by the city administration. One of the focuses of this program is elaboration of the 'smart citizen' concept and creating various tools to receive more feedback from the city dwellers and enhance their participation in urban development processes. Imprecity is tested and oriented towards St.Petersburg users, but can be scaled for other cities.

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[6] Imprecity website - www.imprecity.ru.

Imprecity is developed to engage multiple stakeholders: citizens can share their impressions and discuss urban places, they can also form groups of action aimed at upgrading places they love or vice versa places they find the worst and which hamper their emotional state. Experts in urban studies and urban development receive a unique subjectively loaded data which help them analyze citizen's perception of the city space. For the city administration emotional data is valuable to get an overview of citizen's subjective well-being and to define lists and ratings of places which need to be recovered in frames of city-led projects of urban regeneration, or saved as they are from developmental pursuits.

Engaging with Imprecity has three stages: 1) Mapping emotions (Fig. 1), 2) Forming community and 3) Taking action. At the 1st stage user can authorize through social networks (facebook, Vkontakte and Google+), put emoji and comments on the map, see the heatmaps for each emotion and a general one (Fig. 2). Mapping emotions stage is inheriting services and apps which are creating emotional maps. In nearest future Imprecity will provide its users with illustrated analytics about emotions of St.Petersburg, as well as comments and recommendations from experts about certain places, suggested places and routes. It is also planned to integrated personal statistics toolkit for the user, to take advantage of personal diagnostics of user emotions. Stages 2 and 3 are recently under development. It is planned that users which will be similar in emotional attitudes will be highlighted and suggested to each other. Authorized users will have a possibility to see their friends emotions. Imprecity will provide a chat function. Thus it is planned to create framework for forming of groups of people sharing common emotional experience. A group of people will be provided a possibility to suggest an idea for improvement of a certain place and submit it through Smart City St.Petersburg portal, where it will be considered by Program Office consisting of experts and city officials. The 'project group' will be provided with methodological tips, expert consultation and also information about different possibilities for citizen participation in St.Petersburg.

Such an algorithm differs Imprecity from other apps alike: those, which allow to share emotions about the city space, but do not presuppose further socially meaningful actions (like Foursquare, Ushahidi[7]); those, which support community formation, but do not link them with the experts community and city administration (like WiMo and Tillbaka discussed above, as well as Russian-based apps Locolo[8] and Kto Vokrug[9] (Who's around)); those providing opportunity to report the problems, but not create ideas for urban renewal (like St.Petersburg-based platforms citizen-led one - Krasiviy Peterburg[10] (Beautiful Petersburg) and governmentally supported one - Nash Peterburg[11] (Our Petersburg)); those which allow to vote for urban problems to be solved, but do not foresee community formation (like Moscow-based platforms supported by government Aktivniy Gorozhanin[12] (Active Citizen) and My Street [13](Moya Ulitsa)).

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[7] https://www.ushahidi.com/
[8] https://locolo.me/
[9] https://play.google.com/store/apps/details?id=com.whoisaround.android&hl=ru
[10] красивыйпетербург.рф/
[11] https://gorod.gov.spb.ru/
[12] ag.u-ude.ru/
[13] https://www.mos.ru/city/projects/mystreet/

**a.**

**b.**

**Fig. 1.** Imprecity mobile version. User Interface. (a) Starting page (b) Emotional heatmap for sadness (turquoise).



**a.**

**b.**

**Fig. 2.** Imprecity mobile version. Authorized user. (a-b) Choosing emoji from the list and placing it on the map. The map is filled with personal emoji: joy (yellow), anger (red), sadness (turquoise), fear (blue) and disgust (violet).

# Impressions of St.Petersburg: Analytical Tools and Test Results

Based on data generated through Imprecity we can use several analytical tools to visualize emotions of the city. Here we describe the tools and provide illustrative results on a pilot sample of data (400 emoji and comments from 15 users collected in September 2018). The test sample was created predominantly by MA students of the Institute for Design and Urban Studies at ITMO University, St. Petersburg.

*Emotional Heatmaps*
Emotional diversity and richness is an indicator of the usability of the space, of its ability to generate impressions at all. Urban places shouldn't be sterile or only filled with emotions of joy - it would signify artificial situation when other 'negative' emotions are controlled or suppressed. Interpretation of the emotional maps can be given along with specific environmental features of the given places which were emotionally valued. Imprecity test heatmaps show that users share joy much more than any other emotion, as well as it is also the most disperse and covers the whole of the city, even the Kronstadt island, however the biggest hotbed of joy is in the central city areas and locates close to the central streets with beautiful architecture, cafes and bars, and vibrant public life (Fig. 3, a). Concentration of other emotions is also biggest in the central city area, showing that along with good feelings space properties here elicit bad feelings. There are also some regularities, for example, sadness map shows a clot of sadness collocated with the former industrial area of the city, which is now mostly in ruined and abandoned state (Fig. 3, c).
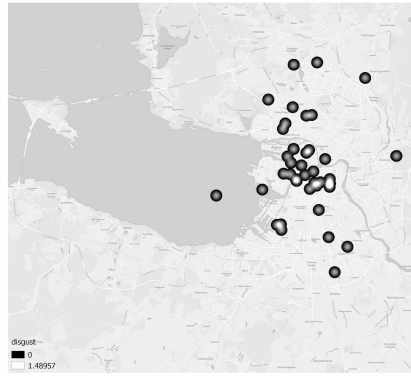


a.

b.

c.

d.

**e.**

**Fig. 3.**. Emotional heatmaps for St.Petersburg city scale (a) joy, (b) anger, (c) sadness, (d) fear, (e) disgust.

*Emotional Ratings of Urban Places*

Emotional ratings can be used as informative base for multiple tasks of urban planning and development, as well as different cultural and economic spheres. For venues and touristic sphere emotional ratings suggest choice of the best venues for creating touristic routes. For the urban planners and decision makers at various levels ratings hint the need to optimize conditions at specific venues. Ratings induce competitive thinking and thus stimulate development, though they should be always backed up with on-site analysis to receive deeper interpretation of the situation. Emotional ratings can be created not only for discrete points, but also for areas, for example, administrative city districts or neighborhoods.

The emotional ratings created for the test sample of Imprecity show that public spaces, such as squares, parks, embankments, are often rated both positively and negatively (Fig. 4). The most rated in joy is Aleksander Nevsky Square, a place favourite with citizens for walks in big historical cemeteries situated here (Fig. 4, a). The most rated with anger is Zenit Arena Stadium, which was built for the Football Match 2018 and has become a site for massive corruption by the city administration and construction companies with many negative feedback many from the citizens (Fig. 4, b).
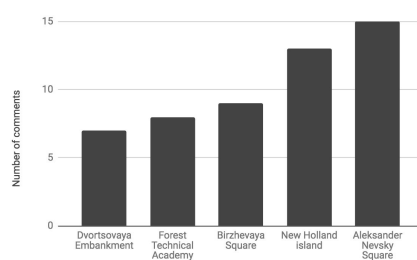


**a.**
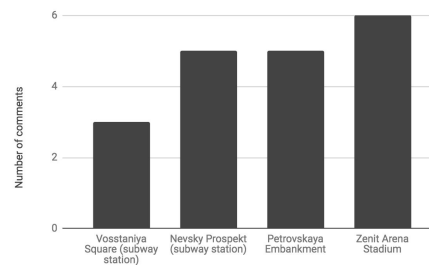


**b.**
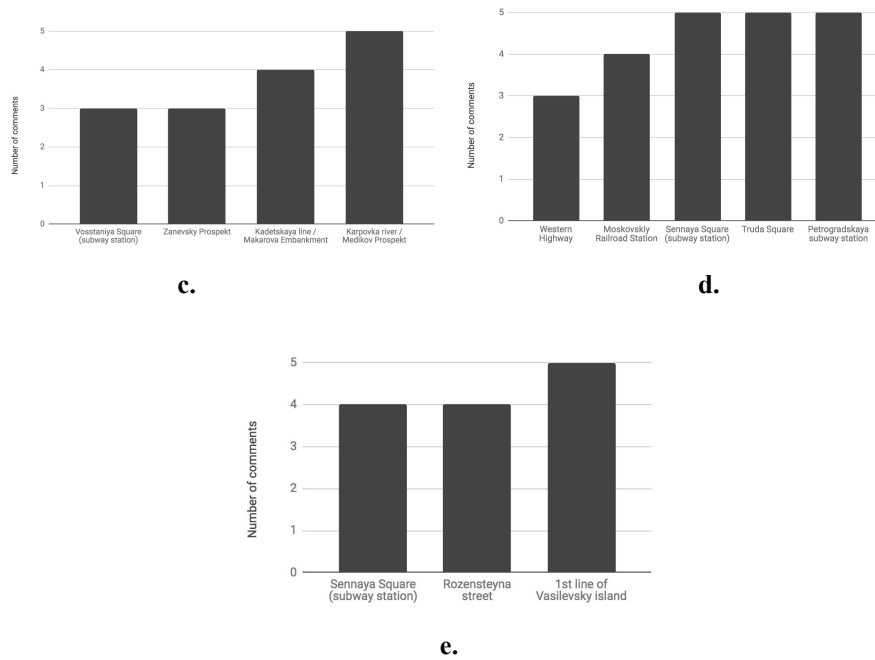
**Fig. 4.** Emotional ratings for top-rated places in St.Petersburg: (a) joy, (b) anger, (c) sadness, (d) fear, (e) disgust

*Semantic Analysis of Comments*

Along with emoji Imprecity generates its own semantic data through comments left by users when they place an emoji on a map. Semantic data can be subjected to tonal and sentimental analysis, which can be processed in different versions, for example, applying existing expert vocabularies of emotionally loaded semantics to user-generated comments or creating a subset of comments evaluated by experts and then using it for machine learning and consequent tonal analysis of the whole dataset. Comments given together with emoji serve as a source of verification for the conclusions made according to emotional heatmaps and ratings, as well as of unique stories which make understanding and interpretation of emotional values much more vivid. In particular, user stories hint the reasons why the emotion is formed or why it occurs in this place now. Here we show an example of a word cloud based on textual data from comments which are associated with the emoji of joy; the words are sized in accordance with the frequency of usage of the word. The most frequent words used are features of the places: adjectives and pronouns 'lovely', 'beloved', 'cosy', 'beautiful', 'cool', 'pleasant', 'public'; nouns signifying urban places: namely 'place', 'park', 'home', 'area', 'university'; nouns signifying properties of the place: 'panorama', 'musicians', architecture', 'greenery', 'landscape', 'coffee', 'cinema'; verbs and nouns signifying actions in the place: 'living [here]', 'walking', nouns signifying diminutive for the names of the districts of the city, namely Petrogradskaya and Vasilevsky island.

**Fig. 5.** Word cloud with comments for happy marks

## Conclusions and discussion

Analysis of emotional perception of the city space has long roots in different fields of research, and nowadays is a trendy area within data analysts as well as application developers. Emotional analysis is a way to improve quality of urban life and urban environment. Results coming from emotional analysis can be employed by urban planners, designers, as well as researchers to diagnose the 'subjective' problems of the city. However retrieval of subjective perceptions and emotional evaluations based on data coming from social media and other spontaneous data is still yet underexplored, and there are quite many drawbacks caused by the nature of data itself, as well as many methodological gaps, in particular, in analysis of particular emotions in connection to the city space, such as joy, anger, fear, etc. We suggest that analysis of social media data should be conducted together with data received deliberately from users with the help of services and apps, such as Imprecity.

We have and are still designing Imprecity as an interactive platform which combines advantages of other services and apps, as well as has an algorithm for connecting major stakeholders of the city - citizens, experts, and city officials. However, Imprecity is a work in progress and there is a series of risks it can face. First risk is deficit of usability if the motivational system is not created correctly. Many of the applications alike do not become popular. We are planning to overcome this barrier through creating a system of engaging infographics and analytics on the city level, which will be publicized by our mass media partners, and on the personal level, which will source for psychodiagnostics for Imprecity users. Second risk is that users won't actively engaged into creating content - sharing emotions and ideas - rather than consuming information. We are going to overcome this by creating a system of tokens or bonuses, such as discounts for cultural facilities and other venues, to praise active users. Third risk is failure of the coherent and sound relation between active citizens and city officials when it comes to the realization of project ideas created by initiative groups. We are planning to eliminate this risk by strong role of the experts who will also act as facilitators as well as by sharing a wide spectre of information on how citizens can participate in urban planning processes in St.Petersburg besides Smart City St.Petersburg Program.

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