

PHOTO REPRESENTATION OF EU CITIES ON GOOGLE MAPS: 2016 AND 2022 COMPARISON

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Received: June 18, 2022 | Accepted: August 19, 2022

DOI: 10.5937/ZbDght2201054M

ABSTRACT

Google Maps is one of the most influential applications in the world. Google Maps provides convenient and accessible features such as Street View, Local Guide, and Google My Business, amongst others. This study analyses and compares the average population of 28 selected cities in the European Union in 2016 and 2022. The presence of Street View in cities was investigated further and the average number of photos was determined in 2022. The average number of photographs in 2016 is between 97 and 139, while in 2022 it ranges between 2,144 and 3,872. This preliminary research was conducted using the counting method to determine whether a certain average number of photos exists concerning the population. The research is significant because it provides insight into the importance and viability of using Google Maps for tourism research.

Keywords: *GIS, Google Maps, Street View, European cities, photos.*

INTRODUCTION

Nowadays, the geographic information system (GIS) and Google Maps are one of the most sought-after innovations in the world of technology. The appearance of these systems and applications showed great technological progress that allows people to navigate and find the shortest and most convenient way to their desired destination. Google Maps has acquired almost 64 million users. Moreover, it has included new features like the location of hospitals, cafes, police stations, and other useful information. Google Maps' algorithms, techniques, and technologies are cutting-edge and highly advanced. Numerous data sets, including historical and real-time data, are analysed by a team of engineers, enabling Google Maps to be so detailed and accurate. Tourists can use this information to choose a vacation destination with confidence (Stankov, Vasiljević, Jovanović, Kranjac, Vujičić, Morar, Bucur, 2019).

The subject of research in this paper is Google Maps photos of selected cities of the European Union, to make a comparison between 2016 and 2022. The selected years were not defined in advance, they were chosen randomly, in 2016 the idea was born and the research was carried out, and in 2022 it was repeated with the same procedure as in the previous phase of the research (Mehta, Kanani, Lande, 2019; Stankov, Durdev, Markovic, Arsenovic, 2012).

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The primary objective of this study is to examine and quantitatively present the number of photographs of selected cities in the European Union. The paper determines the average number of Google Maps photos on different platforms (computer and Android application) relative to the average number of the population in 2022, as well as the average number of Street View photos. Based on these results, the presence of Google Maps photos over six years can be determined, and the data obtained is useful to the tourism industry because it can be used to determine the number of people who have tagged a particular city.

After the introduction, the second section of the paper focuses on the theoretical background, in which the geographic information system (GIS) is further defined, as well as how it was developed in business, and finally, its functions and use in tourism are clarified. In the third section of the study, the creation of Google Maps is analysed, and the application's most important features are described in greater detail. The fourth section, entitled Methods and results, presents the tabular data and the research sample. The conclusion provides a concise summary of the entire paper, highlights the most significant research findings, and identifies the limitations and contributions of the study.

THEORETICAL BACKGROUND

This type of research has not yet been conducted, as the majority of authors study Google Maps and GIS systems independently. This chapter elaborates on the conceptual significance, as well as the origin and evolution of the GIS system and Google Maps. GIS theoretical contributions analysed further, followed by research on the origin of Google Maps and its most essential features, such as the estimated time of arrival and the most popular things that users can do with the program.

Geographic Information System (GIS)

GIS in the narrowest sense is a computer tool for creating and analyzing geographic objects, that deal with phenomena in space (Pahernik, 2006). By general definition, GIS is an integrated system of components, computer tools, user software support, and to collect, organize, handling, analyzing, modeling, and displaying spatial data to solve complex problems of analysis and planning (Jurišić and Plaščak, 2009). GIS is a computer system that collects consolidates, stores, interprets and displays data related to the geographic location and description of the area of interest (Dhanda, 2013).

GIS uses geographic science including a variety of tools, which makes it easier for users to achieve a common goal: getting data from all areas. GIS is used for various functions, the most important are: maps, data, analysis, and applications.

GIS maps are easily connected and installed in applications, and are accessible to almost everyone and everywhere. GIS is used by hundreds of thousands of organizations in almost every field. Created maps are used to facilitate communication, perform analysis, display information on the exchange, and solve complex problems around the world. The most important features of using GIS: are problem identification, monitoring changes, event management, and response, forecasting, setting priorities, and understanding trends (Fazal, 2008).

GIS is about community, sharing, and collaboration. It is used in education, healthcare, insurance, manufacturing, oil industry, retail, sustainability, telecommunications, transportation, and security. Some of the most popular GIS software are ArcGIS, Google Maps, QGIS (Kar, Sieber, Haklay, Ghose, 2016).

The use of GIS in tourism

GIS has an exceptional affinity for use in tourism. However, due to the lack of tourist databases and deficiencies, GIS applications are modest and insufficient. Today, technology is constantly changing and improving, and for this reason, tourist destinations should be harmonized with GIS, various combinations such as GIS and GPS lead to easier navigation for tourists in the destination, virtual tourism - visibility of the destination (e.g. Google Maps and Google street), facilitating the work of tourist boards regarding the movement and number of tourists. The largest number of GIS applications in tourism relates to the inventory of recreational capacities, use of space for tourism management, the impact of visitors assessment, the assessment of conflicts between recreation and the environment, mapping, and the creation of tourist information management systems to assist in decision-making (Stankov, 2012). The application of GIS is different for tourist supply and tourist demand. Tourist offer uses all types of GIS, and tourist demand uses GIS technology compiled by a specific tourist offer. A huge advantage of GIS is the possibility of including all participants who use the tourist area. GIS can unite state institutions, non-governmental organizations, private companies, and various organizations. Based on the viewpoints of all participants, the best decisions can be made for the development of tourism in a certain area (Feick and Hal, 2000). Concretely, GIS in tourism has different uses; environmental protection, marketing of tourist destinations, management of historical and cultural resources, and planning and implementation of sustainable tourism. It mainly serves visitors to display the best and fastest route to the selected location, display pedestrian and bicycle paths, and the most efficient route to hotels, restaurants, and cafes. (Jovanović, 2016; Seferović., Stankov, 2009).

Google Maps

The Google Maps component is a web mapping service, created in the C++ programming language, which was created by the two brothers Lars and Jens Rasmussen in the company called “Where to Technologies”. In 2004, Google took over the program and turned it into a Google Maps web application, which began to be used in February 2005. The difference between previous online maps and Google Maps is the ease of use, quickly available and valid information, continuous updates, and facilitating the navigation in an unfamiliar area. Previously, it had limited features such as navigation, but today it provides a variety of services such as real-time traffic conditions, travel planning by foot, car, bike, air, and public transport. We will now present some of the major functions of Google Maps (Petroutsos, 2014).

Google Maps provides a route plan that provides users with directions to a specific location and displays accessibility. The application can indicate the user’s public transport route, walking navigation features, and in July 2020 a route for cyclists was announced. In addition to these functions, Google Maps also offers; interior maps that show the interior of buildings and even public spaces such as the subway, images of certain cities at an angle of 45°, Earth Timelapse (“Earth’s passage of time”) program through which the change of the Earth in the last 37 years is visible (Petroutsos, 2014).

The most basic and important function of Google Maps is to estimate the time required to reach a certain destination based on the route taken from the source. In the beginning, until 2007, Google Maps suggested the shortest route regardless of the traffic situation in real-time, which turned out to be a big drawback. To overcome this shortcoming, Google began to continuously collect data from all available devices in a selected area to enable the display of other routes. Today, the user can find a route that suits him, despite the shortest route. Google Maps considers the current traffic situation on the selected route. Two ETAs are visible to the user - average optimal conditions and current traffic conditions, which helps the user estimate the time needed to reach a certain destination. As former Google engineer Richard Russell rightly points out, companies that have the best, most accurate, and most advanced real-time data tend to come up with the best forecasts (Svennerberg, 2010).

Street View

In 2007, Google Maps introduced a feature called Street View, an innovation that turned out to be a turning point in the history of navigation and GPS. Street View provides a three-dimensional, HD, panoramic view of many neighborhoods, streets, and other areas that a user can view on their cell phone or computer. Initially, the feature was accepted by only five cities located in the United States of America, while currently many destinations around the world use Street View. In 2009, Google began mapping university and university complexes and surrounding roads. After that, residents of certain areas express concerns about their privacy, although Street View is recorded only in accessible and public places, Google then introduced the blurring of faces and license plates on cars. Another Street View innovation occurred in 2014, an initiative called Google Underwater Street View that included 2,300 kilometers (1,400 miles) of the Australian Barrier Reef. Google uses different devices and tools when creating Street View; a car, a Street View Trekker (a backpack that allows you to collect images in places that can only be accessed on foot), a Street View Cart (mostly collects images from indoor spaces like museums and the White House), a Street View Snowmobile (used to collect photos on snowy mountains), Street View tricycle (collects photos on narrow streets and places). Street View coverage is almost complete in many developed countries and is growing in developing countries. The implementation of such a function allows users to view and virtually travel around the world, and in 2017 Street View navigation became available even on the premises of the International Space Station (Street View, 2022)

Google Earth

Google Earth is a program that produces images of our planet's surface by downloading satellite data from a remote server. The position and size of the region in the image are completely controlled and defined by the user. For more detailed exploration, the user can zoom in to reveal rivers, lakes, cities, and roads. Unlike traditional remote sensing images, Google Earth allows zooming in on small-scale topographic and geological features. Inevitably, the resolution imposes limits on zoom capabilities; resolution varies from region to region and is higher in some urban areas. Google Earth also offers advantages over other images, such as aerial photography, the image can be rotated around a vertical axis allowing us to look at things from the other side. This greatly helps in visualizing the three-dimensional shape of the features in question. The user can adjust the slope of the line of sight. Changing the appearance of the object under these rotations helps convey the 3D geometry of the structure to the viewer. The program allows locations to be saved as placemarks, which eliminates the need to record the location's latitude and longitude for later retrieval. In fact, Google Earth comes with some city view placemarks. An example is Mount St. Helens; one mouse click takes you directly to the volcano. Using the included navigation tools, the user can closely examine the crater, dome, and deposits created by the 1980 eruption. Another landmark of geological interest is the Grand Canyon (Google Earth, 2022).

Google Local Guides

Google offers its users to be part of the global community on Google Maps. It is a project that contributes to the local community and where local guides or residents of a certain destination, can share their experience and visual impression of their place. Everyone can get involved by writing reviews, sharing photos and videos, adding missing places, answering questions, and correcting posted information. Google rewards its users by earning points while using the local guides feature, and these points earn them rewards such as access to some new Google features. There is also a forum that brings together all local guides where they can exchange their stories, different aspects of the destination, acquired knowledge, and atmosphere (Local Guides, 2022).

Google Business Profile (formerly Google My Business)

Google’s Business Profile” feature allows users to connect and collaborate with business partners for free on Google Search, and Google Maps, and open a free company profile. On the company profile, the user can share photos, videos, and offers to attract as many business partners as possible and interestingly present the company. Interested business partners get in touch with the company through calls, messages, or by writing reviews. The user can see on his profile how many calls he got, clicks on the website, requests for instructions, follow-ups, and reservations that interacted with the company profile. In mid-August 2020, Google made it more convenient for company users to edit their user profile directly when browsing, by conveniently entering the word “My Company” or the name of the company. Google Business Profile allows companies to create a website for free (Google Business Profile, 2022).

METHODS AND RESULTS

The paper uses descriptive statistics to analyse and present collected data. The research was conducted in April 2016 and March 2022 by counting images of randomly selected cities on the Google Maps application via desktop and Android. Some of the obstacles that researchers encountered are possible daily changes in the number of images in a certain city, for example when you start collecting data, you need a good internet connection because if the connection breaks, you need to upload all the images again and start over with the collection, which takes three to four hours for one city. The research was conducted for all EU countries whereas the authors have chosen randomly a town with between 50.000 and 100.000 inhabitants. There are some exceptions where these criteria were not feasible (Luxembourg and Malta).

Table 1. Research of Google Maps photos of selected cities in the EU

Nº	City	State	Population Census 2015	The number of photos on Google Maps, April 2016	The number of photos on the Google Maps app on Android, April 2016
1.	Villach	Austria	60,480	100	197
2.	Sint-Niklaas	Belgium	69,725	99	108
3.	Blagoevgrad	Bulgaria	70,881	100	98
4.	Pula	Croatia	62,000	97	149
5.	Strovolos	Cyprus	67,904	99	186
6.	Zlín	Czech Republic	75,112	98	154
7.	Esbjerg	Denmark	71,025	96	60
8.	Narva	Estonia	65,881	98	145
9.	Hämeenlinna	Finland	68,066	98	158
10.	Asnières-sur-Seine	France	75,837	99	42
11.	Bamberg	Germany	70,863	96	182
12.	Zografou	Greece	71,026	98	80
13.	Tatabánya	Hungary	70,003	96	177
14.	Massa	Italy	70,973	99	141
15.	Galway	Ireland	76,778	93	119
16.	Jelgava	Latvia	59,511	97	135
17.	Alytus	Lithuania	56,364	97	97

Nº	City	State	Population Census 2015	The number of photos on Google Maps, April 2016	The number of photos on the Google Maps app on Android, April 2016
18.	Luxembourg City	Luxemburg	107,247	92	187
19.	Qormi	Malta	16,779	98	180
20.	Alkmaar	The Netherlands	94,216	95	197
21.	Stargard Szczeciński	Poland	70,217	98	139
22.	Aveiro	Portugal	67,003	97	187
23.	Slatina	România	70,293	97	82
24.	Melilla	Spain	85,584	99	165
25.	Trnava	Slovakia	68,466	98	151
26.	Maribor	Slovenia	94,809	97	168
27.	Växjö	Sweden	65,000	98	102
28.	Armagh	The United Kingdom	59,340	97	88
Average			70,050	97	138

Table 1. presents randomly selected countries and cities located within them, the population census of the selected countries, and the number of photos on Google Maps; desktop, and Android in 2016. Table 1 shows that the smallest city by population is Qormi, Malta with 16,779 inhabitants, and has 98 photos on the desktop and 187 photos on Android, and the largest is Luxembourg City, Luxembourg with 107,247 inhabitants, and has 92 photos on the desktop and 180 photos on Android. The average population in these 28 European cities is 70,050. The average number of photos of selected EU cities on Google Maps in 2016 is 97 via the desktop and 138 via the mobile application on Android. This data tells us that population size does not determine the number of photos on Google Maps. Data is useful for cities in terms of tourism, more photos means more visits to cities, cities that have few photos must work on marketing and better promotion, thus better visibility.

Table 2. Survey of Google Maps photos of selected EU cities and Street View

Nº	City	State	Population Census		The number of photos on Google Maps, April, 2016	The number of photos on the Android application, April, 2016	Street View
			Year	Number			
1.	Villach	Austria	2014	60,004	100	197	✗
2.	Roeselare	Belgium	2013	58,823	100	76	✓
3.	Gabrovo	Bulgaria	2011	58,930	100	96	✓
4.	Pula	Croatia	2011	57,460	100	119	✓
5.	Larnaca	Cyprus	2011	51,468	100	176	✗
6.	Opava	Czech Republic	2014	57,931	100	152	✗
7.	Kolding	Denmark	2014	58,021	100	38	✗
8.	Narva	Estonia	2015	58,375	100	145	✗
9.	Vaasa	Finland	2015	66,581	100	109	✓
10.	Pessac	France	2013	60,763	100	68	✓
11.	Dormagen	Germany	2014	62,773	100	197	✗
12.	Veria	Greece	2011	66,547	100	179	✓
13.	Sopron	Hungary	2012	61,390	100	137	✗
14.	Pomezia	Italy	2012	57,114	100	62	✓
15.	Limerick	Ireland	2015	56 779	100	62	✗

№	City	State	Population Census		The number of photos on Google Maps, April, 2016	The number of photos on the Android application, April, 2016	Street View
			Year	Number			
16.	Jelgava	Latvia	2013	62,800	100	134	✗
17.	Alytus	Lithuania	2016	54,437	100	97	✗
18.	Luxembourg City	Luxembourg	2014	107,247	100	187	✗
19.	Birkirkara	Malta	2013	22 319	100	118	✗
20.	Nieuwegein	Netherlands	2014	61,011	100	182	✓
21.	Bełchatów	Poland	2010	60,970	100	77	✓
22.	Évora	Portugal	2011	56,596	100	148	✓
23.	Zalău	Romania	2011	56,202	100	126	✓
24.	Segovia	Spain	2009	56 660	100	189	✗
25.	Martin	Slovakia	2014	56 053	100	131	✓
26.	Maribor	Slovenia	2015	95,881	100	187	✗
27.	Halmstad	Sweden	2014	58,577	100	120	✗
28.	Hereford	UK	2011	53,516	100	80	✓
Average						127	

Table 2. presents randomly selected countries and cities within them, the population census of the selected countries, the number of photos on the Google Maps application on Android in 2016, and whether the selected cities contain Street View on the Google Maps application. Table 2 shows the average number of photos of selected EU cities on the Google Maps application on Android, which is 127 photos. Out of a total of 28 cities, 13 of them have Street View, and 15 do not. The smallest city by population is Birkirkara, Malta with 22,319 inhabitants and has 187 photos on Android and does not contain Street View, and the largest is Luxembourg City, Luxembourg with 107,247 inhabitants and has 187 photos on Android and also does not contain Street View. This data tells us that population size does not affect whether a country has Street View. The data is useful in encouraging countries that don't yet have Street View to develop it, as tourists increasingly use Google Maps and browse photos to get to their destinations.

Table 3. Research sample of Google Maps photos of selected cities in the EU

№	City	State	The number of photos on Google Maps, March 2022.	The number of photos on the Android app, March 2022.	Street View at Google maps, March 2022.	Street View on Android app, March 2022.
1.	Villach	Austria	2479	3327	143	150
2.	Sint-Niklaas	Belgium	3107	3553	147	127
3.	Blagoevgrad	Bulgaria	2557	3457	339	412
4.	Pula	Croatia	1985	4731	28	22
5.	Strovolos	Cyprus	406	612	2971	2826
6.	Zlín	Czech Republic	2813	4875	20	53
7.	Esbjerg	Denmark	1787	4378	10	45
8.	Narva	Estonia	2805	3128	38	28
9.	Hämeenlinna	Finland	1802	4782	2936	94
10.	Asnières-sur-Seine	France	238	3764	165	89
11.	Bamberg	Germany	2603	3955	13	14
12.	Zografou	Greece	2080	4322	666	107

Nº	City	State	The number of photos on Google Maps, March 2022.	The number of photos on the Android app, March 2022.	Street View at Google maps, March 2022.	Street View on Android app, March 2022.
13.	Tatabánya	Hungary	2804	3488	1046	3066
14.	Massa	Italy	2564	3708	54	3152
15.	Galway	Ireland	2156	5855	2856	3572
16.	Jelgava	Latvia	2725	3858	3102	3190
17.	Alytus	Lithuania	3071	3457	3254	3068
18.	Luxembourg City	Luxemburg	2381	4672	35	-
19.	Qormi	Malta	995	2992	2221	2332
20.	Alkmaar	The Netherlands	1490	8432	11	15
21.	Stargard Szczeciński	Poland	1312	2146	6	505
22.	Aveiro	Portugal	1901	3707	20	24
23.	Slatina	România	2450	3166	2884	141
24.	Melilla	Spain	2972	3883	27	54
25.	Trnava	Slovakia	3103	4349	275	79
26.	Maribor	Slovenia	1543	4359	84	97
27.	Växjö	Sweden	2599	4120	2411	3925
28.	Armagh	The United Kingdom	1308	1332	2095	2112
Average			2144	3872	995	1046

Table 3. shows EU countries and the cities within them, the number of photos, and Street View on Google Maps on the desktop and the Android app in 2022. Table 3 shows the average number of photos in 2022 of the same selected EU cities as in 2016 on Google Maps via desktop and Android applications. Street View is additionally included in the table. The average number of photos via desktop is 2144 photos and 995 Street View, while via the application it is 3872 photos and 1046 Street View. The data tells us that the least photos; France has 238, and the most; 3107 Belgium on the desktop via Google Maps while via the application on Android the least; 612 photos have Cyprus, and the most; 5855 has Ireland. There is the least amount of Street View, that is, there is none at all - Luxembourg, and the most; Sweden has 3925 via the application on Android, while via the desktop the least; Poland has 6, and the most; 3254 has Lithuania. From this data, we see a large increase in the number of photos in 2022 compared to 2016, and all cities have Street View except Luxembourg, which is useful for future tourists to find their way around the city more easily.

CONCLUSION

This research was conducted in 28 selected cities of the European Union, the date of the research is April 2016 and March 2022, and the change within 6 years is shown. The research was conducted on Google Maps via the desktop and via Android application. The research shows that the average city of 70,000 inhabitants in the European Union in 2016 was represented by an average of 97-138 photos on Google Maps, while in 2022 that number is significantly higher and amounts to an average of 2144-3872 photos. The difference in the number of photos between 2016 and 2022 is 2,047 photos on the desktop and 3,734 photos via the Android application.

In 2016, out of 28 selected EU cities, only 13 included Street View, while in 2022, all cities will include Street View, with an average of 995-1046 photos. The city of Stargard Szczeciński (Poland) has the fewest Street View

via desktop - 6, and the most is Alytus (Lithuania) - 3264, while the city of Luxembourg City (Luxembourg) does not have a single Street View via the Android application, the city of Växjö (Sweden) has the most - 3925.

The number of photos shown is not the same on different platforms (desktop vs. app on Android), the the population does not affect the number of images, and some smaller cities have more images than larger ones. It is evident from the tables that the number of photos is significantly higher in 2022 than in 2016, people nowadays use technology and the Internet more to research the destination they are traveling to, and there would be more photos if it were not for COVID-19, which caused people not could travel. Cities must have Street View because it makes it easier for tourists to move around and better communicate with restaurateurs who offer accommodation facilities.

It is possible that during the collection and analysis of data there were errors in observation, evaluation, recording, or interpretation due to interruptions in uploading images or a weak Internet connection, the research was conducted on an Android application, so iOS users are limited in the research itself.

The theoretical contribution stems from the conducted research. In the future, the number of available photo materials could be related to the number of tourists in a certain town, which could probably show a correlation.

Recommendations for improvement: before a future tourist decides to travel to a certain destination, the first thing he does is enter the chosen destination in Google Maps to roughly see and explore the fastest way to get there, along with the route, Google Maps also shows restaurants, hotels, bars, attractions, gas stations, parks, museums and other categories that are more interesting when a photo is displayed next to them. The fact is that every tourist destination tries to attract as many tourists as possible, therefore tourist boards and social media of a destination should make sure that as many people as possible tag a certain city because Google collects all the photos from the web. Therefore, providing free WiFi in key tourist attractions and urban centers combined with a brand ambassador strategy (whereas tourists are encouraged to share their UGC - User Generated Content - on social media) is one of the key recommendations for destination marketing.

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