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## **CREATION AND IMPLEMENTATION OF ELECTRONIC DATABASE AND MARKING SYSTEM FOR IDENTIFYING AND OBTAINING INFORMATION ON PLANT SPECIES IN BOTANICAL GARDENS, DENDROLOGICAL PARKS, AND PARK MONUMENTS OF THE LANDSCAPE ART**



A special system for identifying and obtaining information on plant species has been developed in order to extend the range of services for visitors of Feofaniya national park monument of landscape art. The system includes an electronic database and a special system for marking with QR-codes. It enables to optimize ecological and educational activities in botanical gardens, arboretums, and parks monuments to attract more visitors, to enhance the quality of recreation services, to spread information about unique objects of nature reserve fund of Ukraine.

*Keywords:* system, database, marking, QR-code, and Feofaniya national park monument of the landscape art.

Over the last five years, mobile electronic devices based on various operating systems, the so-called smartphones and tablets, which are essentially miniature computers and capable of performing the complex tasks, have become very popular. Most of them have GPS receivers, access to Internet, photo and video cameras, which with the help of appropriate software are able to recognize the bar and QR- codes. Such codes enable to encrypt certain information (text, e-mail addresses, reference to web pages, etc.) and are often used for advertising purposes, to accompany goods and services and to provide information about product. In some countries, QR-codes are used in the botanical gardens (USA), museums, etc. [1–4]. In Ukraine, despite the attempt to implement QR-codes, this technology has not

yet been widely used in the educational and environmental field.

In 2016, the Institute for Evolutionary Ecology of the NAS of Ukraine within the framework of implementation of R&D project «*Creation and Implementation of Electronic Database and Marking System for Identifying and Getting Information on the Plant Species in the Botanical Gardens, Dendrological Parks and Park Monuments of Landscape Art*» developed and implemented on the territory of *Feofaniya* National Park Monument of Landscape Art (PMLA) an electronic database and marking system for identification and obtaining information on the species of park phytodiversity. With the help of this system, the visitor of botanical garden or park, using a mobile gadget, has an access to an electronic map of the reserved area with the designation of buildings, recreation areas, natural and landscape objects, their location, as well as detailed information on the plant

species (or other objects) presented in the exhibitions. The work of the system involves the installation near the special types of plants or objects of special plates bearing QR-codes containing encrypted references to the corresponding records in the database stored on the remote servers of the relevant institutions. The tested system consists of several components of *My Feofaniya Park* software [5] to be installed on the visitors' mobile devices, databases, and Internet pages filled in with the information from this database [6]. Requirements to the technical level of mobile devices are low, and the interface is user friendly.

The computer program is designed for use on the mobile devices operating on Android, version 4.0 and higher. It performs functions of scanning, recognizing and decoding the QR-codes, accessing the database, displaying the information, defining and visualizing the location of user and local points on the screen, as well as processing and displaying the geospatial information about the

main objects (plant species and shapes, elements of infrastructure) in the park area. Functioning of the program involves the availability of database of plant species on the remote server, access to the system of geo-positioning (GPS), access to the Internet network using the wireless communication channel, the presence of plates with QR-codes installed near the corresponding plant objects.

The program consists of individual modules, which are launched using a graphical interface. After running the program, a window with three buttons appears (Fig. 1). The button «Characteristic of the plant» allows the visitor to scan the plate with QR-code, the «Park map» button opens a map of the park, the «Help» button opens the help for using the program.

When you click the button «Characteristic of the plant», the QR-code scanner window is called. To scan, you need to put the mobile camera on the QR-code plate so that the QR-code is located in the center of the screen of the mobile

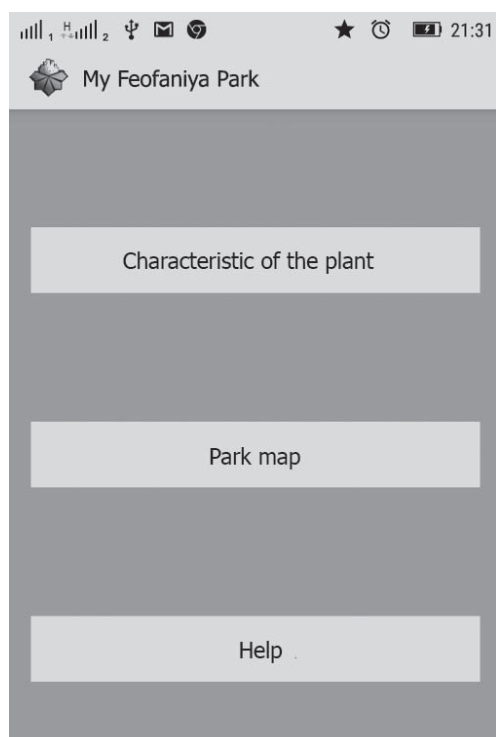


Fig. 1. Start screen



Fig. 2. QR-code scanner window

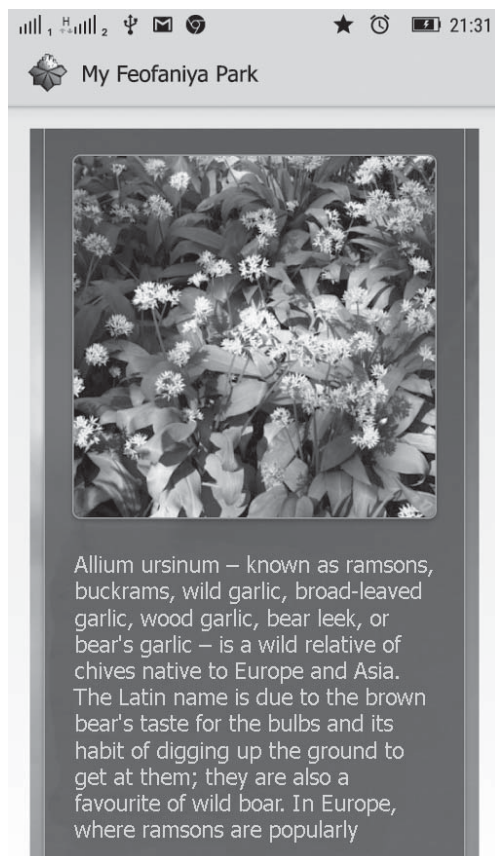


Fig. 3. Plant Information window

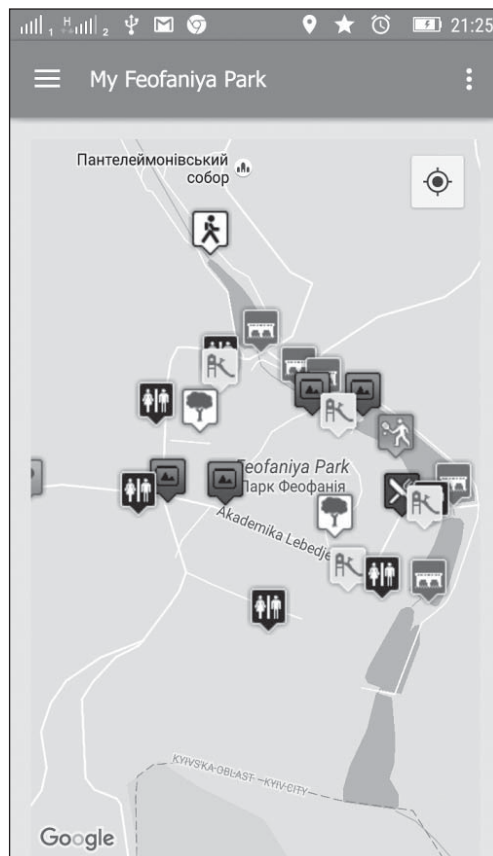


Fig. 4. Park Map window

device and hold the mobile device in this position (Fig. 2). After successful reading the QR-code by the scanner a separate window opens the information about the selected plant (Fig. 3). The information is downloaded to the device via a wireless communication channel.

Clicking the «Park Map» button calls a window that displays the online map of the territory with the signs of park infrastructure objects and the location of the user (Fig. 4). In order to determine the exact location, it is necessary for the electronic device to support the geo-positioning technology. You can rotate the map, zoom out and plot the routes to the selected points. For the convenient use, the program has the function of visualizing the individual groups of objects, such as playgrounds, parking zones, public transport stops, etc. Also, when you click the object's

marks, information about the object is displayed on the screen.

*My Feofaniya Park* software is publicly available via link: [https://play.google.com/store/apps/details?id=ua.kiev.feofaniya.volodimirg.my\\_park\\_feofaniya](https://play.google.com/store/apps/details?id=ua.kiev.feofaniya.volodimirg.my_park_feofaniya).

The database contains detailed information on each type of plant presented in the *Feofaniya* PMLA collection: its botanical name, historical information on propagation and use, peculiarities of biology, photographs in various phenological phases of development, etc., prospects for its use in horticulture, and main features of cultivation. The database of plant species is flexible enough and allows you to quickly make changes, add new records, and automatically generates the QR-codes with a reference to a separate record in the database. Also, visitors have the oppor-

tunity to receive information without installing a mobile application. You only need to scan the QR-code from the plate and identify it by any software product, and then go to the reference for the relevant information.

The use of such a system enables to significantly expand the ecological and educational activities of the institutions of the nature reserve fund of Ukraine; its wide introduction will contribute to increasing the awareness and involvement of population in the environmental protection activities and instilling the love for the native land and Ukraine.

### CONCLUSIONS

An electronic database and marking system for the identification and obtaining the information about the plant species that can be introduced on the territory of botanical gardens, arboretums, parks, parks monuments of landscape art, national natural parks (with the use of ecotourism routes), etc. has been developed. The necessary conditions for use are the ability of access to the Internet network using the wireless communication channel, the presence of plates with QR-codes and the corresponding records in the database of plant species. Implementation of the development will contribute to improving the quality and expanding the possibilities of providing the information during the excursion service both of organized groups of visitors and individual nature lovers.

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СТВОРЕННЯ ТА ВПРОВАДЖЕННЯ  
СИСТЕМИ ЕЛЕКТРОННОЇ БАЗИ ДАНИХ  
І МАРКУВАННЯ ДЛЯ ІДЕНТИФІКАЦІЇ  
ТА ОТРИМАННЯ ІНФОРМАЦІЇ  
ПРО ВИДИ РОСЛИН У БОТАНІЧНИХ САДАХ,  
ДЕНДРОЛОГІЧНИХ ПАРКАХ  
ТА ПАРКАХ-ПАМ'ЯТКАХ САДОВО-ПАРКОВОГО  
МИСТЕЦТВА

З метою розширення сфери послуг відвідувачам парку-пам'ятки садово-паркового мистецтва загальнодержавного значення «Феофанія» створено спеціалізовану систему для ідентифікації та отримання інформації про види рослин, до якої входить електронна база даних і спеціальне маркування з використанням QR-кодів. Система дозволяє оптимізувати еколого-освітню діяльність у ботанічних садах, дендрологічних парках та парках-пам'ятках садово-паркового мистецтва, збільшити чисельність відвідувачів, поліпшити якість надання рекреаційних послуг, поширити інформацію про унікальні об'єкти природно-заповідного фонду України.

*Ключові слова:* система, база даних, маркування, QR-код, парк-пам'ятка садово-паркового мистецтва загальнодержавного значення «Феофанія».

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СОЗДАНИЕ И ВНЕДРЕНИЕ СИСТЕМЫ  
ЭЛЕКТРОННОЙ БАЗЫ ДАННЫХ  
И МАРКИРОВКИ ДЛЯ ИДЕНТИФИКАЦИИ  
И ПОЛУЧЕНИЯ ИНФОРМАЦИИ О ВИДАХ  
РАСТЕНИЙ В БОТАНИЧЕСКИХ САДАХ,  
ДЕНДРОЛОГИЧЕСКИХ ПАРКАХ  
И ПАРКАХ-ПАМЯТНИКАХ  
САДОВО-ПАРКОВОГО ИСКУССТВА

С целью расширения сферы услуг посетителям парка-памятника садово-паркового искусства общегосударственного значения «Феофанія» создана специализированная система для идентификации и получения информации о видах растений, в которую входит электронная база данных и специальная маркировка с использованием QR-кодов. Система позволяет оптимизировать эколого-образовательную деятельность в ботанических садах, дендрологических парках и парках-памятниках садово-паркового искусства, увеличить количество посетителей, улучшить качество предоставления рекреационных услуг, распространять информацию об уникальных объектах природно-заповедного фонда Украины.

*Ключевые слова:* система, база данных, маркировка, QR-код, парк-памятник садово-паркового искусства общегосударственного значения «Феофанія».