Abstract

of the dissertation work of Chinibayev Y.G. "Development of methods for visualization of three-dimensional objects using augmented reality technology", submitted for the degree of Doctor of Philosophy (PhD) in the specialty 6D070400 - Computer Engineering and Software

Relevance of the study.

The Information Society is currently on the rise, and the development rates are very high. The dominant activity is associated with the content production. A person's integration to this society depends on how effectively he can operate with the information. Moreover, information flows that modern specialists need to navigate in are steadily increasing, stimulating the development of new technologies (a set of tools and methods) for working with information.

The globalization of virtual reality has led to the introduction of a new term "augmented reality" into scientific circulation. If the current user interface technologies are focused mainly on the interaction of a person and a computer, then augmented reality with the help of computer technology offers an improvement in the human interface and the real world around.

The modern stage of augmented reality research began in the 1990s. Many works have been published about the relevance and serious potential of this topic. However, the development of consumer electronics has only now reached a level that can ensure the mass adoption of this technology.

At the moment, augmented reality is one of the most relevant objects for research, because the niche has not yet been filled by major players. If we intensify scientific and practical research in this area for popularization and widespread implementation, then Kazakhstan can join the ranks of the main players.

The aim of the study is to create a set of models and methods for assessing augmented reality traffic, as well as assessing the quality of perception of augmented reality applications by the user.

Research objectives.

To achieve the goal of the study, the following interrelated tasks were set and solved:

1) analysis of the current state in the field of augmented reality research, identifying the shortcomings of modern augmented reality systems and suggesting methods for their solution.

2) search and analysis of methodological, algorithmic and software tools for research purposes.

3) development of models of the service space, the area of perception and user behavior.

4) formulation of recommendations for designing a user interface for visualization by means of augmented reality.

The object of research in the dissertation work are computer methods of information processing.

The subject of the research is an information system with interactive visualization technology using augmented reality.

The theoretical and methodological basis of the research is in the field of image processing and analysis, computer graphics and human-computer interaction.

In the course of the research, the works of both foreign and Kazakhstani scientists were used (R. Azuma, M. Billingharst, O. Bimber, D. Wagner, B. Victor, F. Kisino, T. Kodela, A. Kay, V.I. Loiko, S. Mann, P. Milgram, D. Mitsel, D. Raskin, I. Sutherland, S. Siltanen, S. Finer, G. Fitzmaurice, D. Schmalstieg, D. Engelbart, A. Kuandykov, R. Uskenbaeva, Y. Dayneko, M. Ipalakova, B. Amirgaliyev and etc.), who have made a significant contribution to the development of the theory of information systems, the development of issues of human-computer interaction, user interfaces and augmented reality.

Research methods.

In the course of the work, the methods of computer graphics and modeling were used.

Scientific novelty.

The following main scientific results were obtained in the dissertation work:

1. A new classification of augmented reality applications is proposed, considering applications for the Tactile Internet and the Internet of Skills.

2. A model of the user's service space has been developed, which differs in that when providing augmented reality services, in addition to the interactive data request at the user's request, the possibility of predictive data request according to the decision of the client application is also considered.

3. A model of the user perception area has been developed, characterized in that the predicted user perception area is represented as an ellipse built on the basis of the probable user coordinates and the probable area of user perception of data, which makes it possible to provide at least 25% more efficiency than when using other figures.

4. A model of behavior of a mobile user of an augmented reality service moving in the environment of Internet of Things devices has been developed, which differs from the known ones in that the user is represented as a queuing system M/G/1, and the incoming stream is formed from K services available to the user, including video , text, graphics, speech, music, tactile sensations, etc., which makes it possible to calculate such systems using the queuing theory apparatus.

5. The distributions of the speeds of pedestrians and drivers and passengers of vehicles are determined, differing in that these distributions are presented in the form of multimodal ones to obtain estimates of the augmented reality user's traffic.

Provisions to be defended.

1. Model of the user's service space, which considers, in addition to the interactive data request at the user's request, the possibility of predictive data request according to the decision of the client application.

2. User perception area model, in which the predicted user perception area is represented as an ellipse based on the probable user coordinates and the probable user perception area, which makes it possible to provide at least 25% more efficiency than other figures.

3. Behavior model of a mobile user of an augmented reality service moving in the environment of Internet of Things devices, in which the user is represented as a queuing system M/G/1, and the incoming stream is formed from K services available to the user, including video, text, graphics, speech, music, tactile sensations, etc.,

which makes it possible to calculate such systems using the apparatus of queuing theory.

The practical significance of the study is the possibility of direct application of the developed information system in real business processes of design, trade and a number of other areas.

Approbation of work and publication. ; The 10th International Conference on Future Networks and Communications / The 12th International Conference on MobiSPC 2015 (Belfort, France 2015), 2 articles published in collections of international foreign conferences (South Korea, France).

Publications:

1. R. Uskenbayeva, **Y. Chinibayev** (2021). Development of an interactive information system using augmented reality means. Journal of Theoretical and Applied Information Technology E-ISSN 1817-3195 ISSN 1992-8645 Vol.99 November 2021 No 21. pp 5268-5275 (Процентиль -36% General Computer Science, CiteScore – 1.3). (http://www.jatit.org/volumes/Vol99No22/4Vol99No22.pdf)
2. R. Uskenbayeva, **Y. Chinibayev** (2018). Analysis of vizualization method of 3D objects in Augmented Reality. Herald of the Kazakh-British technical university ISSN1998-6688. Vol.15, No4 (2018). - pp. 123-128.
3. R. Uskenbayeva, **Y. Chinibayev** (2018). The Bulletin of KazATC. ISSN – Vol.107, No4 (2018). - pp. 253-259.
4. Е.А. Дайнеко, М.Т. Ипалакова, Т.Т.Чинибаева, Ж.Ж. Болатов, **Е.Г.Чинибаев** (2018). Использование возможностей технологии дополненной реальности для изучения физики. Вестник КазНИТУ имени К.Сатпаева. – 2018. – No4 (128). - С. 159-164.
5. A. Kuandykov, R. Uskenbayeva, Young Im Cho, D. Kozhamzharova, O. Baimuratov, N. Karimzhan, **Y. Chinibayev** (2016). Multi-Agent Based Anti-Locust Territory Protection System. Procedia Computer Science 56(1):477-483. doi:10.1016/j.procs.2015.07.186
6. A. Kuandykov, R. Uskenbayeva, Young Im Cho, D. Kozhamzharova, O. Baimuratov, N. Karimzhan, **Y. Chinibayev** (2016). Analysis and Development of Agent Architecture for Pest Control Systems. ISSN: 1877-0509, Procedia Computer Science, v.56, no.1, pp.139 - 144 DOI: 10.1016/j.procs.2015.07.186

7. T. Temirbolatova, **Y. Chinibayev** (2016). Development of the augmented reality applications based on ontologies. COMPUTER MODELLING & NEW TECHNOLOGIES 2016 **20**(4) 18-22
http://www.cmnt.lv/upload-files/ns_33art02_CMNT2004_Temirbolatova.pdf

Structure and scope of work.

The structure of the work is determined by the goal and the sequence of solving the formulated tasks and is built according to the problem-thematic principle. The dissertation consists of an introduction, four chapters, a conclusion, a bibliographic list that includes 40 references.