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ENHANCING PLACES THROUGH TECHNOLOGY

Antoine Zammit and Therese Kenna (Eds.)

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Enhancing Places through Technology

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CONTENTS

Tweeting in Open Public Space

Case Study Belgrade

Aleksandra Djukic
Milena Vukmirovic
Jugoslav Joković
Nikola Dinkic

Abstract – *Public spaces represent essential elements of vibrant, inclusive, and smart cities. Being attractive, safe, comfortable, active and sociable, open public spaces play the main role in revitalizing communities, supporting their sense of identity and culture and triggering their economic development. Considering the current trends and demands in design and use of open public spaces, the role of ICT becomes more important. This paper will present and analyze the connections which are established and intensified between users and open spaces via online social networks. The emphasis will be on Twitter which currently has around 300 million active users.*

The case study is a network of several open public spaces placed in the historical urban core of Belgrade. The analyzed network presents one of the most attractive and important urban route for pedestrians with the squares as nodes. The method that was used in analysis is the method of mapping users on the social maps (via social networks) and through the other ICT tools. It was based on a new software application – Twitter search engine – developed at the University of Nis, Faculty of Electronic engineering, during the PhD course "Advanced topics in data and knowledge engineering".

The aim was measuring the concentrations of users in open public spaces. The obtained results have enabled the determination of the image of the open public spaces perceived by the users, as well as the intensity of users and tweets through the social networks, with the aim to measure the quality of open public spaces and concentration of users. This research has indicated the potential of the analyzed area for the formation of transverse and longitudinal pedestrian flows. On the one hand they could enable active use of a selected segment of the network as one of the most important urban pedestrian route of the city, as well as to improve the image of it.

Keywords: open public spaces, Belgrade, tweets, social maps

I. INTRODUCTION

The quality of public spaces is one of the most important factors influencing the increasing intensity of its use. According to a survey of Ellaway, in neglected and devastated open public urban spaces (waste, graffiti, animal droppings) in Europe, there are three times less users than in the good designed and well maintained public spaces [1].

If we focus on attractiveness, the general definition states that it is a quality of a person or an object which causes interest of other people. By observing it in relation to a place, attractiveness quantifies how much something is able to attract the attention and influence the decisions of one or more individuals ([2], [3]) and can help to explain a variety of spatial-temporal phenomena [4]. Various methods were used to express attractiveness in a quantitative way[1], while the very phenomenon was the subject of action of various disciplines: urban design, traffic, marketing, sociology, tourism, etc.

In the domain of urban design, Jan Gehl has equated the measure of attractiveness of certain space to overall quality of a location (public open space). By establishing correlation between the quality of public open space and the number of people that spend time in them, Gehl notices that by increasing the quality of the urban environment, the level of follow-up activities increases [5]. The stated correlation is presented in a diagram where it is seen that independent from the quality of outer environment, the level of necessary activities does not change, but by increasing the quality of the environment, the level of follow-up activities increases dramatically, which causes increase in social activities. Social activities[2] are a fruit of quality and the longitude of other two types of activities, because they happen spontaneously during encounters.

Over the last ten years, digital tools, social networks and applications play the main role in our everyday lives ([6], [7], [8]). This new way of communicating has already sharpened urban life through more dynamic exchange of information ([9], [10]). Furthermore, virtual performances posted by the users of social networks such as Facebook, Instagram, Tweeter, or other open generated data, may help urban designers to collect necessary information about cognitive and perceptive impressions of the users.

During the last ten years, Twitter has grown at an exponential rate, today counting among its active users more than 4 percent of all people living on Earth [11]. On its website, Twitter calls itself “the global town square - the place where people around the globe go to find out what’s happening right now”. It is one of the most popular data sources for research and offers an opportunity to study human communication and social networks [12] because of its open network allowing access to information published through the platform. Furthermore, it is an important social medium that allows creative participation of users and social maps are important indicators for measuring the concentration of users and their satisfaction about the quality of open public spaces.

With the aim to research the attractiveness and quality of the open public spaces on the selected territory, we have used data provided from Twitter as a base for evaluation of the concentration of the public space users which is interpreted as a indicator of public space attractiveness.

[1] Primarily the Gravitational Attractiveness Model by Reilly and the Theory of Central Places by Christaller.

[2] They do not include children playing, greeting and conversation, mutual activities of various kinds or simply observing and listening to other people.

II. METHODOLOGY

Having in mind the general aim of the research, measuring the concentrations of users and recording the status of attractiveness of open public spaces in the city center, the focus is placed on the spatial level of the problem. The intensity and concentration of users was measured and their satisfaction about the quality of open public spaces was recorded. The research used the method of geo mapping – social maps.

Geotagging is the process of adding geographical identification metadata to various media such as a geotagged photograph or video, websites, SMS messages, QR Codes or RS feeds and is a form of geospatial metadata. This data usually consists of latitude and longitude coordinates, though they can also include altitude, bearing, distance, accuracy data, and place names. It can help users find a wide variety of location-specific information. For instance, one can find images taken near a given location by entering latitude and longitude coordinates into a suitable image search engine. Geotagging-enabled information services can also potentially be used to find location-based news, websites, or other resources. Geotagging can tell users the location of the content of a given picture or other media, or the point of view and, on some media platforms, show media relevant to a given location [13].

Geographic information systems (GIS), as the systems for storing, processing and manipulating geospatial data [14], allow the visualization and analysis to have geo-reference. Geo-information is now used on a daily basis - photos can be stored with location information, users on social networks publish their location or require the shortest path to the desired object in the city. Geographic information attached to tweets are used primarily as a mechanism for filtering [15]. Geotagging is the case when Twitter users make available their position, so others can see the exact place where the tweet was sent. Information can be analyzed based on location and profile generated by the user.

Twitter search engine is a Web application that enables the collection, storage, processing and analysis of data from the social network Twitter. It is the micro-blogging platform that provides a rich collection of real-time commentaries on almost every aspect of life. Data collection is based on the Twitter REST API [16], that allows the collection of tweets in the space defined with geo-referenced points and the given radius. This API provides a wide range of information related to their own tweets and users who post them. In addition to basic information such as text, time, number of retweets, the number of likes and information about the application from which it was posted/sent, the geographical location of where the tweet was shared presents the basis for the analysis and processing of geospatial data.

A large amount of data necessary for a successful and good analysis is the main advantage of Twitter REST API, but at the same time, availability of data only over a period of seven days from the moment of sending the request can cause major constraints and obstacles. Furthermore, this API provides the tweets that were sent in the last week within the given

radius from a predetermined location. Improvements and developments of API were necessary regarding the collection and storage of data for a longer period than seven days. In order to overcome these problems, Twitter search engine allows collection and storage of data for unlimited periods of time.

In addition to the collection and storage of data, this application offers a display, analysis and execution of complex geospatial queries of the data stored in the database. These queries are executed with the help of relational geospatial functions offered by MySQL database. These functions are correlated (i.e. there is interrelationship between the two objects determined with georeferenced points). The application also has the option of drawing a polygon on the map of Google, within which analysis has been carried out, taking into account that the site must be within the area for which information was collected.

The polygon of the research included the area of Belgrade city center and its five main open public spaces have been chosen: Kosancicev Venac, Republic Square, Sava Quay, Park near Vuk's Monument, and Slavija Square. The selected public spaces present the most recognizable nodes at the city level. Kosancicev venac is one of the oldest preserved residential areas of the city with the best position, next to the Belgrade Fortress, on the hill above right Sava's riverfornt with the one of the most attarctive vista of the city. Republic Square is the city square and the most important pedestrian and traffic node. The buildings of National theatre, National museum and lots of cafes and stores are positioned on it. Sava Quay is a recently revitalised area of old warehouses where the most interesting restaurants and clubs are located. Park near Vuk's monument is situated in the heart of the University district, next to five technical faculties and a student dormitory builidng. It is recognisable by the huge green area and underground railway station. Slavia Square is one of the most frequent traffic nodes in the city that connects the motorway with the city centre and the main train station. The considered spaces are the most frequented and the most attractive open public spaces in walking distance, within the historical urban core of Belgrade. The active use and the distances between selected open public spaces, can provide the network of transverse and longitudinal pedestrian flows which connect them and form the network [17].

The heatmap presented in Fig. 1 shows the places people like, based on the number of panoramio photos at each place in Belgrade [18]. Markers show the hottest places on the map: lighter markers are hotter. Hotness of a spot indicates the number of photos taken there. The hottest places have markers linking photos, streetview, wikipedia, wikivoyage, foursquare and google plus articles about the site. Area populations are based on the geonames database.

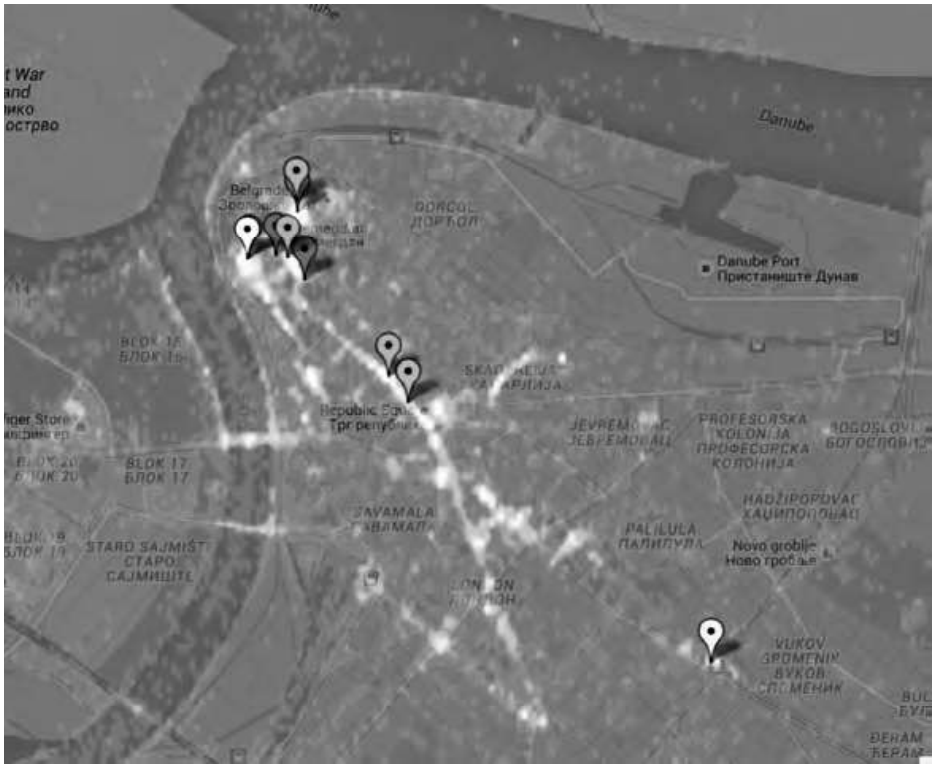

Figure 1. Hotness of a spot indicating the number of photos taken in Belgrade.

III. RESULTS

As a first step of analyses regarding geo-maping, all geocoded tweets sent between July 1st 2015 and February 29th 2016 were collected. It is important to point out that tweets were collected in predefined places of interest determined by coordinates and radius. The data illustrating attractiveness of places, based on activities of Twitter users at the Kosancicev Venac, Republic Square, Sava Quay, Park near Vuk's Monument, and Slavija Square, in the considered period, are presented in Table 1. The data about the number of geocoded tweets emanating from these locations are presented in Table 1. and Fig. 2. The most visited location was Republic Square, whilst the least visited location was Slavia Square.

A. The representation of tweets at locations of interest

In the considered period of eight months, 2,872 tweets, posted by 1,041 users were collected, which means that each user on average posted 2.759 tweets.

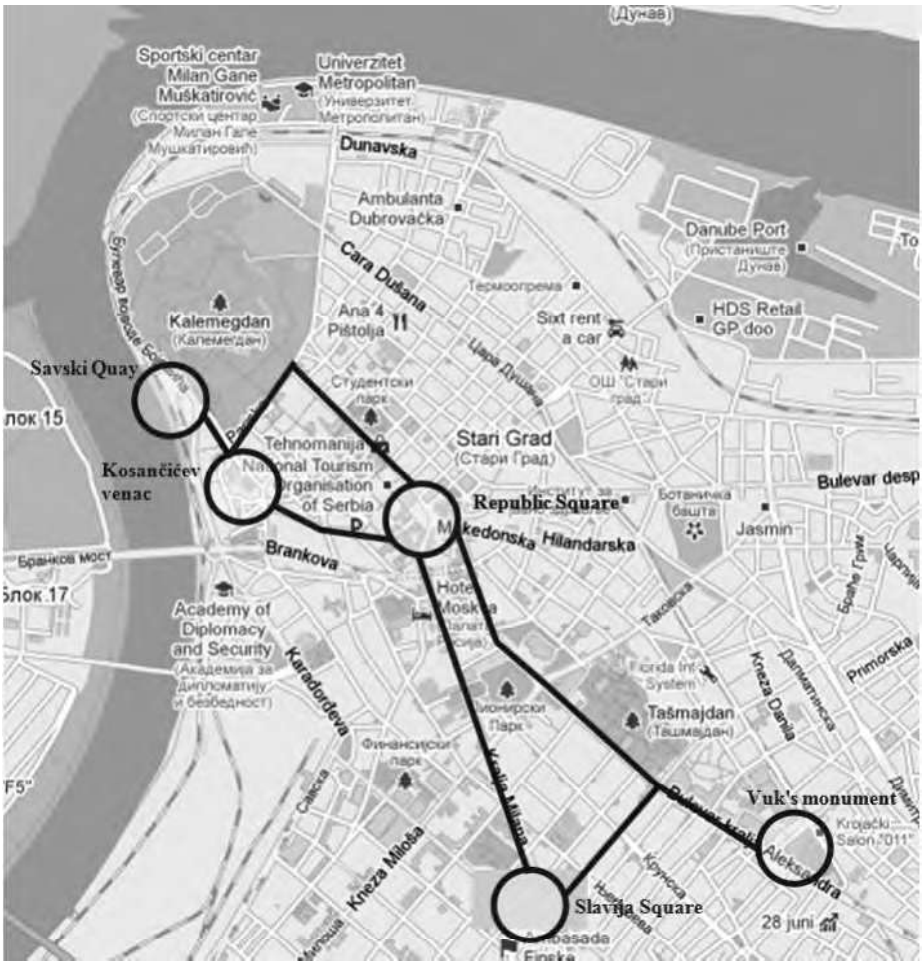

Figure 2. Spatial distribution of tweets at selected locations.

TABLE I. THE NUMBER OF TWEETS BY LOCATION

No	LOCATION	NUMBER OF TWEETS	PERCENTS
1.	Republic Square	1809	66%
2.	Kosancicev Venac	639	20%
3.	Vuk`s Monument	240	8%
4.	Sava Quay	155	5%
5.	Slavija Square	29	1%

The activity of users on a monthly basis is shown in Table 2. and Fig. 3. On average, 359 tweets per month were collected. The users were most active during September, with 440 tweets, and the least active during January with 233 tweets. According to the collected data, it can be concluded that largest number of tweets has been posted in Republic Square during September (314) and the second largest were posted in the same location during July (263). During August there were no posted tweets on Slavija Square which is, at the same time, the location with the least number of posted tweets during each month. Significant difference in the number of tweets by months is noticed at the location of

Vuk`s Monument. This fact can be connected with the classes during winter semester and presence of the students, because the recorded number of tweets is two to five times higher during the semester.

TABLE II. THE NUMBER OF TWEETS BY LOCATION AND BY MONTH

No	LOCATION	NUMBER OF TWEETS BY MONTH							
		JULY 2015	AUG. 2015	SEP. 2015	OCT. 2015	NOV. 2015	DEC. 2015	JAN. 2016	FEB. 2016
1.	Republic Square	263	237	314	206	217	213	147	212
2.	Kosancicev Venac	66	80	69	85	98	73	66	102
3.	Vuk`s Monument	26	16	27	49	48	48	8	18
4.	Sava Quay	12	13	26	30	16	27	10	21
5.	Slavija Square	3	0	4	11	2	4	2	3
Total		**370**	**346**	**440**	**381**	**381**	**365**	**233**	**356**

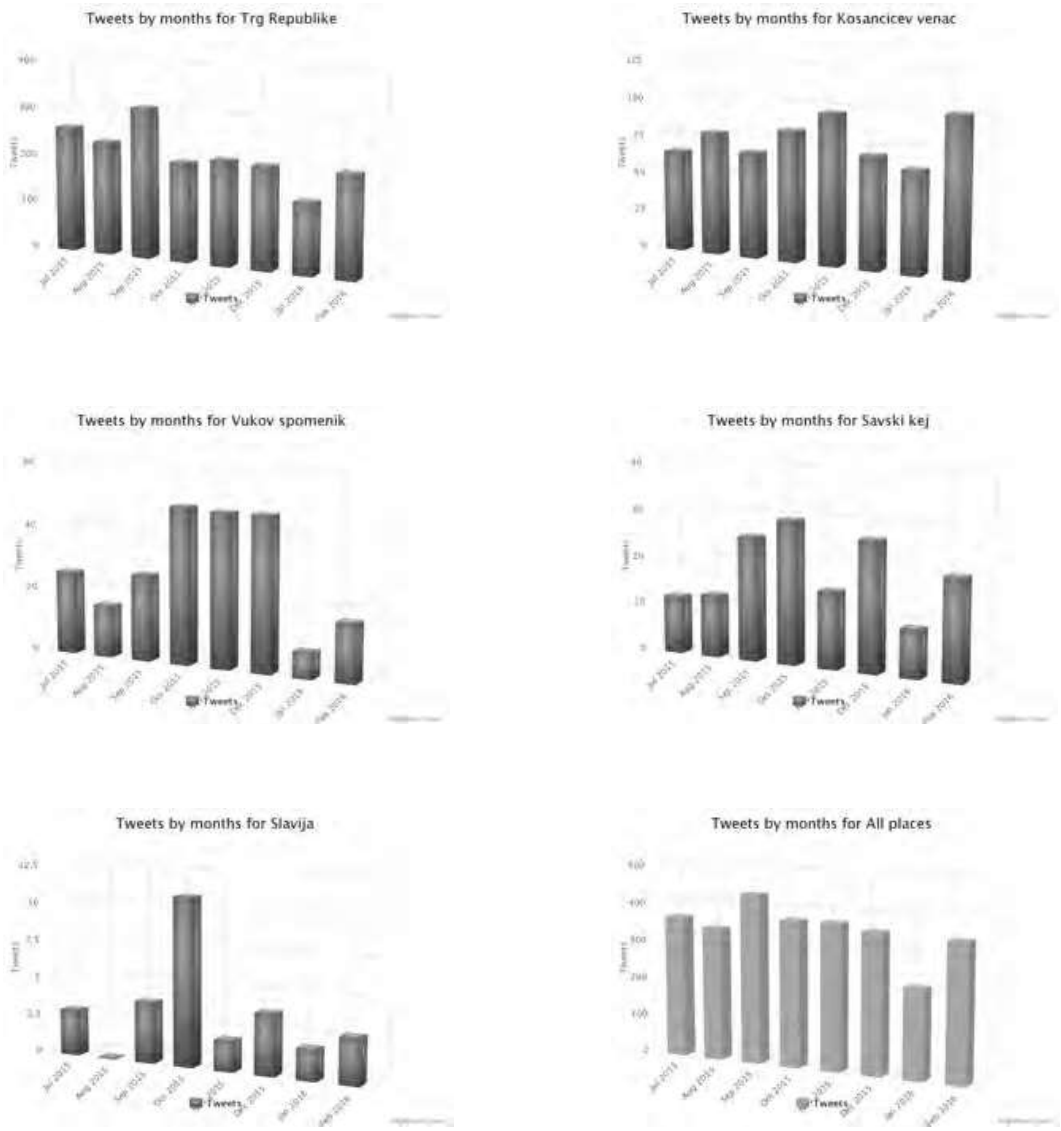

Figure 3. Number of Tweets on a monthly basis per location and for all locations.

B. Applications used for post and content of tweets

The users posted 2,872 tweets at selected locations by 15 different applications. Distribution of tweets by applications that are used for their sharing is not equal. The most popular social network is Instagram with 1,325 tweets (46.1%), following Foursquare with 1,215 (42.3%), while other applications are represented with 332 tweets (8,9%). The popularity of applications for sending tweets varies according to the location from which the tweets were posted. Regarding the application from which the tweet was posted, it is possible to conclude about the content of the tweet. Three categories of the content of tweets are presented in Fig. 4. and 5. Foursquare is a location-based social networking website for mobile devices, such as smart phones. Users "check in" at venues using a mobile website, text messaging or a device-specific application by selecting from a list of venues the application locates nearby.

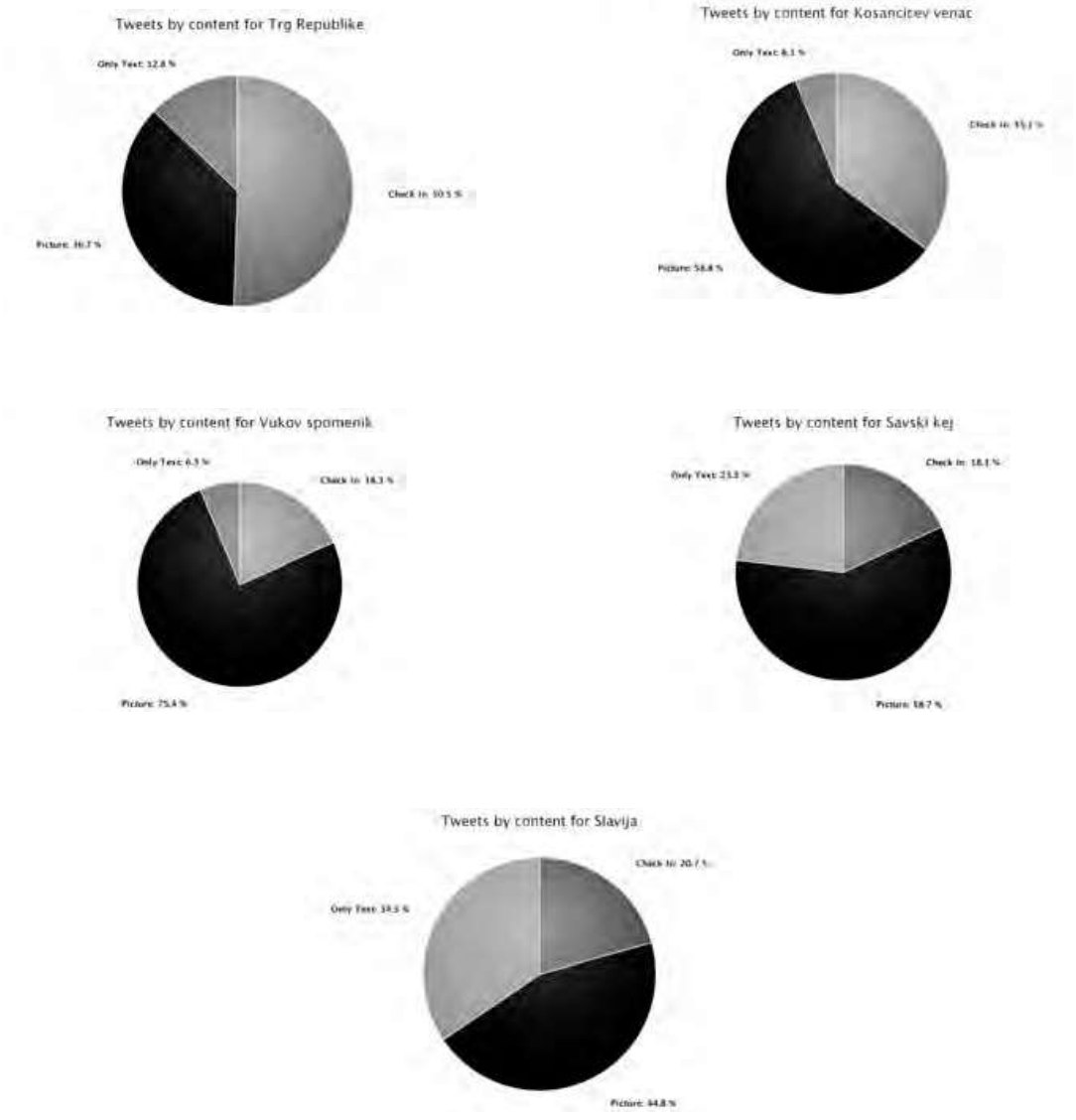

Figure 4. Distribution of tweets according to the content at selected locations.

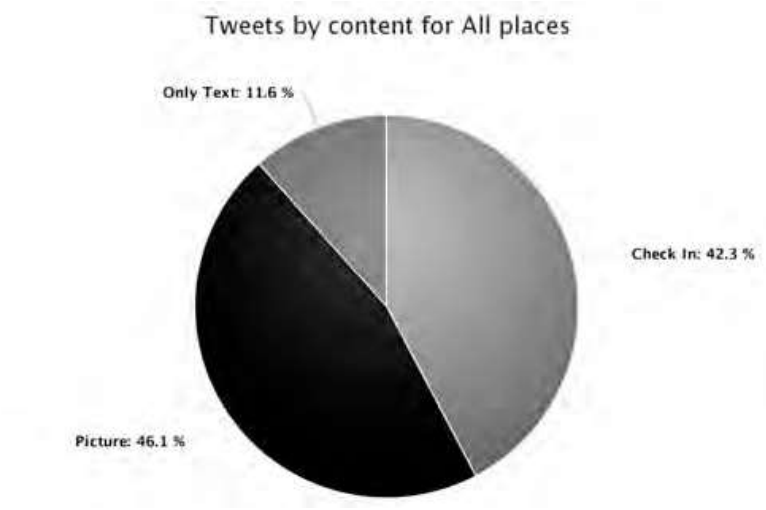

Figure 5. Distribution of tweets according to the content for all locations.

Instagram is an online photo-sharing, video-sharing and social networking service that enables its users to share their photos and videos, apply digital filters to them and share them on a variety of social networking services, such as Facebook, Twitter, Tumblr and Flickr. The social network Instagram allows users to add different types of filters, a specific figure on which we can make conclusions about the content. Users most commonly take photographs at the locations of Kosancicev venac, Vuk`s Monument and Sava Quay, while the Republic Square is the most popular location for CheckIn. Slavia Square is the location where the most tweets (34,5%) are recorded in relation to other types of social network content.

C. Popularity of tweets

A large number of factors influence the popularity of the tweets, but the two mos important ones are the number of followers of a user and information about user activity that is, how often the user post the new tweets. Accordingly, popularity of tweets can be divided into two categories: the popularity based on the number of shares (retweets) and the popularity based on the number of "likes".

The most popular tweets based on the number of shares, or retweets, are presented in the Fig. 6. As can be noticed, even 9 of the 10 most popular tweets are posted on the Republic Square. Furthermore, only 3 tweets are posted by foreigners, while the other users are citizens of Serbia. The most popular tweets regarding the number of "likes" are presented in Fig. 7. Popularity based on support (Like) is most evident in the locations of Republic Square and Kosancicev Venac. All the tweets are posted by the citizens of the Republic of Serbia.

Finally, as an illustration, the most popular tweet in both cases during the period of eight months is the one that describes the changing identity of the most important open public space within the historical city core. It consists of six words "Once bookstore "Yugoslavian books" today MaxMara" (Fig. 8).

#	Ime	Text	Mesto	Broj deljenja
1	Kompjuter biblioteka	U 6 reči : Nekada knjižara Jugoslovenske knjige, danas MaxMara. http://t.co/OOjckdacpo	Trg Republike	15
2	Jovana Gligorijević	Medija centar, sad. KZN povodom zabrane #sedamhiljada #SrebrenicaGenocide20Years http://t.co/FwOZfowtRz	Trg Republike	6
3	André Fran	Na Sérvia, em um centro de distribuição de mantimentos para refugiados, um menino sírio desenhou a... https://t.co/RCQPAwZmfh	Trg Republike	5
4	Sergey Ponomarev	#refugees travel by train as go to #belgrade. #migrants #refugees #nytassignment #onassignment... https://t.co/Xw1Yr3qDT0	Trg Republike	4
5	Jovana Štetin	Nedeljni ručak kod tašte :) @ Beograd na vodi https://t.co/epv18byXnC	Savski kej	4
6	Milos Djajic 6962	#zonabezmrznje (@ Trg Republike in Beograd) https://t.co/rugcibwlft http://t.co/ExM4vjEQz2	Trg Republike	3
7	Tanya L. Domi	Beograd Pride! @ Beograd https://t.co/tOc6EIQF5d	Trg Republike	3
8	Gr. opština Vračar	U @SkolaRibnikar čestitali smo prvacima/kinjama proces godine, poklonili im knjigu i deo pribora :) Srećno! http://t.co/TRIETljk9M	Trg Republike	3
9	Milena Rasic		Trg Republike	3
10	Milos Djajic 6962	Medjunarodni dan demokratije i KZN (at @Medijacentar in Belgrade) https://t.co/JVBgsCDp9v http://t.co/DwWYrRdCly	Trg Republike	2

Showing 1 to 10 of 10 records

Figure 6. The most popular tweets based on the number of retweets.

#	Ime	Text	Mesto	Broj deljenja
1	Kompjuter biblioteka	U 6 reči : Nekada knjižara Jugoslovenske knjige, danas MaxMara. http://t.co/OOjckdacpo	Trg Republike	49
2	N E N A	Panic Ljiljana Marija 25.07.1936 -14.07. 2015. Moj drug, moja sreca, podrska. Moja draga majka.	Trg Republike	44
3	SEDMA SILA	"Beograd na vodi" Da li dobro vidim da se ne dešava ništa na lokaciji? Faza 0 A	Kosancicev venac	34
4	Zoran Čičak	Malo istorije... Branislav Nusic (u sredini) sa prijateljima, pocetak 1930-tih. Moj deda Milorad, stoji treci s desna http://t.co/YEwEuV9BTk	Kosancicev venac	29
5	Natalija Jeličić	@Blondie_Yeah and me❤ http://t.co/t1Z1rIRZOX	Trg Republike	26
6	Jovana Gligorijević	Svaki put kad premijer podigne naočare, jednoj pandi umre mama.	Trg Republike	26
7	SEDMA SILA	Koliko je sve u ovoj zemlji otišlo u PM ako uzmemo u obzir koliko ljudi ima, a medju njima i poznatih ličnosti, koji nemaju struju.	Kosancicev venac	24
8	LUTKA IZ IZLOGA	Dobro jutrooooo ❤ (@ Knez Mihailova in Beograd, Central Serbia) https://t.co/pCSeibCvb9 https://t.co/IRA6q739OT	Trg Republike	21
9	kamila na kisi	Nesvakidasnja ljubav usla je tiho, na prstima u moj mali svet.	Trg Republike	21
10	kamila na kisi	http://t.co/3AVui5wRHq	Trg Republike	18

Figure 7. The most popular tweets based on the number of "Likes".

IV. DISCUSSION AND CONCLUSION

The results of the analysis in this paper represent only part of the possibilities of Twitter search engine application. In general, the social network Twitter is convinient for this type of research, since the platform (REST API) provides support for data analysis, primarily based on a large amount of public information that is crucial to any successful analysis.

According to the analysis of data collected during the period of 8 months (July 2015 – February 2016) in five of the most important open public spaces within the historical core of Belgrade: Republic Square, Kosancicev Venac, Vuk's Monument, Sava Quay and Slavija, it can be concluded that each user has sent 2.8 tweets on average and that the users were the most active during September. The users posted tweets via different applications, mostly through Instagram (46.1% of all tweets), and Foursquare (42.3%). Accordingly, 46.1% tweets contained pictures, 42,3% of the tweets were used only for CheckIn, while only 11.6% of all tweets contained text-only. According to the data provided by the research, the number of open public space users are not equally distributed on selected open public spaces. Republic Square is the open public space with the largest number of tweets, with 66% of all collected tweets. Republic Square is next to the main street Knez Mihajlova and within walking distance of the Kalemegdan fortress and park. Furthermore, other points of interests for public space users such as facilities, parks, cafes, restaurants and shops are in large numbers near by. It is obvious that the concentration of activities provides the concentration of users and pedestrians. On the other hand, Slavija Square is the location with the smallest number of Twitter users. It is an attractive public space but mostly dedicated to traffic with less concentrated activities than in Republic square or Vuk's Monument. There are large groups of pedestrians who are just walking through the locations and usually do not stay more than is necessary for passing through it.

The fact that the most popular tweet from the location is the one dedicated to the image of the place, collective identity is also very important for our survey. It can be concluded that the constant changing of the image of the most important public spaces within the historical city centre, even if it is only changing the activities and functions, is one of the main concerns of the Twitter users. Globalization and insisting of unifications of all main streets and squares regarding the types of activities and brands in shops, could provide less interesting places without identity. Futhermore, so called "no-places'' can contribute to users feeling like they are at home in every town or city worldwide. In general, data from Twitter represents an excellent basis for different types of analysis. All analysis that can be performed in the context of this application can greatly help in designing urban plans for the city. They can also be used to test the attractiveness of certain locations, and public open spaces in the city, as well as their mutual correlations.

Figure 8. The most popular tweet for the period of 4 months in selected locations – "Once the bookstore "Yugoslavian book", today MaxMara".

In this regard, the possible directions for future research are related to the semantic analysis of content, such as classification of positive and negative impressions based on tweets, as well as the creation of the happy user traces.

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Fostering knowledge about the relationship between Information and Communication Technologies and Public Spaces supported by strategies to improve their use.

CyberParks Project, funded by the European Cooperation in Science and Technology Programme | COST TU 1306 - www.cost.eu/COST_Actions/tud/TU1306), is a collaborative research platform for knowledge and experiences exchange on the role of Information and Communication Technologies (ICTs) to promote participatory urban design processes and the production of inclusive public open spaces. CyberParks is devoted to explore the contribution of ICTs to transform our cities into more social environments, rather than just more high-tech.

In April 2016 CyberParks organised the mid-term research event **ICiTy - Enhancing places through technology**, in Valletta, Malta, focused on the opportunities and challenges to public spaces brought about by the advancements of ICTs. The conference provided an excellent opportunity to synthesise the current 'state of the art', which is now reflected in this collection. It presents interdisciplinary perspectives, analysis of new methodologies, new theoretical or conceptual models for the digital era, as well as preliminary studies of peoples' use of, and engagement with, technology in public spaces.

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