

IT-technologies – a Development Audio-Visual Interface “Arkhangelsk: Center, Chumbarov-Luchinsky, Solombala – Walking around the City”

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Abstract

The development of modern telecommunication and information technologies, cybernetic algorithms ensures the solution of a wide variety of problems in the field of information technology, meeting the needs of citizens, industry, business and the State. Using new information technology and information-telecommunication multimedia service, in the field of cultures and art, social area is an important state problem. The State assists in realization of these problems and expansions of the using information technology, information-telecommunication multimedia service. To implement these programs, public authorities assist in the creation and operation of tourist information centers, the development of multimedia and telecommunication systems for navigation, orientation, activities of museums on the use of modern computer technologies, informatization of the industry; support for innovative projects; introduction of new information and telecommunication multimedia technologies, fundamental and applied research. New information technologies are the basis for the development of the digital economy. The digital economy provides solutions for a wide range of tasks: from increasing production efficiency to the quality of products and labor intensification. Modern information technologies provide the decision of social and cultural problems of the development society. One of the areas of information technology development is the use of 3D programming methods and virtual and augmented reality technologies. An example of the use of virtual and augmented reality can be defined as virtual museum technologies. A virtual museum can be implemented using both virtual and augmented reality methods. The Methods to virtual reality are the most modern information technology. The development of virtual reality is possible with the development of specialized software, hardware and software. Software that can be used to implement virtual and augmented reality programs is based on object-oriented programming methods and high-level software tools. The practical implementation of virtual and augmented reality programs involves the use of dynamic visualization programs and external interfaces. The social orientation of the virtual and augmented programs determines the relevance of the topic.

Keywords: virtual reality, augmented reality, virtual museum, social urgency, methods of the programming, state program, state value

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ИТ-технологии – разработка аудиовизуальных интерфейсов «Архангельск: центр, Чумбарова-Лучинского, Соломбала – прогулки по городу»

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Аннотация

Развитие современных телекоммуникационных и информационных технологий, кибернетических алгоритмов обеспечивает решение самых разнообразных задач в области информационных технологий, обеспечения потребностей граждан, промышленности, бизнеса и государства. Применение новых информационных технологий и информационно-телекоммуникационного мультимедийного сервиса, в области культуры и искусства, социальной области является важной государственной задачей. Государство содействует в реализации этих задач и расширения применения информационных технологий, информационно-телекоммуникационного мультимедийного сервиса. Для реализации этих программ государственные органы содействуют в создании и функционировании туристских информационных центров, разработки мультимедийных и телекоммуникационных систем навигации, ориентирования, направлений деятельности музеев по применению современных компьютерных технологий, информатизации отрасли; поддержки инновационных проектов; внедрение новых информационно-телекоммуникационных мультимедийных технологий, проведение фундаментальных и прикладных исследований. Новые информационные технологии являются основой развития цифровой экономики. Цифровая экономика обеспечивает решение самого разнообразного направления задач: от повышения эффективности производства до качества выпускаемой продукции и интенсификации труда. Современные информационные технологии обеспечивают решение социальных и культурных задач развития общества. Одним из направлений развития информационных технологий является применение методов 3D-программирования и технологий виртуальной и дополненной реальности. Примером применения виртуальной и дополненной реальности можно определить это – технологии виртуального музея. Виртуальный музей может реализовываться как с помощью методов виртуальной, так и дополненной реальности. Методы виртуальной реальности являются самыми современными информационными технологиями. Разработка виртуальной реальности возможна при развитии специализированного программного, аппаратного и математического обеспечения. Программное обеспечение, которое может применяться для реализации программ виртуальной и дополненной реальности, основывается на методах объектно-ориентированного программирования и высокоуровневых программных средств. Практическая реализация программ виртуальной и дополненной реальности предполагает использование программ динамической визуализации и внешних интерфейсов. Социальная направленность программ виртуальной и дополненной направленности обуславливает актуальность темы.

Ключевые слова: виртуальная реальность, дополненная реальность, виртуальный музей, аудиогид, социальная актуальность, методы программирования, государственная программа, государственная значимость

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Introduction

The development of modern telecommunications and information technologies, cybernetic algorithms provides solutions to a wide variety of tasks in the field of information technology, meeting the needs of citizens, industry, business and the state. The use of new information technologies and information and telecommunications multimedia services in the field of culture and art, social sphere is an important state task [1]-[3].

The state contributes to the implementation of these tasks and the expansion of the use of information technologies, information and telecommunications multimedia services. To implement these programs, the state bodies assist in the creation and operation of tourist information centers, the development of multimedia and telecommunications systems for navigation, orientation, activities of museums on the use of modern computer technologies, informatization of the industry; support for innovative projects; the introduction of new information and telecommunications multimedia technologies, conducting fundamental and applied research [4; 5].

The theoretical part

Tourist activities, information and telecommunications multimedia services, the procedure for organizing and conducting excursions are determined by state laws, regulatory documents and by-laws. The main normative document regulating, including tourist activities in the Russian Federation, is the Constitution of the Russian Federation¹. Federal laws and regulatory legal acts of the Russian Federation, laws and regulatory legal acts of the subjects of the Russian Federation are the basis for regulating tourist activities in the Russian Federation².

State policy defines tourism as one of the most important sectors of the economy. Information support is a priority area of state regulation of tourism activities (The State Program of the Russian Federation "Development of Culture and Tourism" for 2013-2020³):

- innovation and modern technologies; digitalization and investment;
- presentations in the information and telecommunications network "Internet"; animation and development of the technological base;
- fundamental and applied research.

The state in the sphere of tourism establishes the terms and conditions of the provision of emergency care; safety, security of tourists in Russia and abroad, information security, information assurance (Tourist information Centres, navigation, and orientation), provide

access communications, medical, legal and other types of emergency. The legislation of the Russian Federation provides the tourist with access rights to the means of communication. The tourist product is formed from the market conditions or tasks. One of the forms of the tourist product is the information and telecommunications services "virtual museums". The phenomenon of the "virtual museum" is currently being studied by science. To study the social and informational nature of the service "virtual museum", it is necessary to conduct a comprehensive study of this phenomenon as a normative and scientific concept [6]-[17].

In the regulatory documents, the main terms are defined as follows: 1) Museum – a cultural institution for the storage, study and presentation of museum exhibits.

2) Virtual museum – an interactive software product of electronic museum collections.

"Cultural values are movable objects of the material world, regardless of the time of their creation, having historical, artistic, scientific or cultural significance"⁴.

"A museum object is a cultural value, the quality or special features of which make it necessary for society to preserve, study and publicly present it"⁵.

"A museum collection is a set of cultural values that acquire the properties of a museum object only when they are connected together by virtue of the nature of their origin, or by species kinship, or by other characteristics"⁶.

"A museum is a non-profit cultural institution established by the owner for the storage, study and public presentation of museum objects and museum collections included in the Museum Fund of the Russian Federation, as well as for achieving other goals defined by this Federal Law"⁷.

"Publication is one of the main forms of the museum's activity, which involves all types of presentation of museum objects and museum collections to the public through public display, reproduction in printed publications, on electronic and other types of media, posting information about museum objects and museum collections in the information and telecommunications network "Internet"⁸.

Service virtual Museum displays, Museum exhibits by means of information and telecommunication [6]-[11].

The criteria for the concept of the "virtual museum" service are determined by the type of interaction with the tourist:

- presentation of the exhibition;
- exhibit or additional information;
- language localization;
- accessibility for people with disabilities.

When considering the "virtual museum" service, three levels of

¹ The Constitution of the Russian Federation (was Adopted at National Voting on December 12, 1993. [Electronic resource]. Available at: <http://www.constitution.ru/en/10003000-01.htm> (accessed 10.01.2022). (In Eng.)

² Federal Law of the Russian Federation of November 24, 1996 No. 132-FZ "On the Foundations of Touristic Activity in the Russian Federation" (latest edition) [Electronic resource]. Available at: http://www.consultant.ru/document/cons_doc_LAW_12462 (accessed 10.01.2022). (In Russ.)

³ Government Directions of the Russian Federation of 15.04.2014 no. 317 On Approval of the State Program of the Russian Federation "Development of Culture and Tourism for 2013-2020" (latest edition) [Electronic resource]. Available at: <http://pravo.gov.ru/proxy/ips/?docbody=&nd=102349848&rdk=9> (accessed 10.01.2022). (In Russ.)

⁴ Federal Law of the Russian Federation of May 26, 1996 No. 54-FZ "On the Museum Fund of the Russian Federation and Museums in the Russian Federation" (latest edition) [Electronic resource]. Available at: http://www.consultant.ru/document/cons_doc_LAW_10496 (accessed 10.01.2022). (In Russ.)

⁵ Ibid.

⁶ Ibid.

⁷ Ibid.

⁸ Ibid.



virtual museum implementation and relations in various combinations of mechanisms and indicators can be considered.

The virtual museum service can be implemented locally or on large territories.

A museum located on a large territory can be implemented locally as a “virtual museum” service for each of them. For example, the Vladimir-Suzdal Museum.

The Virtual Museum service is an independent application.

3) The exposition is the main form of museum communication.

4) Virtual exposition – a virtual representation of museum exhibits, which provide a representation of the exhibits, logically constructed, as well as the exposition, and explanatory materials to them.

5) Exhibit – an object displayed for viewing in a museum, exhibition or displayed by multimedia means of information and telecommunications technologies.

6) Excursion-a collective or individual visit to a museum, attraction, exhibition, enterprise, etc.

7) Virtual tour – a tour of the virtual exhibition.

8) Metadata – described structured data.

9) Content of the information content.

10) Interface – means of interaction.

11) Interface degradation – the inability to display the interface when the main functions are running.

12) Web application-client-server application.

13) Tile graphics – a method of representing images of identical elements (patterns).

14) Multi-resolution-representation of an image with a variable resolution.

In the dissertation research, the phenomenon of the new scientific concept “virtual museum” is considered as an aspect of the introduction of new information and telecommunications technologies in the practical activities of museums⁹.

Thus, the complex definition of the information and telecommunications service “virtual museum” is a complex interactive multimedia software product, the result of engineering and creative activity, consisting of computer programs for the information and telecommunications computing system and other objects, includes a legally protected state result of intellectual activity, a kind of multimedia work¹⁰ [15]-[17].

Definition according to scientific sources: information and telecommunications multimedia service “virtual museum” is an independent web application in the information and telecommunications network of the Internet or a mobile client-server application implemented independently or on the software and hardware of the Museum, the state portal or other facilities.

The definition of a virtual museum according to normative legal sources defines the concept of virtual as a product of information technologies¹¹.

The implementation part

For the effective operation of the software of the information and telecommunications multimedia service “virtual museum” in Arkhangelsk, the implementation of the server component is necessary.

When implementing the server component of the virtual museum service, it is recommended to use open source solutions:

1) Databases: PostgreSQL, MySQL;

2) Server-side programming languages: PHP, Ruby, Java, Javascript (Node.js).

The client component of the virtual museum service is implemented using a software and information priority basic set of technologies for creating Internet pages: HTML, CSS, JavaScript (Node.js).

The developed software of the server and client parts of the virtual museum service must ensure correct operation.

The virtual Museum service must work correctly:

1) Internet browsers (HTML5 and CSS3).

2) Computer systems operating systems:

a) stationary: Microsoft Windows, Apple Mac OS, Linux;

b) mobile: Apple iOS, Android.

To solve the information and telecommunications multimedia tasks of mobile computers-creating specialized mobile applications of the server and client parts, placing them in app stores-Apple Store, Google Play Market.

Adapts the interface of the application under development to changing the size of the iframe container. When changing the size of the iframe container, the virtual museum service should automatically rebuild the interface accordingly, without reloading or refreshing the page.

An important feature of the developed service “virtual museum” is the complementarity or updatability of the content. The content of the Virtual Museum service is administered using database management software. The virtual museum service being developed should have database management tools, modify, update, or add new content. Replenishment and updating of the content of the “virtual museum” service is carried out by the Museum or the administrator of the broadcast Internet site. When developing the program code of the virtual museum service, it is necessary to provide for software extensibility and modernization. The developed architecture of the virtual museum service should be characterized

⁹ Maksimova T.E. *Virtual'nye muzei kak sociokul'turnyj fenomen: tipologiya i funkcional'naja specifikaja* [Virtual museums as a sociocultural phenomenon: typology and functional specificity] : Thesis for the degree of Candidate of Cultural Studies 24.00.01. MSIC, Moscow; 2012. 187 p. (In Russ.); Chesnokova M.N. *Jevoljucija muzejnoj jekspozicii kak znakovoj sistemy* [Evolution of the museum exposition as a sign system] : Thesis for the degree of Candidate of Cultural Studies 24.00.03. SPbU, Saint Petersburg; 2010. 163 p. (In Russ.); Makarova I.I. *Rossijskij hudozhestvennyj muzej v sovremennom sociokul'turnom prostranstve: strategii kommunikacii* [The Russian Art Museum in the modern socio-cultural space: communication strategies] : Thesis for the degree of Candidate of Cultural Studies 24.00.01. RSUH, Moscow; 2011. 207 p. (In Russ.); Danilkina I.I. *Koncept vizualizacii voobrazhenija v tvorcestve kak fenomen kul'tury* [The concept of visualization of the imagination in creativity as a phenomenon of culture] : Thesis for the degree of Candidate of Philosophical Sciences 24.00.01. TSU, Tambov; 2009. 177 p. (In Russ.); Kirillova A.A. *Problema virtual'noj real'nosti: social'no-filosofskij aspekt* [The problem of virtual reality: the socio-philosophical aspect] : Thesis for the degree of Candidate of Philosophical Sciences 09.00.11. Murmansk; 2009. 156 p. (In Russ.)

¹⁰ Shlyakhtina L.M. *Osnovy muzejnogo dela: teorija i praktika* [Fundamentals of museum business: theory and practice]. Lan, Planeta muzyki, SPb; 2018. 248 p. (In Russ.); *Muzejnoe proektirovanie* [Museum Design]. Shcherbakov A.A. (ed.), comp. by A.V. Lebedev. M.: 2009. 256 p. [Electronic resource]. Available at: http://www.future-museum.ru/lmp/books/archive/Mus_Proj.pdf (accessed 10.01.2022). (In Russ.)

¹¹ Grin E.S. *Pravovaja ohrana avtorskih prav* [Legal protection of copyright]. Prospect, Moscow; 2016. 112 p. (In Russ.); Sudarikov S.A. *Pravo intellektual'noj sobstvennosti* [Intellectual property law]. Yurayt Publ., Moscow; 2017. 800 p. (In Russ.); Bliznets I.A., Leontyev K.B. *Avtorskoe pravo i smezhnye prava* [Copyright and related rights]. Prospect, Moscow; 2018. 456 p. (In Russ.)



by modularity, expandability and ways of displaying exhibits, and synchronizability. The mobile version of the Virtual Museum app for mobile devices must be synchronized with the version of the virtual museum for stationary devices. The “virtual museum” service must provide work without an Internet connection. The virtual Museum service provides free public access to culture and world art values. The high traffic to the sites and web pages of the virtual museum service characterizes them as an effective means of solving problems of dissemination and familiarization with the culture of the general population. From the scientific side, the phenomenon of the “virtual museum” service is a new object of research.

The main goal of the work is to create a socially significant and popular software product in the regional tourism sector to ensure the accessibility of the population to cultural values.

The object of research is the process of providing historical and cultural information about the city Archangelsk using information and telecommunications multimedia technologies.

The subject of the research is the development and promotion of audiovisual user interfaces of software in the regional tourism sector.

The problem of the research is to determine the ways to create a mobile application audio guide and the service “virtual museum” in the city Archangelsk. Let’s make a choice of the programming language.

Blender – for creating tools or prototypes, logic algorithms in games, as a means of importing / exporting files, and automating the virtual museum service. Supports structured, object-oriented, functional, imperative, and aspect-oriented programming. Architecture – dynamic typing, automatic memory management, introspection, exception handling, multithreaded parallel computing, high-level data structures.

To implement the project of the “virtual museum” service, you can use the software tools in accordance with Figure 1: Java, Python, XML, jMonkeyEngine, SDK, OpenGL, LWJGL.

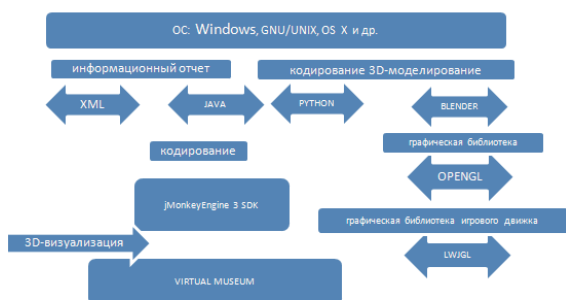


Fig. 1. Software service “Virtual Museum”

When developing software (software) for mobile applications, testing is important. If you use Android, then you need to test on a large number of devices that differ significantly in characteristics (screen resolution, versions). Testing manually on a large number of devices is quite difficult, so you need to automate the testing of user applications. Various tool environments have been developed

for testing mobile applications. Software environments of automating libraries provide the ability to test various parts of programs.

IOS: iOS UI automation is a tool product from Apple, with the implementation of tests in Java Script.

Android: UI Automator is a specialized software tool, similar to UI-Automation, used for testing Android applications.

UI Automator-is a development of Google Corporation and is bundled with the Android SDK.

With this UI Automator software, you can create a universal test script for a variety of devices for accuracy and reproducibility.

Appium is an open source framework for automating mobile app testing. Used for Yandex testing tasks.

Espresso performs testing of the user interfaces of Android applications, characterized by open source code.

Android Studio is an integrated development environment (IDE) for working with the Android platform.

Android Studio is the official Android application development tool, characterized by an advanced layout editor, various types of app assembly and generation of .apk files, templates of the main components and Android layouts.

Android Studio is developed on JetBrains IntelliJ IDEA software in accordance with¹².

Exhibits under Android is developed on base two official programming languages Kotlin or Java on platform Google. Kotlin idle time and suitable programming language, is basically used for development Android-exhibits. Kotlin completely with Java. Convert Java – a file in Kotlin possible by means of Kotlin. The Conversion is necessary to check. Kotlin possible to use for functioning(working) on virtual machine Java (JVM). On Kotlin possible to use the existing libraries Java, and mixture of the code Java and Kotlin at development project on Android. Kotlin combines to functions as functional, base - a mathematical functions, so and procedural, base – a calling the procedure, programming. The Particularity Kotlin is that all methods are final, no need to finish the line a semicolon, file is compiled in byte-code, application exactly such as Java. When making project possible simply to convert the existing files Java, or further create the new files Kotlin. The powerful infrastructure of the models of the parallelism are Used on Android HaMeR (Handler, Message and Runnable).

Java – powerful and popular language of the object-oriented programming the development to corporations Sun Microsystems (Oracle) with large community of support. The Majority of applications for Android is designed on Java. Applications are for Android possible to develop by means of C or C++. At development under Android-applications is used not only Kotlin/Java, but also with XML. XML – “Extensible Markup Language” that means the upgradeable language of the sectoring, and is “Markup Language” that is marked as “language of the sectoring”. Kotlin defines the logic or dynamic actions, but XML – indicates the place on page, where occurs something and the models. These elements hereinafter perfect in corresponding to code on Kotlin or Java. XML-file, defining model of the user interface of the action. For compiling the files of the code, the data and resource in archive package Android with .apk – an extension, are used facility Android Studio SDK. The File .apk contains completely all necessary data and use for installation of application Android.

¹² Android Studio. Google Developers; 2022. [Electronic resource]. Available at: <https://developer.android.com/studio> (accessed 10.01.2022). (In Eng.)



The Artifacts – a new library for inverse compatibility between issue Android. Androidx is a library by default. The System functions Android (the interface, processing the intentions), available through interfaces Java. Use the code C or C++ possible through package Android Native Development Kit (NDK), for instance, for development of the plays, with own logic on OpenGL and possible use the advantage of the extensive libraries C, oriented on development of the plays. Using C or C++ provides increasing to power computing device. Use NDK Android requires the high qualification a programmer. Thereby, operating system (OS) Android is used for

applications on Java or Kotlin. The Social directivity of the programs virtual and complemented directivities urgency of the subject.

The task of the “virtual museum” service is to develop a software tool for the mobile application of the audio guide of the city Archangelsk for conducting excursions or self-use by tourists around the city Archangelsk using modern multimedia technologies and specialized software [18]-[25] in accordance with Figure 2.

Information and telecommunications multimedia technologies that provide the implementation of the visualization elements of the “virtual museum” are Adobe Flash, Unity3D (Table 1).

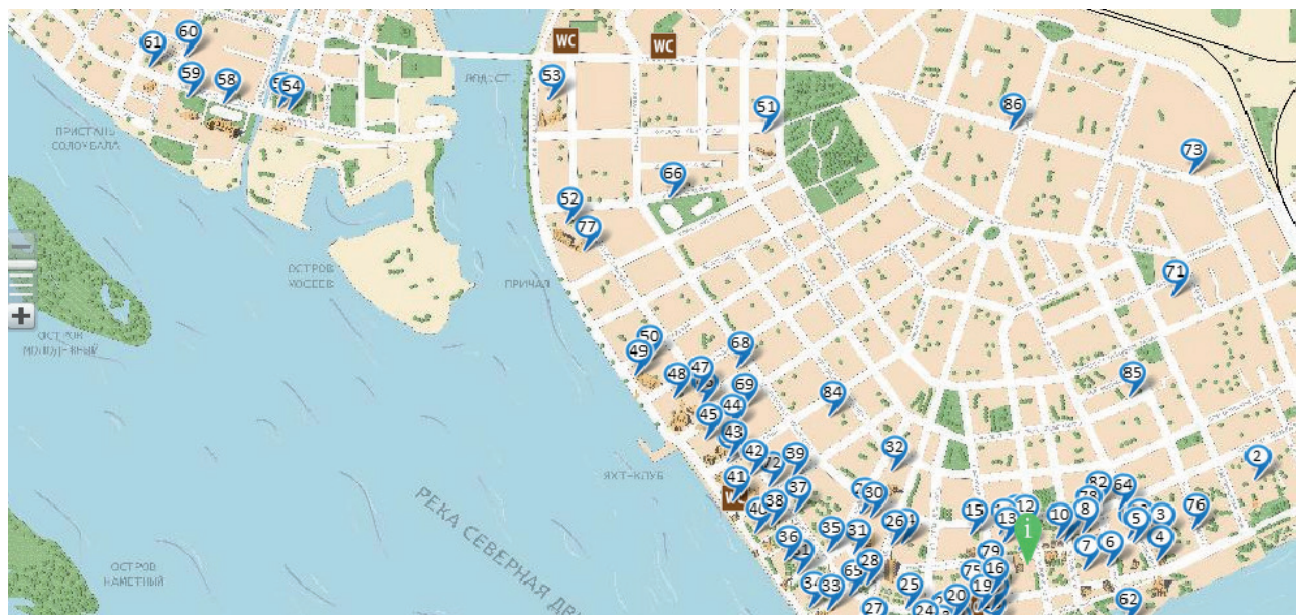


Fig. 2. Information and telecommunications multimedia service “Virtual Museum”

Table 1. Technologies for implementing the “Virtual Museum” components

Component	Level 1	Level 2	Level 3
Presentation mechanism			
The mechanism of presentation of the exhibition	HTML, CSS, JavaScript	HTML, CSS, JavaScript	HTML, CSS, JavaScript
	HTML, CSS, JavaScript	HTML, CSS, JavaScript + Adobe Flash или Unity3D	Adobe Flash, Unity3D или аналог
		HTML, CSS, JavaScript + Adobe Flash или Unity3D	Unity3D
The mechanism of the view exhibit	HTML, CSS, JavaScript	HTML, CSS, JavaScript	HTML, CSS, JavaScript
		HTML, CSS, JavaScript	Adobe Flash, Unity3D или аналог

The experimental part

An integral part of the developed software service “virtual museum” is the “audio guide”. The “audio guide” is a set of interface with management tools and audio files of the virtual museum service object that are placed on the server and contain a tour or explanation of the Museum object. An integral part of the mobile applications and audio guide of the Virtual Museum service is the QR code recognition subsystem. In the QR-code symbols on the screens of mobile devices of the virtual museum service, information is

encrypted using specialized software, technologies of the Internet information and telecommunications network. The basis for encoding and decoding the information of the virtual museum service is the QR-code system. These conditions are implemented with the help of technical means-electronic information and communication means-audio guide of the service “virtual museum”. The content of the developed mobile application of the service “virtual museum” – audio guide consists of: audio, video, text, images, geolocation. Creating an information and telecommunications product-a mobile application audio guide, includes the following steps:



1. Analysis of the consumer relevance of the project of the service "virtual museum".
2. Modeling of the studied subject area of the mobile application of the service "virtual museum".
3. Definition of technical requirements, development of the architecture of the mobile application of the audio guide service "virtual museum".
4. The development of a logic model of the project implementation, mobile app audio city Archangelsk service "virtual Museum".
5. Development of the design of the appearance and interface of the mobile application audio guide service "virtual museum".
6. The interface of the program of the service "virtual museum".
7. In the "virtual museum" service, the audio file with the tour is automatically played (or the information is read using a QR code).

The location of the user of the virtual museum service is determined automatically using GPS navigation or QR codes.

The user's location is visualized using Google Maps.

Conclusion

In the course of the research work of the service "virtual museum" Arkhangelsk, it is necessary to solve the following subtasks:

- to analyze the conceptual approaches and software-analytical methods used in the development of tourist software products-mobile applications of the audio guide service "virtual museum";
- анализ analysis of programs that can be used in the implementation of the project of the mobile application of the audio guide of the city Archangelsk service "virtual museum";
- development of the appropriate software for the implementation of this research project-the audio guide of the service "virtual museum".

An effective means of solving these problems from the set of existing numerous resources of the information and communication network of the Internet is the service "virtual museum" – a modern and dynamically developing phenomenon of culture.

The scientific and technical solution is the development of information and telecommunications projects and an audio guide for the city Archangelsk¹³.

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