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METHOD OF CREATING WEB-GIS OF POLISH BURIALS AT KYIV BAIKOVE CEMETERY

Elaboration of the method of creating a web-GIS of Polish burials at the Baikove Cemetery in Kyiv. Achieving this goal involves the following tasks: to develop the structure of the geographic information system, its framework and to fill the file database. For realization of the set tasks the technological scheme consisting of 12 stages of work is offered. The first stage involved the collection of cartographic and descriptive data on the territory of the object of study, as well as the search for possible registers of Polish burials within the object under study. In the second stage, field surveys were performed to determine the coordinates of each grave of the Polish burials at the Baikove Cemetery using a GIS tablet with an RTK antenna LT700H (accuracy up to 0.30 m). The total number of coordinated points was 565, which were concentrated in 7 sections of the cemetery. The third stage included the coordination of reference points and the binding of this support in the GIS MapInfo environment of the fragment of the topographic plan of Kyiv on a scale of 1: 2000 to the territory of the Baikove Cemetery. There were a total of 11 landmarks. The maximum binding error is 0.2 m. In the fourth stage, all point objects were displayed according to their coordinates on the basis of the map and the corresponding symbols were selected. The next step was to develop and populate a relational database for point objects. The database contained the following columns: grave number, name and surname of the buried person, grave coordinates and hyperlinks to burial information in the file database. Next, all map layers were exported to html format, and the point object layer was exported to kml format using a universal translator, which allowed to view burial data in GoogleEarth. At the eighth stage of the technological scheme the structure of layouts of each html-page of the created online GIS was developed. All map data had hyperlinks to the selected AOI objects. In the case of the Baikove Cemetery scheme, plots with Polish burials were marked. Clicking on them opened a topographic plan with marked point objects of burials. In turn, when you click on them, information about the burial appeared from the file database. At the tenth stage, 5 sheets of topographic plans with burials were generated. One sheet of scale 1:2000 and four sheets of scale 1:500, for better “spreading” and initialization of burials. The eleventh stage is devoted to the creation and filling of a file database on Polish burials. This database contained the following structure: photo of the burial, coordinates, surname and name, years of life, additional photographs (if available), sex of the buried person, interpreted inscription on the tombstone, as well as, if possible, detailed information and belonging of the buried person to a certain profession, its outstanding achievements and accomplishments. At the last stage, the hyperlinks of the transition between the pages were configured and the system was tested. The scientific novelty lies in the development of the concept of joint use of various applications of geoinformation and non-geoinformation purposes. The technological scheme of creation of WEB-GIS of Polish burials of the Baikove Cemetery in Kyiv is offered. Implemented geographic information system is designed for inventory of burials, analysis of the condition of tombstones and their spatial location in the cemetery. In addition, the created GIS can be used for tourism purposes and in the study of historical figures of Polish origin.

Key words: WEB-cartography, Polish burials, Baikove Cemetery, historical GIS, file database, burial inventory.

Introduction

GIS technologies have found practical application almost everywhere – in forestry, construction, cartography, ecology, seismology, etc. They are studied in universities and research institutions. GIS technology is a whole industry that affects almost all aspects of human life.

GIS allows mapping of world objects, and then analyze them for a large number of parameters,

visualize them and on the basis of these data to predict a variety of events and phenomena. This powerful technology allows to use GIS to solve a huge number of both global and private problems. GIS technologies can be at the service of all mankind, preventing environmental disasters or helping to solve the problems of overpopulation in certain regions. GIS technologies are widely used in various fields. By identifying the relationship between different indicators, it is possible to develop more efficient technologies, save significant funds, and analyze how the relationship between soil type, climate and yield of certain crops, which is important for understanding where best to grow them. By setting certain search criteria, we can easily find the desired object and, without wasting time, to engage in its development. Finding an apartment that will have a certain number of rooms, kitchen area and at the same time will be located near the work and school of your children is now very easy.

GIS can have a positive impact on the business climate within organizations. A powerful database can be useful in any field of human activity, as it creates opportunities for clear work planning and monitoring. Utilities have the opportunity not only to promptly monitor the condition of equipment and plan preventive work, but also to notify those participants (residents, employees of institutions, enterprises and organizations) who will be affected. Today, maps of cities and localities are rapidly aging – new construction is underway, new roads are being designed or processes of self-afforestation of agricultural lands are taking place, settlements in depressed regions are "disappearing" and so on. GIS allows to track these changes and make them into the database almost instantly. Such a card launched in a virtual network will allow to always have up-to-date and reliable data in free access.

Preservation of cultural heritage is a problem of international importance, as evidenced by the Convention for the Protection of the World Cultural and Natural Heritage, adopted by UNESCO. Solving the problems of studying and preserving cultural heritage is closely related to mapping. The creation of heritage maps is increasingly attracting the attention of researchers and has now formed in a special area of thematic mapping, which needs further development. In addition to the main purpose – inventory of heritage in order to protect it, mapping provides society with new information and knowledge, promotes understanding of the past, present, future. The creation of data banks and heritage maps allows for a fuller assessment of the importance of cultural monuments, to expand programs for their preservation and restoration. Heritage mapping is especially important for historic cities, including Kyiv.

The current state of collection and storage of materials on monuments of historical and cultural heritage is characterized by a variety of documents used to create archives, registers and records. Accounting and information storage services spend large amounts of time on the preparation and issuance of the necessary materials, both to customers and their own departments that are part of the security body.

The materials used by these services are very diverse: textual documentation, historical notes, technical passports, plans of land plots, results of stereo photogrammetric survey (digital models of facades, dimensional drawings), photographic materials, etc. [Pidlisetska, 2015].

As the flow of documents increases, it becomes increasingly difficult to record, store, issue and share them with different services and consumers. The development of modern technologies allows us to optimize the joint work of services, which gave impetus to the idea of creating an information system "Atlas of Polish burials at the Baikove Cemetery in Kyiv" together with our Polish colleagues.

Many foreign and domestic scholars have worked on the creation of various methods for mapping historical and cultural heritage sites. The method of mapping cultural heritage objects using a combination of interpretation of archival aerial photographs and georadar survey is covered in a scientific article [Chetverikov, et al., 2017]. Mapping of cultural heritage objects on archival cartographic and aeromaterials is described in a number of publications [Chetverikov, 2019, 2020; Arnoud de Boer, 2010; Knowles, 2008]. Along with the mapping of historical and cultural heritage sites,

the issues of 3D modeling and reconstruction of architectural structures are important [Apollonio, et al., 2012; Clini, et al., 2017]. The use of spatial data and remote sensing data to monitor historical and cultural heritage sites in their work has been described [Rhein, 1996; McKeague, et al., 2012; Remondino, 2007; Vacca, et al., 2018]. The method of creating geoportals with data on cultural heritage sites is covered in the works [Fiedukowicz, et al., 2018; Gregory, & Ell, 2007]. The design of any atlas is based on the previous achievements of scientists in the field of integrated atlas mapping of various research objects. For example, Bainozarov A. M. covers the method of designing cartographic works of the educational complex of Ukraine. Prasul Yu. I. [Prasul, 2004] substantiates the list, structure and content of plans, series of maps and atlases that make up the regional system of cartographic works for tourism. Polyvach K. N. [Polyvach, 2007] in his research considers the cultural heritage and its impact on the development of the regions of Ukraine as an object of socio-geographical research, etc.

Aim

The aim of the work was to develop a method of creating a web-GIS of Polish burials at the Baikove Cemetery in Kyiv. The main task of the study was to develop the structure of the geographic information system, its framework and filling the file database.

Methods and results of work

To achieve this goal, a technological scheme was proposed, consisting of 12 stages of work (Fig. 1). The first stage involved the collection of cartographic and descriptive data on the territory of the object of study, as well as the search for possible registers of Polish burials. The input graphic materials used in the work were:

- a fragment of the topographic plan of Kyiv on a scale of 1: 2000, created in 2009 (since the territory of the cemetery did not change during this time, the year of making the plan satisfied us) (Fig. 2);

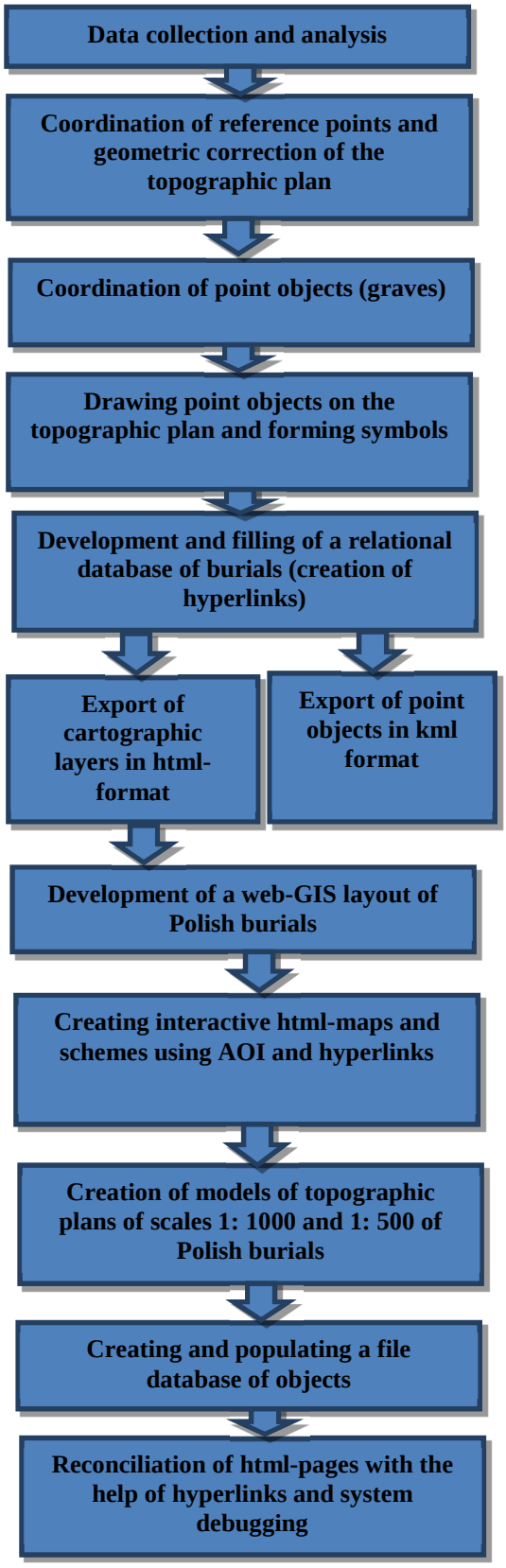


Fig. 1. Technological scheme of creating a web-GIS of Polish burials at the Baikove Cemetery

Fig. 2. Fragment of the topographic plan of the Baikove Cemetery on a scale of 1:2000

- the scheme of the Baikove Cemetery made on the basis of an orthophoto plan (Fig. 3);

Fig. 3. Scheme of Baikove Cemetery

- maps and space images of the online resource Google Maps.

In addition, descriptive materials of figures buried in the cemetery from the Internet and a paper register of Polish burials of the Baikove Cemetery were used as input data.

In the second stage, field surveys were performed to determine the coordinates of each grave of the Polish burials of the Baikove Cemetery using a GIS tablet with an RTK antenna LT700H accuracy up to 0.30 m. (Fig. 3). There were a total of 565 such points in seven sections of the cemetery. The coordinates are obtained in the coordinate system Latitude/Longitude of the WGS84 projection, which are later translated into fractions of a degree for processing point objects in GIS.

Fig. 3. The process of obtaining the coordinates of burials using a GIS tablet LT700H

Coordinates of reference points obtained at characteristic points along the perimeter and inside the cemetery by GNSS survey by the ElNav i70 receiver.

The third stage included the coordination of reference points and the binding of this fragment in the GIS MapInfo fragment of the topographic plan of Kyiv at a scale of 1:2000 on the territory of the Baikove Cemetery. There were a total of 11 reference points. The transformation was performed according to the polynomial model of the second degree. The maximum binding error is 2 pixels, which corresponds to 0.2 m on the ground (Fig. 4).

In the fourth stage, all point objects were spaced according to their coordinates on the map and the symbols were chosen (Fig. 5).

The standard icon from the MapInfo symbol library – a rectangle with a cross – is selected for the symbol. The symbol was assigned a red color for contrast display on the background of the topographic plan and set the size – 12 (Fig. 6).

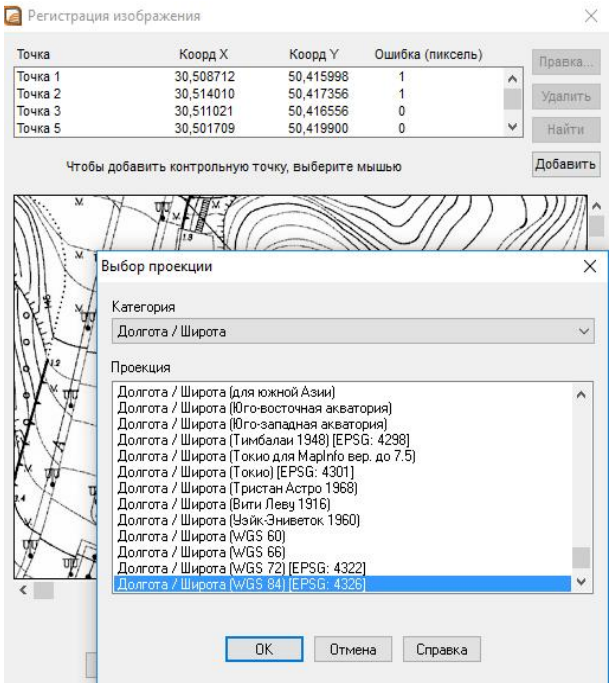


Fig. 4. Topographic plan binding window

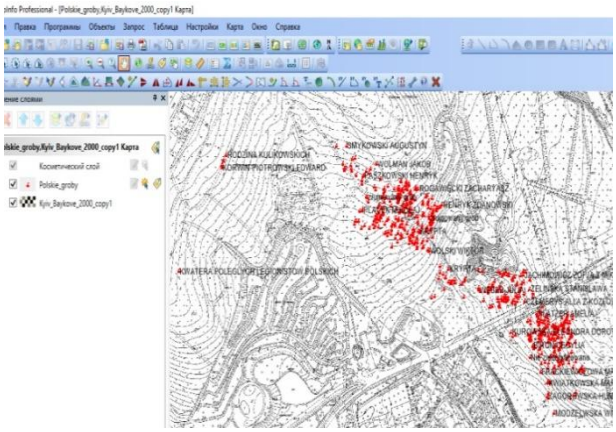


Fig. 5. Visualization of the applied point objects of burials on the topographic plan of the Baikove Cemetery

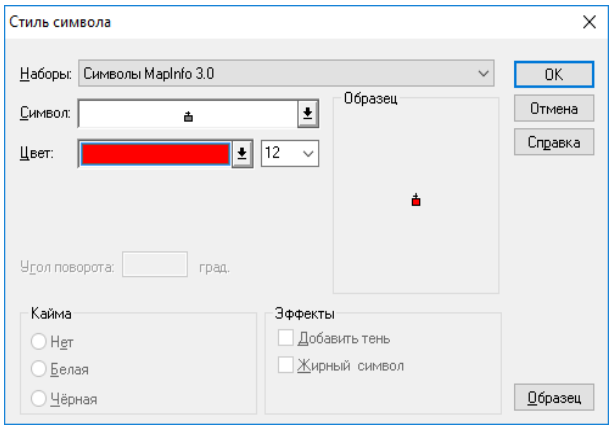
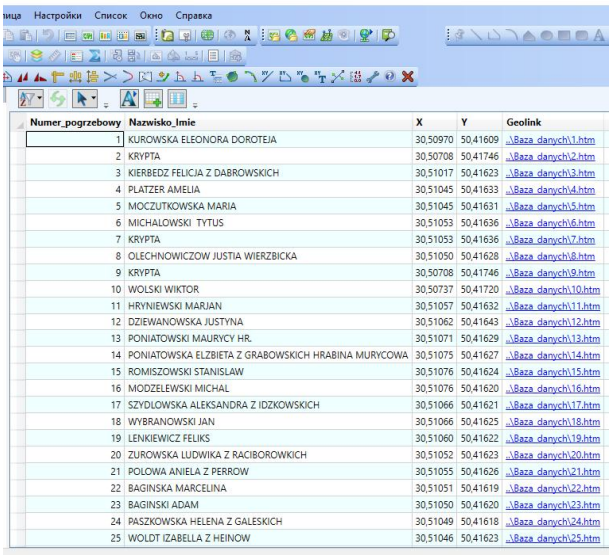


Fig. 6. Symbol settings window

The next step was to develop and populate a relational database (Fig. 7) for point objects, which included the following columns:

- grave number;
- surname and name of the buried person;
- coordinates of the grave;
- hyperlinks to burial information in the file database.



Numer_pogrzebowy	Nazwisko_Imie	X	Y	Geolink
1	KUROWSKA ELEONORA DOROTEJA	30,50970	50,41609	..\Baza_danych\1.htm
2	KRYPTA	30,50708	50,41746	..\Baza_danych\2.htm
3	KIERBEDZ FELICJA Z DABROWSKICH	30,51017	50,41623	..\Baza_danych\3.htm
4	PLATZER AMELIA	30,51045	50,41633	..\Baza_danych\4.htm
5	MOCZUTKOWSKA MARIA	30,51045	50,41631	..\Baza_danych\5.htm
6	MICHALOWSKI TYTUS	30,51053	50,41636	..\Baza_danych\6.htm
7	KRYPTA	30,51053	50,41636	..\Baza_danych\7.htm
8	OLECHNOWICZOW JUSTIA WIERZBICKA	30,51050	50,41628	..\Baza_danych\8.htm
9	KRYPTA	30,50708	50,41746	..\Baza_danych\9.htm
10	WOLSKI WIKTOR	30,50737	50,41720	..\Baza_danych\10.htm
11	HRYNIEWSKI MARJAN	30,51057	50,41632	..\Baza_danych\11.htm
12	DZIEWANOWSKA JUSTYNA	30,51062	50,41643	..\Baza_danych\12.htm
13	PONIATOWSKI MAURYCY HR.	30,51071	50,41629	..\Baza_danych\13.htm
14	PONIATOWSKA ELZBIETA Z GRABOWSKICH HRABINA MURYCOWA	30,51075	50,41627	..\Baza_danych\14.htm
15	ROMISZOWSKI STANISLAW	30,51076	50,41624	..\Baza_danych\15.htm
16	MODZELEWSKI MICHAL	30,51076	50,41620	..\Baza_danych\16.htm
17	SZYDLOWSKA ALEKSANDRA Z IDZKOWSKICH	30,51066	50,41621	..\Baza_danych\17.htm
18	WYBRANOWSKI JAN	30,51066	50,41625	..\Baza_danych\18.htm
19	LENKIEWICZ FELIKS	30,51060	50,41622	..\Baza_danych\19.htm
20	ZUROWSKA LUDWIKA Z RACIBOROWKICH	30,51052	50,41623	..\Baza_danych\20.htm
21	POLOWA ANIELA Z PERROW	30,51055	50,41626	..\Baza_danych\21.htm
22	BAGINSKA MARCELINA	30,51051	50,41619	..\Baza_danych\22.htm
23	BAGINSKI ADAM	30,51050	50,41620	..\Baza_danych\23.htm
24	PASZKOWSKA HELENA Z GALESKICH	30,51049	50,41618	..\Baza_danych\24.htm
25	WOLDT IZABELLA Z HEINOW	30,51046	50,41623	..\Baza_danych\25.htm

Fig. 7. Filled tabular database to the vector layer of point objects

Next, all map layers were exported to html format, and the point object layer was exported to kml format using a universal translator, which allowed to view burial data in GoogleEarth (Fig. 8).

To export data to html-format used the application MapInfo HTML-map, written in the programming language MapBasic. This appendix specifies the layer and column that will be used to define the hyperlink. The title of the map and its size in the browser window were also set (Fig. 9).

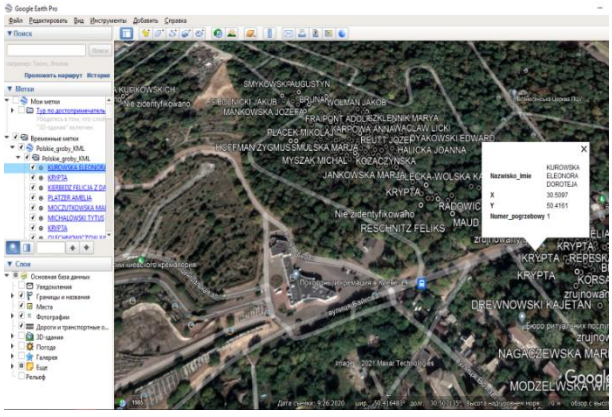


Fig. 8. Exported burial dots layer in kml format, opened in GoogleEarth

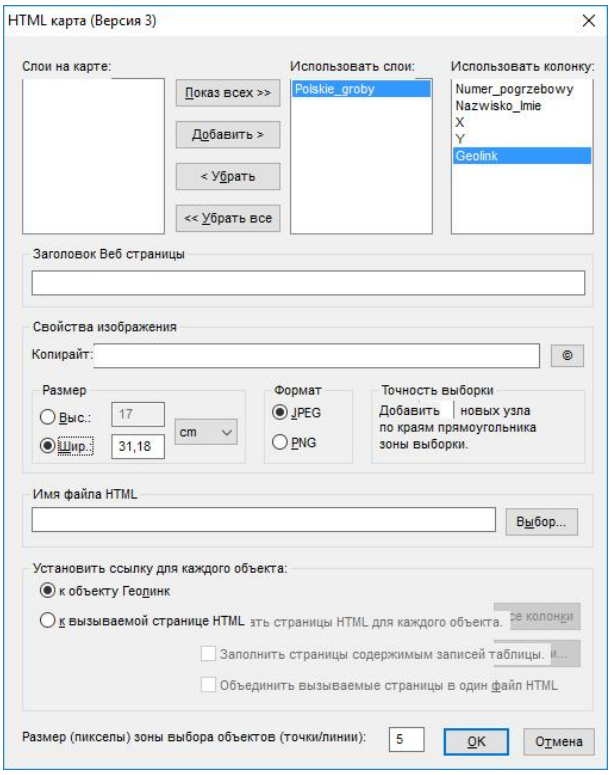


Fig. 9. HTML map creation window

At the eighth stage of the technological scheme the structure of layouts of each html-page of the created online GIS was developed (Fig. 10).

Fig. 10. The main page of the developed GIS

The space image on the main page of the system served as a hyperlink to go to GoogleMaps to view the location of the object and the surrounding infrastructure (Fig. 11).

All map data had hyperlinks to the selected AOI objects. In the case of the scheme of the Baikove Cemetery, the areas where there are Polish burials were selected and when clicked on, a topographic plan with marked point burials opens (Fig. 12, 13).

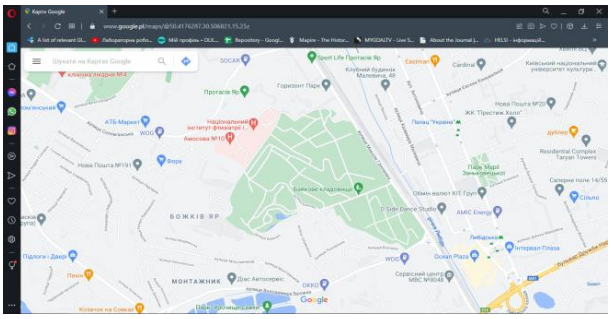


Fig. 11. GoogleMaps transition window

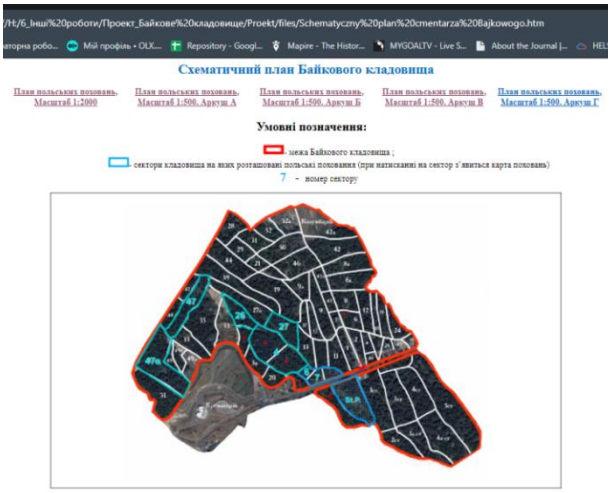


Fig. 12. The location scheme of the Baikove Cemetery with configured hyperlinks territories to topographic plans

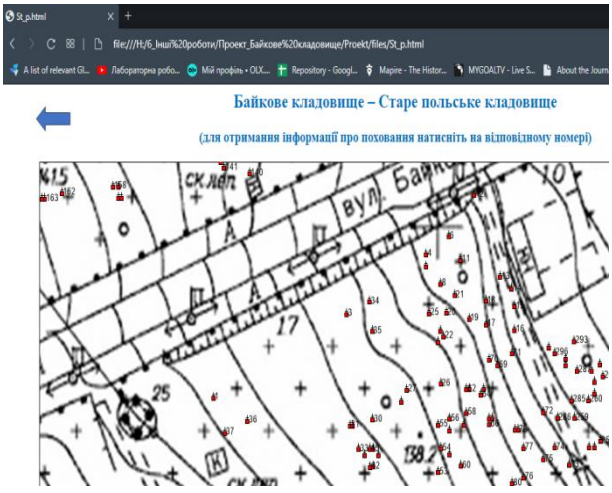
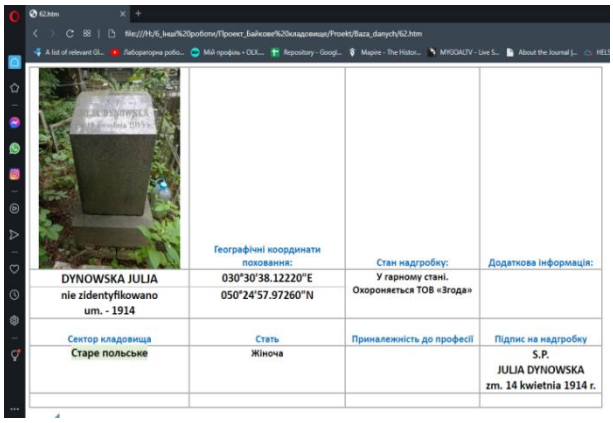


Fig. 13. Example of one of the territories of the cemetery in the form of a topographic plan with point objects with programmed hyperlinks to the file database

In turn, clicking on them, information about the burial appears from the file database (Fig. 14).



	Географічні координати поховання:	Стан надгробку:	Додаткова інформація:
DYNOWSKA JULIA nie zidentyfikowano um. - 1914	030°30'38.12220"E 050°24'57.97260"N	У гарному стані. Охороняється ТОВ «Згода»	
Сектор кладовища	Стать	Приналежність до професії	Підпис на надгробку
Старе польське	Жінча		S.P. JULIA DYNOWSKA zm. 14 kwietnia 1914 r.

Fig. 14. Example of displaying a database file with burial information

At the tenth stage, 5 sheets of topographic plans with burials were generated. One sheet of scale 1:2000 and four sheets of scale 1:500, for better "spreading" and initialization of burials (Fig. 15).

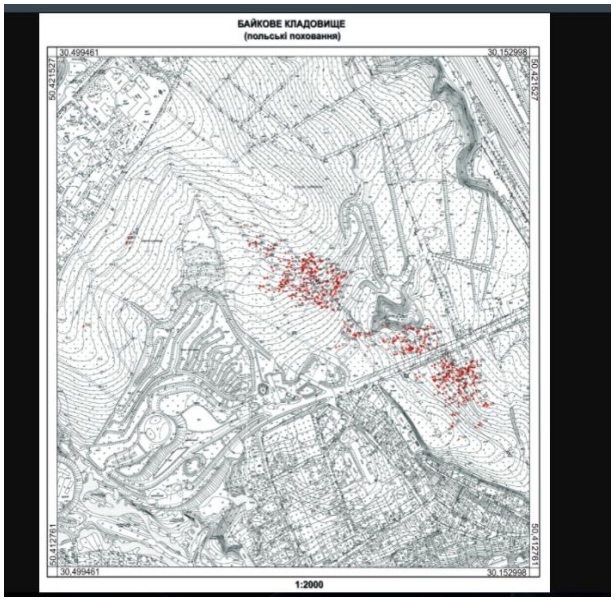
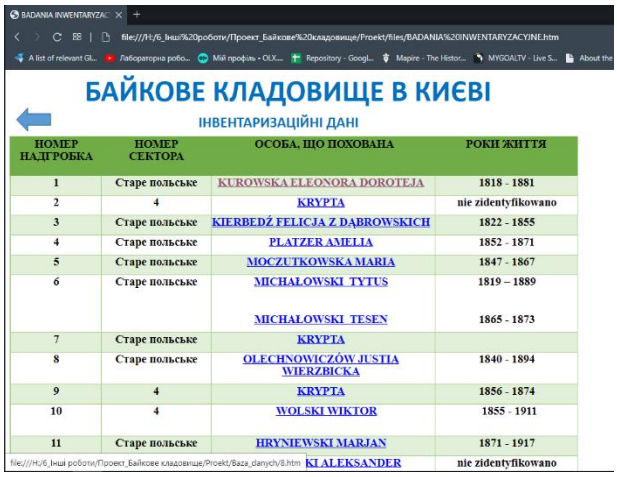


Fig. 15. Example of displaying one of the topographic plans with spot objects of Polish burials

During the eleventh stage, a file database on Polish burials was created and filled. It included the following structure: photo of the burial, coordinates, surname and name, years of life, additional photographs (if possible), sex of the buried person, interpreted inscription on the tombstone, as well as, if possible, supporting information and belonging of the buried person to a certain profession (Fig.16,17).

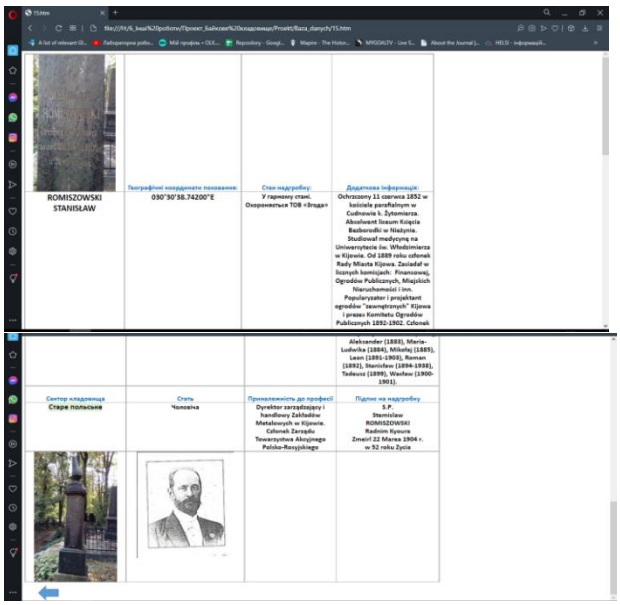


БАЙКОВЕ КЛАДОВИЩЕ В КИЄВІ

ІНВЕНТАРИЗАЦІЙНІ ДАНІ

НОМЕР НАДГРОБКА	НОМЕР СЕКТОРА	ОСОБА, ЩО ПОХОВАНА	РОКИ ЖИТТЯ
1	Старе польське	KUROWSKA ELEONORA DOROTEJA	1818 - 1881
2	4	KRYPTA	nie zidentyfikowano
3	Старе польське	KIERBEDŹ FELICJA Z DĄBROWSKICH	1822 - 1855
4	Старе польське	PLATZER AMELIA	1852 - 1871
5	Старе польське	MOCZUTKOWSKA MARIA	1847 - 1867
6	Старе польське	MICHAŁOWSKI TYTUS MICHAŁOWSKI TESEN	1819 – 1889 1865 - 1873
7	Старе польське	KRYPTA	
8	Старе польське	OLECHNOWICZÓW JUSTIA WIERZBICKA	1840 - 1894
9	4	KRYPTA	1856 - 1874
10	4	WOLSKI WIKTOR	1855 - 1911
11	Старе польське	HRYNIEWSKI MARJAN	1871 - 1917
		KI ALEKSANDER	nie zidentyfikowano

Fig. 16. Page with inventory data on Polish burials



	Географічні координати поховання:	Стан надгробку:	Додаткова інформація:
ROMISZOWSKI STANISŁAW	030°30'38.74200"E	У гарному стані. Охороняється ТОВ «Згода»	Ochrzczony 11 czerwca 1852 w kościele parafialnym w Cudnowie k. Żytomierza. Absolwent liceum Księża Bazborodki w Niażynie. Studiował medycynę na Uniwersytecie św. Włodzimierza w Kijowie. Od 1889 roku członek Rady Miasta Kijowa. Zasiadał w licznych komisjach: Finansowej, Ogrodów Publicznych, Miejskich Nieruchomości i inn. Popularyzator i projektant ogrodów "zewnętrznych" Kijowa i prezes Komitetu Ogrodów Publicznych 1892-1902. Członek Aleksander (1883), Maria-Ludwika (1884), Mikołaj (1885), Leon (1891-1903), Roman (1892), Stanisław (1894-1938), Tadeusz (1899), Wacław (1900-1901).
Сектор кладовища Старе польське	Стать Чоловіка	Приналежність до професії Dyrektor zarządzający i handlowy Zakładów Metalowych w Kijowie. Członek Zarządu Towarzystwa Akcyjnego Polsko-Rosyjskiego	Підпис на надгробку S.P. Stanisław ROMISZOWSKI Radosn łysusa Zmarł 22 Marca 1904 r. w 52 roku Życia

Fig. 17. Example database file with burial information

At the last stage, the hyperlinks of the transition between the pages were configured and the system was tested.

Scientific novelty and practical significance

The scientific novelty lies in the development of the concept of joint use of various applications of geoinformation and non-geoinformation purposes.

The technological scheme of creation of WEB-GIS of Polish burials of the Baikove Cemetery in Kyiv is offered. Implemented geographic information system is designed for inventory of burials, analysis of the condition of tombstones and their spatial location in the cemetery. In addition, the created GIS can be used for tourism purposes and in the study of historical figures of Polish origin.

Conclusions

As a result of realization of the set purpose the online geoinformation system of the Polish burials at the Baikove Cemetery which includes the following sections is created:

- areas of the cemetery with Polish burials, which are reflected in the topographic plan M 1:2000, linked in the coordinate system WGS84;
- point objects of each tomb of Polish burials were identified using a GIS tablet with an accuracy of 0.30 m. The objects were plotted on a topographic basis and created geo-links to the corresponding file from the system database;
- models of plans with Polish burials in scales 1:2000 and 1:5000;
- inventory table of Polish tombs in the cemetery with the sector of burials, number of the tomb, the person buried and years of life. The person's last name and first name are linked by a geolink to a file database that includes 565 objects;
- generated file with kml extension for viewing burial spot data using GoogleEarth software.
- the system is connected to GoogleMaps.

The project was implemented in cooperation Ukrainian scientists with the Consulate of the Republic of Poland in Ukraine.

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МЕТОДИКА СТВОРЕННЯ WEB-ГІС ПОЛЬСЬКИХ ПОХОВАНЬ НА БАЙКОВОМУ КЛАДОВИЩІ У КИЄВІ

Опрацювання методики створення WEB-ГІС польських поховань на Байковому цвинтарі в Києві. Досягнення поставленої мети передбачало виконання таких завдань: розробити структуру геоінформаційної системи, її каркас та виконати наповнення файлової бази даних. Для реалізації поставлених завдань запропоновано технологічну схему, що складалася з 12 етапів роботи. Перший етап передбачав збір картографічних та описових даних на територію об’єкта досліджень, а також пошук можливих реєстрів польських поховань у межах досліджуваного об’єкта. На другому етапі виконувалися польові вишукування з визначення координат кожної могили польських поховань Байкового цвинтаря за допомогою ГІС-планшета з RTK-антеною LT700H (точність до 0,30 м). Загальна кількість закоординованих точок – 565, що зосереджені на 7 ділянках кладовища. Третій етап включав координування опорних точок та прив'язку за цією опорою в середовищі ГІС MapInfo фрагмента топографічного плану м. Києва в масштабі 1:2000 на територію Байкового кладовища. Всього було 11 опорних точок. Максимальна похибка прив’язки 0,2 м. На четвертому етапі відображено всі точкові об’єкти за їхніми координатами на карті-основі та обрано відповідні умовні позначення. Наступний крок присвячений розробленню і наповненню реляційної бази даних для точкових об’єктів. Вона містила такі стовпці: номер могили, прізвище та ім’я похованої особи, координати могили та гіперпосилання на інформацію про поховання в файловій базі даних. Далі всі картографічні шари були експортовані в html-формат, а шар точкових об’єктів за допомогою універсального транслятора експортований у kml-формат, що дало можливість перегляду даних про поховання у програмі GoogleEarth. На восьмому етапі технологічної схеми розроблена структура макетів кожної html-сторінки створюваної онлайн ГІС. Всі картографічні дані мали гіперпосилання виділених об’єктів AOI. У випадку схеми Байкового кладовища, були виділені ділянки, на яких є польські поховання. При натисканні на них відкривався топографічний план з позначеними точковими об’єктами поховань. Своєю чергою, при натисканні на них з’являлась інформація про поховання з файлової бази даних. На десятому етапі згенеровано 5 аркушів топографічних планів з нанесеними похованнями. Один аркуш масштабу 1:2000 і чотири аркуші масштабу 1:500, для кращого «рознесення» та ініціалізації поховань. Одинадцятий етап присвячений створенню і наповненню файлової бази даних про

польські поховання. Вона містила наступну структуру: фото поховання, координати, прізвище та ім’я, роки життя, додаткові фотографії (за наявності), стать похованої людини, інтерпретований надпис на надгробку, а також, за можливості, детальну інформацію та приналежність похованої людини до певної професії, її видатні здобутки і досягнення. На останньому етапі налаштовувались гіперпосилання переходу між сторінками і проводилось тестування системи. Наукова новизна полягає у розробці концепції сумісного використання різних прикладних додатків геоінформаційного і негеоінформаційного призначення. Запропоновано технологічну схему створення WEB-ГІС польських поховань Байкового цвинтара у Києві. Реалізована геоінформаційна система, призначена для інвентаризації поховань, їх збереження та опіки над ними різними неурядовими організаціями і волонтерами, аналізу стану надгробків та їхнього просторового розташування на території кладовища. Окрім цього, створену ГІС можна використовувати в туристичних цілях та при вивченні історичних постатей польського походження.

Ключові слова: WEB-картографія; польські поховання; Байковий цвинтар; історична ГІС; файлова база даних; інвентаризація поховань.

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