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SOCIAL NETWORKS AS SOURCE OF GEO-CARTOGRAPHIC DATA ANALYSIS

ABSTRACT

The main aim of this paper is to investigate the use of data accessible through social networks on issues pertaining to contemporary needs of geographic and cartographic analysis and configuration of today's urban reality.

Today, with the widespread use of mobile devices and the free and easy access to the Internet, more and more people share information on their activities in social media.

This information may be accompanied by spatial data on the user's location at the time of publication. Following the theoretical framework of participatory planning, which wants the design basis to be the citizen, social media are probably the cradle of this approach and this logic.

The use of such data creates a new perspective on how those involved with the spatial analysis can perceive the choices and needs of people even in real time.

In this paper, we will present the results of digital data correlation with the physical space to take advantage of the various sectors of modern urban centers. The method of collection and visualization of data and the issues have been reasonably created, examined and analyzed in the context of work.

KEYWORDS:

social networks, geographic analysis, urban and participatory planning

INTRODUCTION

As urbanization levels are continuously growing at unprecedented rates, urban areas tend to acquire a very different and complex form. The large concentration of population in cities, although it can offer many socio-economic advantages, is directly related to serious environmental problems [Andrikopoulou *et al.*, 2007]. Difficulties in managing waste, natural resources, transportation, in-

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adequacy and aging of building infrastructure are the modern challenges in city operations today (Smarter Cities for Smarter Growth).

To address these contemporary problems, spatial-urban planning is required to provide effective solutions and directions for achieving urban viability. Giving, as stated in the EU Intelligent Planning Strategy, a specific emphasis on the European Innovation Partnership of 2013.

In this context, this work seeks to explore new sources of information provided by the citizens themselves and may enrich the individual planning processes. In the Big Data era, urban planning can be fed by user data. Social media tools act as flow channels for such data, where users publish real-time information about their physical location or enrich the already existing points of interest.

Forming spatial knowledge is a multidimensional process that requires a set of actions and activities that are often costly, time-consuming or resource-intensive. Scientists exploring the site can study this information to better understand the current state of a region, utilizing spatial knowledge shared by users. This method has advantages over the cost and time of the method as well as the remote realization of the overall work.

MATERIALS AND METHODS OF RESEARCH

Participation and modern technologies in spatial planning

Participation in spatial planning

Undoubtedly, in the entire process of urban planning the main component is the same citizens who experience the reality and the problems around them better than anyone. As mentioned in the relevant literature, participation must be a strategy that leads to the development of a more optimistic, desirable and virtually just city, without social exclusion, where differences are not just tolerated but treated with recognition and respect [Andrikopoulou *et al.*, 2007; Fainstein, 2009].

This knowledge of the citizens is a rich source of up-to-date information, which can help improve the quality of analyses, leading to solutions different from the usual data.

In contrast to traditional participatory spatial methods, which failed to collect useful data, and promote the exchange of ideas adequately [Forrester *et al.*, 1999; Van den Brink *et al.*, 2007 cited by Bugs et *al.*, 2009], the recent development of participatory technologies such as social media tools can be a development tool that will introduce more interactive and effective methods.

Technological tools and geo-network

The development of communication and information technologies is one of the most basic features of the last decade. The intensity of digitization with the simultaneous consolidation of the internet has caused the transition of digital space from an amorphous and abstract world-wide form to its individualization and integration into the daily routine of people [McCullough, 2005].

As McCullough reports [Knudsen *et al.*, 2011]: Instead of pulling us through the glass in a sterile and bright world, digital technology now flows out across the screen in our messy world, according to the rules of physics, built in our rooms, built in our brackets and devices – everywhere. In the field of the city, the data may come from either the whole installed sensors and the connected databases or from the citizens themselves. Data recordings, as digital traces of human reconciliation [Guo *et al.*, 2010], often refer to movements, energy consumption, economic activities or the location of points of interest [Batty, 2013].

Social networks and geo-network

The entity of these data, which is linked to the physical space, forms the geo-web. Geo-Internet is commonly referred to enriching web content with geographic information systems using the technologies and tools offered by Web 2.0, such as user interactivity for content generation. A central practice closely related to the use of geo-Internet, as reported by Ellwood [2010], is the geotagging of "online" content, such as assigning names, coordinates or other spatial data to a text, image, video or other content of the Internet. Geographers approach the geo-net with a series of neologisms such as Turner's Neogeography [2006], volunteered Geographic Information (VGI) Goodwill (2007) and New Spatial Media of Champton [2009b], as well as one theoretical framework with methodological data usage practices, user privacy, and critique approaches to the societal impact of geo-web

on issues of participation, politics, power and knowledge [Dodge and Perkins, 2009 cited by Elwood, 2009, 2010; Flanagin and Metzger, 2008]. A basic source of geo-spatial information is social networking tools. The information is made available in real time through the sharing of text, images and locations [Wen & Wei, 2016] which are indissolubly linked to the physical space.

Spatial point of view of social networks

Facebook

From the point of view of spatial analysis, Facebook enables users to publish their presence on any Point of Interest of the natural world as well as the ability to add their own POI. The publication of physical presence in one place is achieved by the "Check In" function, where the user can attach to any distributed information. The "Check In" was initially only achieved with the smart phone devices where the built-in service of the GPS satellite signal was used to locate the user's location. Later, GPS was a complementary service for the proposal of points within easy reach of the user, and Check In could be carried out even by fixed computers, regardless of the actual location of the user. Points of interest, which users declare their presence, are registered in the network database and include the total number of users who have visited it since they were created. This cumulative magnitude can benefit in the spatial analysis process as we can easily build the existing state of a region by recognizing patterns of areas of interest and concentration of the population. The map of POIs of an area, after proper pre-treatment, can be used to extract data in real time. In this way, the observation of the conditions and the imprinting of the movement of the users in the natural world according to the temporal change (concentration of people according to the time of the day) is achieved.

Twitter

From a spatial point of view, Twitter allows the geo-referencing of a message in such a way that the physical space to which the message refers can be known. Unfortunately, only 1% of the messages posted to the service are geo-referenced, so more research is needed to locate and link messages that relate to space with specific spots in the physical space. Specifically, the analysis of texts and messages can contain useful geo-information to accurately locate the reporting position of a message. The work of S. Middleton, L. Middleton, S. Modafferi [2014] has shown that through a combined text message analysis and word recognition process describing a particular location, the identification of the reporting position of a message can be achieved with great precision. Their work on the mapping of crisis situations, such as natural disasters, has resulted in the creation of a complete picture of both building damage and other damage and dangers that occur almost in real time in the case of Hurricane Sandy in New York and a similar hurricane in Oklahoma in 2014.

Methodology of data collection and processing

In order to explain the method followed for the development process of this paper, a flow chart visual presentation is given and the individual steps are then analyzed.

In summary, the following various stages can be distinguished according to the environment in which the data are processed:

1. **Environment of Geoinformation Systems (GIS).** Collecting coordinates from the study area, which will be used as search points of points of interest in the Service.
2. **Online application.** Connect to the Service and search for points of interest.
3. **Editor applications.** Editing and formatting of data.
4. **Visualization tools for presenting geographic data (Visualization Tools & GIS).** Visualize and analyze data to extract useful spatial information.

The spatial data searched are now ranked by point of interest within social networking databases. The collection of these data is made possible under the operating rules of the API Application Platform, and may vary depending on the social networking medium. In this task as usual, the Service returns points of interest that are located in a user-defined radius in meters from a user-defined point of coordinates. Initially, it is necessary to identify the points that will be later introduced to the Service as search centers, taking care of the spatial coverage required by the survey. Later on, the Service is searched for by the required procedures. Data returns must be processed and formatted appropriately so that they can be linked to other analysis and visualization software. Fi-

nally, the spatial analysis of the data and its visualization is done, with the final aim of extracting useful conclusions.

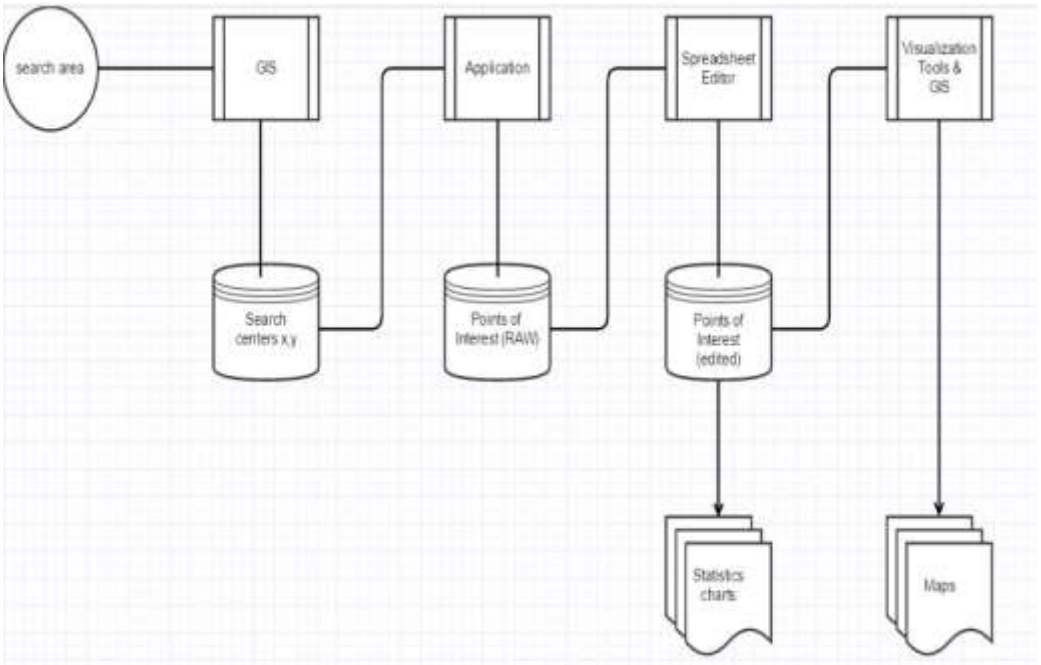

Figure 1. *Flow chart of the paper*

RESULTS OF RESERCH AND ITS DISCUSSION

Data analysis

After collecting 73,328 separate POIs (81,537,672 published check-ins) and covering the largest geographic area of Greece in order to investigate the value of information and the correlation of digital space as depicted in social networking means with that of the physical space Statistical and spatial analysis tools were used. The following features can be identified. By collecting the 10 main categories, which account for 95% of the points of interest, the service can be attributed to the results of a close relationship with the service, leisure and entertainment sector. However, by comparing the percentage of points of interest identified with the number of publications they collect, we see differences depending on the category. In the categories of local businesses such as restaurants, cafés, bars, night clubs, the number of spots is higher than the percentage of publications made on them. There is a number of businesses that, regardless of their publicity in the digital domain, have created their digital link. On the other hand, the categories of retail stores, hotels, services, and class of education gather a larger number of publications corresponding to the percentage of points of interest they represent. The tendency to publish the presence of users of a social networking medium to a point of interest in which a service is produced and offered can be assumed to be related to economic activity occurring in the physical space of an area. By looking at this, we look for causal relationships between digital aggregation elements, GDP per capita, population, tourist accommodation, and prefecture level.

The following search for the correlation of economic factors with the number of publications is not an end in itself and its subject matter is moving away from the field this paper wants to focus on. The main reason for its existence is to cover a point: the spatial data entity, which has not been explored.

Spatial zones of high and low activity

By visualizing data at the city level, we can understand the multi-center system of an urban area. The various local centers by concentrating more activities on the residential areas can be easily identified and grouped by the number of publications made through the spatial analysis tools.

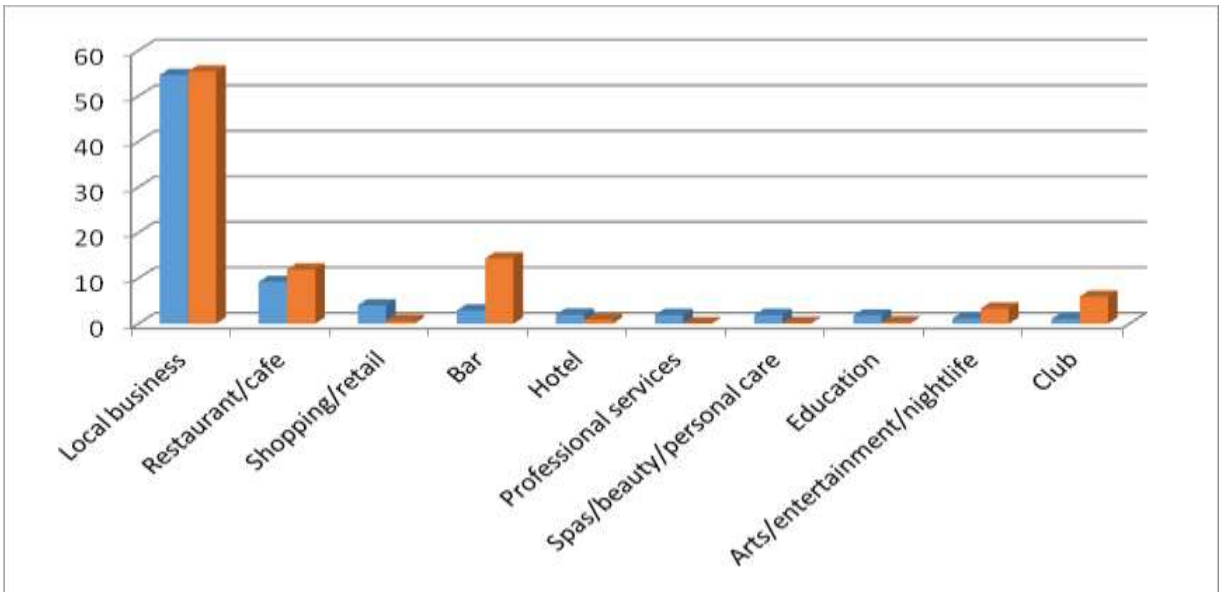

Figure 2. *Comparison of number of POIs and publications per category (Facebook Source, Incorporated)*

Using a statistical "Hot Spot Analysis" (Getis-Ord Gi*) 8 distinct spatial zones are observed. This tool detects statistically significant hot spots or cold spots, calculating the statistical value of Z. Very high or very low values of the statistical variable Z with the simultaneous statistical validity of the sample (variable p) denotes the existence of spatial zones with common features in terms of the number of publications. Intermediate values do not show any statistical correlation and are distributed as random, spatially however we can assume that such areas may be residential areas where points of interest are limited. In the north and west part of the city, there are two areas with increased concentration of publications, which form the local centers of Evosmos and Polichni-Neapoli respectively (see map 1/area 3). The schematic representation of the points highlights the linearity of the activities, which are developed either on footpaths, for the Evosmos area or on connecting roads-arteries, for the area between Neapoli and Polichni. To the south of the area, the area of Ambelokipi is located, with a small concentration of publications, except for the area where slaughtered nightclubs (see area 4) have been installed in recent years. The central spatial zone of the historical center of Thessaloniki is observed with increased concentration rates from the height of the coastal front to the boundaries of the settlements of the Upper Town. On the opposite side of the high concentration of the city center, moving eastwards, there is a spatial zone that develops at a distance from the coastal front and along the main arteries connecting the center with the suburbs. In this area, there is a tendency to gather low publications prices, which spatially map the areas that serve local needs without replacing the use of the center due to the short distance from it (see map area 6). On the south, we observe a spatial zone separated from the surrounding points of interest and coinciding with the pedestrian area of the Kalamaria area (Figure 7). Finally, at the South-East end of the city, we create a spatial entity of dense digital activity, which corresponds to the area of the Mediterranean Cosmos shopping mall. As we can see, the analysis of data outweighs time and cost compared to traditional methods of recording and studying the current state of a large spatial unit. Obviously, the specific method, as is shown by the preceding analysis, cannot be supported on its own, but it can guide the researcher to focus his study on specific areas, thus communicating the relationships that verify the data. By maximizing the speed and the method of analysis, we are given the opportunity to observe with the same immediacy several spatial areas around the world, regardless of distance and accessibility. Possession of this kind of information is necessary for the scientists involved in the field, as the development of policies and plans is based on the formation of a complete and correct perception of the spatial field, as experienced by the inhabitants of the area.

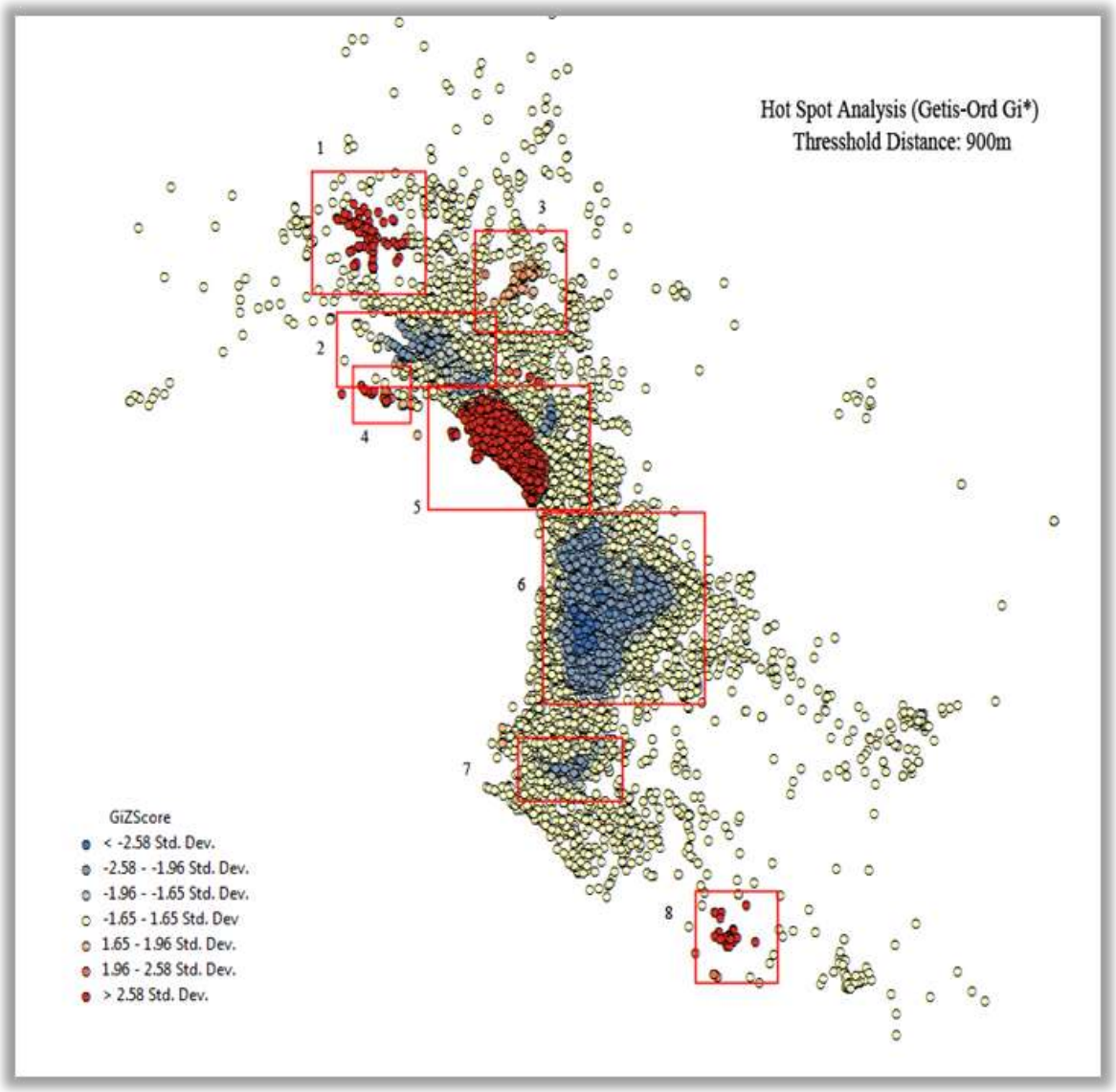

Figure 3. *Hot Spot Analysis Map (Facebook Data Source, Edit)*

Individual spatial zone analysis

The foregoing analysis was based on Points of Interest, as collected by Facebook's social networking tool, to identify spatial zones with a similar number of visitors. Conversely, in this chapter, point data will be compiled into grouped spatial units that arise from the urban environment structure, such as building blocks, to draw conclusions about the peculiarities and characteristics that govern them. In particular, for each spatial zone, the main categories of points of interest, the number of points and the number of visitors. Selectively, we analyze three spatial zones within the historical center of Thessaloniki:

Spatial zone 45

This zone is bounded by the streets: Nikis Avenue, Ethnikis Amynis Street, Mitropoleos Street and Komninon Street. The area is located within the Historic Center of Thessaloniki on the coastal front of the city. Within it, the central square of the city, Aristotelous Square, is located. Based on the analysis, 368 points were identified in which 1,936,828 persons had been published. The land uses of the points of interest of the area under consideration concerned 27 different categories with higher concentrations of those of Local businesses, Bars and Restaurants-Café.

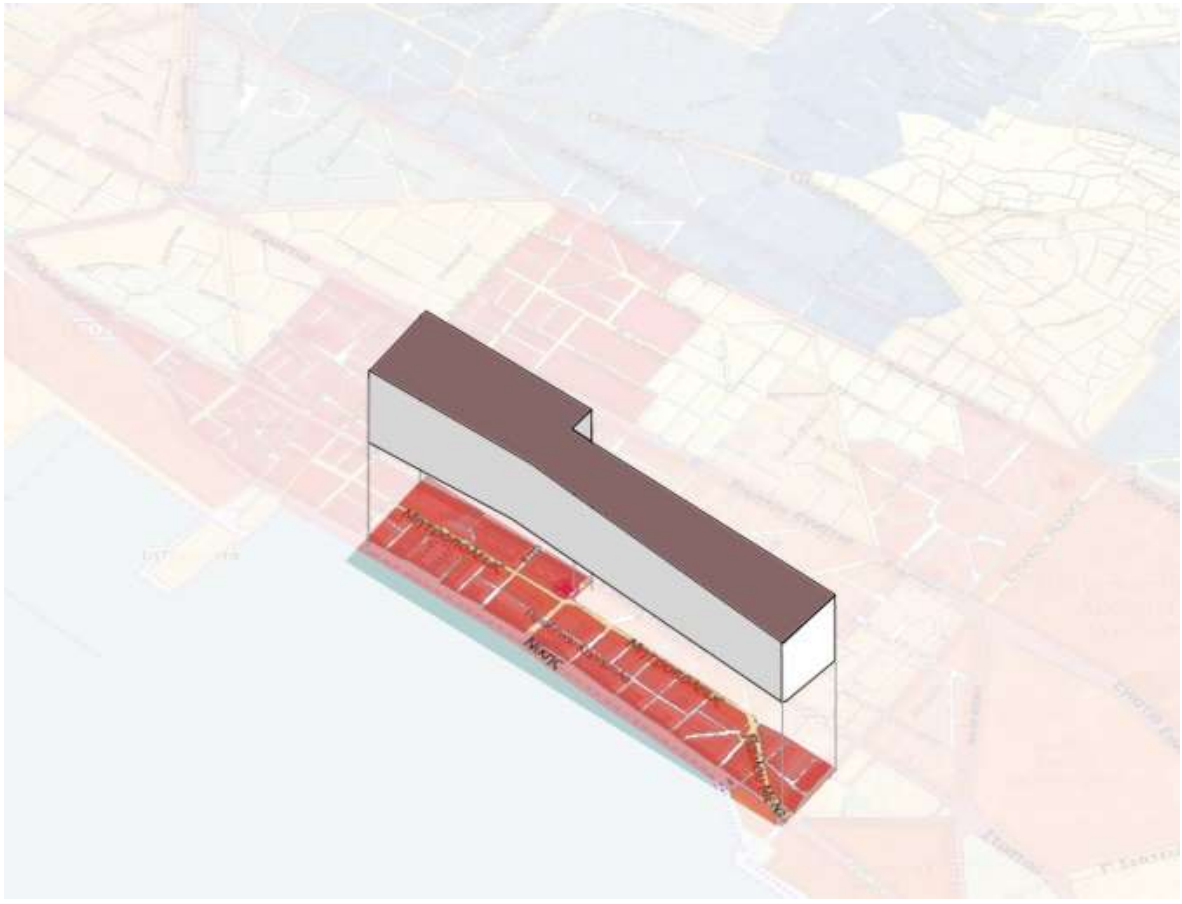

Figure 4. *Visualization of the spatial zone 45*

Spatial zone 41

This zone is bounded by the streets: Kountouriotou, Ionos Dragoumis and Polytechnic. The area is located in the western boundaries of the Historic Center of Thessaloniki opposite the town's loser. Within it, Ladadika is located, a very special area with historical and tourist interest. Most of the area is pedestrianized and includes restaurants and fun shops. Based on the analysis, 198 points were identified in which 1,507,370 persons were published. The land uses of points of interest in the area under consideration concerned 33 different categories with higher concentration rates of Bars, Local Businesses and Arts / Entertainment / Nightlife.

Spatial zone 108

The area is enclosed by the Egnatia, Karaoli and Demetriou streets of Cypriots and Agios Dimitrios and Ionos Dragoumis streets. The location of the area brings together several services, offices and hotels, elements that are also reflected by the data collected. Based on the analysis, 148 points were identified in which 41,727 persons were reported. The categories of points of interest of the area under consideration concerned 39 different categories with higher concentration rates of those of Local Businesses, Companies, Hotels and Retail Shops. As can be seen, although the distance between the spatial zones is small, the differences in function and activity that they collect may be quite large. In the first zone there is a very large number of signs, resulting from the dense activity that is concentrated around the central square of Aristotle. The second zone has high numbers of visits due to the special character of the area and the leisure and entertainment stores to which most publications correspond. Finally, the third area in which the publications, which are much less compared to the previous areas come from business or business offices and hotels. The detailed analysis of small spatial zones within the urban environment enables the drawing of conclusions about what activities are attracted or concentrated within an area or even through more ex-

tensive analysis and observation which are the factors that shape the siting and operation of activities. By looking at areas with the smallest number of visits, we identify some general features that help us better understand the map of the following spatial zones. Less-favored spatial zones included the following:

- green recreation areas (Sykies grove, Saint Paulos- Seih Shoo)
- Special land uses with limited access to the public (6th Pier Container Terminal, camps)
- Neighborhoods with primary land use the residence (Neapoli area, Kalamaria residences).

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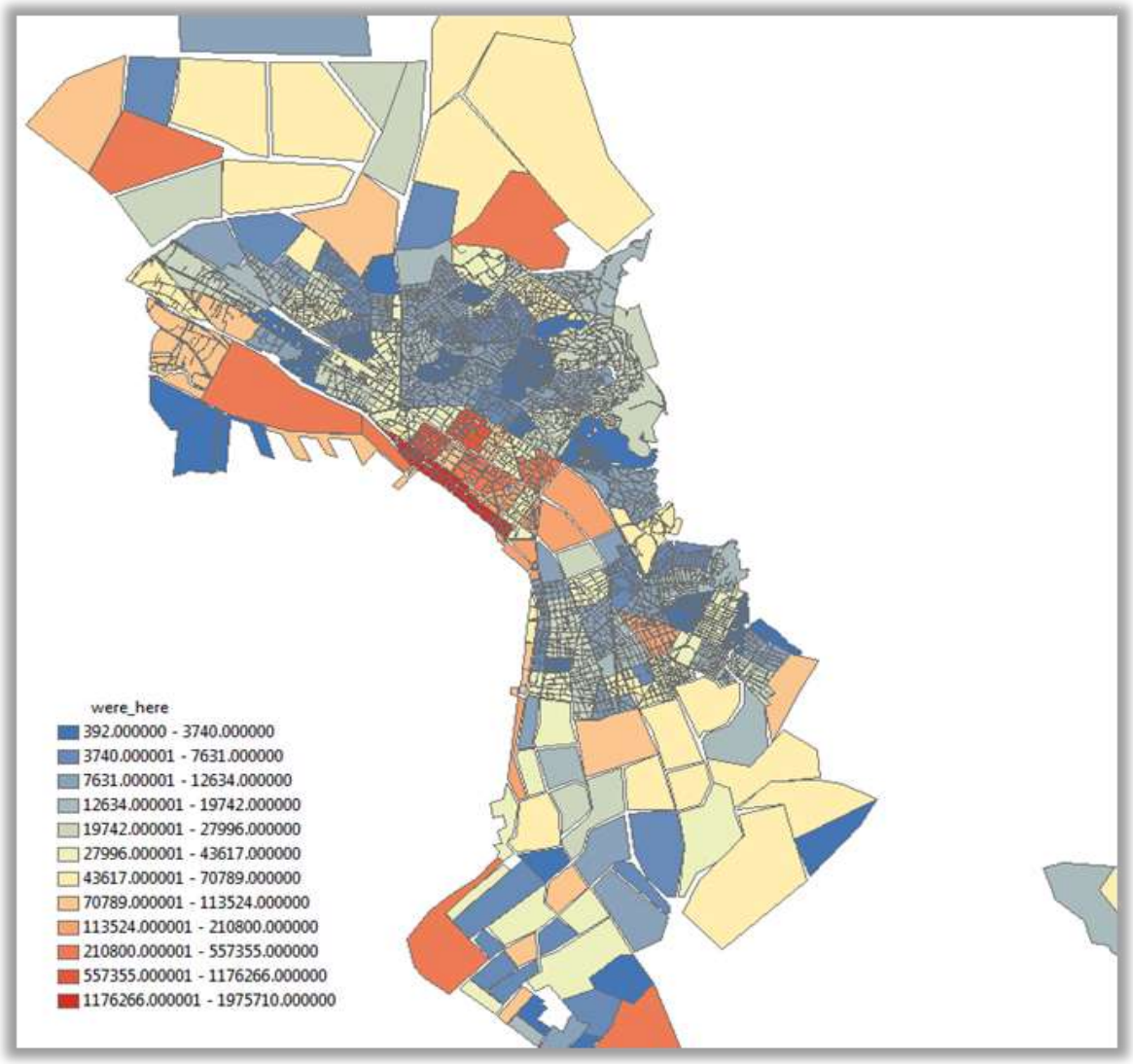

Figure 5. *Publications by spatial zone for the Thessaloniki region*

The map below shows the increase in the number of publications per spatial zone, with cold colors corresponding to low and red areas with high numbers. Based on the data reported, areas with low digital activity may correspond to those areas that are mainly houses, while those with high local office functions and workplaces. Taking advantage of this feature, we can fuel transport patterns where transport weights are determined by high or low activity areas and the direction from low to high.

In addition, we can add the time element, as this method, although working in real-time, imparts, due to their form, an overall image that is formulated for the total life and function of points of interest.

Time Analysis

A number of scientists specializing in space analysis have given considerable weight to the factor of time. As Hoile [1950; 1968] mentions, for ecological models of urbanization, spatial zones are not only created by spatial but also temporal relationships. Later, Karaletsou [1998] writes, on the phenomenon of urbanization, "There are different times of transformation of space as a physical object and as a vector of significance". In the time-based and spatial transformation factor, shrinking the analysis range in just one day, we can distinguish the pulse of human mobility within the city, using the data provided by social networking tools. Applying the method of collecting and analyzing the spatial data we have analyzed above, for more than one time, over a certain period of time, we can have a complete picture of human mobility in the physical space as it naturally varies and occurs in the digital environment. By gathering data about the historical center of Thessaloniki, we can see the digital pulse of the city where we can detect how the concentration of people changes over time during the day. Generally, the chart is planned for the period from 4.30am to 3pm with queries per 1hour. The trend of the merger has three major changes, from 4.30 to 8.30, from 8.30 to 18.30 and from 18.30 until completion of the survey. In the early hours, users gather in nightlife, with all users gradually dropping to 8.30am, which is also the lowest point of the day. From 8.30am to 3pm there is a reciprocal increase, with emphasis on the points of interest that are located in the coastal zone, the tourist-historical sights and the services. From 14.30 to 16.30 there is an increase in the category of restaurants.

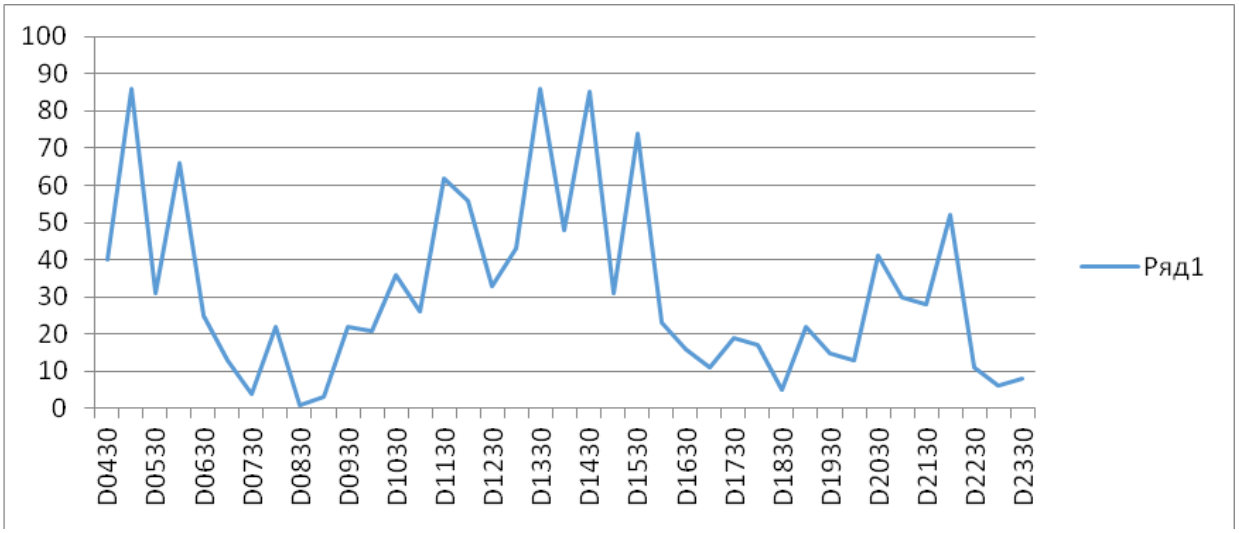

Figure 6. *Hourly change of check-in for the area of the historical center of Thessaloniki*

From 15.30 to 18.30 there is a significant decrease in the number of publications, marking the second lowest price of the day at 18.30, and from there it starts to increase until the end of the survey. Bar categories and points on the coastal front begin to increase their concentration. Unlike previous data analyzes, the introduction of the time element enables us to re-examine the validity data in particular in the case of reporting traffic and crisis management studies. This feature responds to the initial queries of monitoring citizens' mobility for the planning and immediate response of responsible operators at critical moments, as the location and time of the merger are known. The lack of data for all people working in an area can be addressed through the continuous coverage and renewal of the database. Multiple questions at fixed intervals can feed statistical models to predict the spatial presence of citizens at any given time with more precision which will lead to realistic conclusions.

CONCLUSIONS AND FUTURE RESEARCH

The qualitative dimension of the data is obviously amenable to further analysis and is not entirely or autonomously a research method.

In particular, the areas of data exploitation by social networking tools, in the light of space, number an enlarged set. As examples, we can mention possible applications in research areas such as:

The transport analysis techniques: It can use the data to identify the loads and the special "weights" of movement that result from the concentration or interest of users for specific spatial points. Smart switching techniques can take advantage of spatial information and enrich the databases they use. The real-time data element of geo-data can also be used in the control area of a transport network.

Land Uses: Within the spatial data that users publish, additional information about the characteristics and function of an area is contained, as mentioned above. By capturing all the data with urbanization methods, we can perceive the land uses as urbanized space by the citizens themselves, with a high spatial analysis of the urban character and the specific category to which each site belongs.

In addition, we can refer to economic analysis and business scheduling, where technical studies can translate the presence or interest of users as part of an economic activity. Specialized analysis and modeling of these elements can also lead us to the discovery or support of standards and specific variables that affect the economic development of an area. Also, the economic field of urban planning includes the market value of real estate and how it is influenced by the element of their "reputation" – as expressed through the publication of spatial entities.

Tourism development: The tourism sector is directly linked to the information of users, as the tourist product in our days is redistributed mainly through the internet. Direct user contact with data can provide a different experience to visitors, presenting a range of options and suggestions that match their preferences.

In the social dimension of planning, geo-information flows are directly related to people and the physical space. New social movements across the globe use social media extensively on the basis of their development to organize and develop themselves. The study of data through semantic techniques can bring a better understanding of real socio-political conditions. As an example, the recent revolt of the countries of North Africa, also referred to as the Arab Spring. The rebellious social movements that have been created, coordinated communications and their operation through social media communication channels, informing users in real time of any situation.

Crisis management and natural disasters: Data released by users can be analyzed in real time, giving us a continuous retransmission of the current situation. Recent studies are geared towards exploiting user information to alert the public and authorities to the possibility of a natural disaster.

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ПЕРСПЕКТИВЫ ИНТЕРНЕТ-РЕАЛИЗАЦИИ ИНФОРМАЦИОННЫХ СИСТЕМ ОКЕАНОГРАФИЧЕСКОГО ХАРАКТЕРА

АННОТАЦИЯ

Описывается тестовая версия интернет-реализации электронной интерактивной информационной системы «Морские берега Крыма», основанная на использовании языка программирования javascript в совокупности с современной открытой библиотекой leaflet и векторных форматов представления океанографических данных. Первая версия системы включает полный набор материалов опубликованной ранее монографии «Современное состояние морских берегов Крыма», реализованных в виде интерактивных карт. В отличие от печатного варианта последние позволяют получать данные по протяжённости отдельных участков побережья, площадям прибрежных объектов и другие характеристичные данные. Дальнейшее развитие продукта предполагается выполнять с широким использованием современных технологий векторной графики, таких как GeoDjango, C3-D3, Dojo и других надстроек над javascript. Основное внимание будет уделяться оперативному представлению результатов натурных наблюдений с оценкой динамики прибрежной зоны Крыма в целом. Варианты такого подхода в настоящее время уже реализованы с использованием данных по измерению положения линии берега северо-западного побережья. Дополнительно в системе зарезервированы разделы по основам и результатам внедрения разработанной ранее кадастровой оценки пляжей Крыма, включая их рекреационные зоны, экономической оценке рекреационных ресурсов, а также результатам комплексного междисциплинарного мониторинга экологического состояния Севастопольской бухты за период с 1998 г. по настоящее время, включая картографическое представление географических элементов региона в целом. Результаты мониторинга позволяют реализовать визуализацию пространственных распределений гидрологических, гидрохимических и гидробиологических характеристик морской среды бухты в заданном пользователем цифровом формате, выполнять построение вертикальных распределений, а также выполнять некоторые расчёты. Предполагается размещение финальной версии системы на официальном сайте МГИ.

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