

## REVIEW OF THE OFFICIAL REVIEWER

for the dissertation work of Chinibayev Yersain Gulislamovich

on the topic “Development of methods for visualization of three -dimensional objects through augmented reality technology”,  
provided for the degree of Doctor of Philosophy (PHD) in the specialty "6D070400 - computer technology and software."

№	Criteria	Compliance with the criteria (mark one of the answer options)	Substantiation of the position of the official reviewer
1.	The topic of the dissertation (as of the date of its approval) corresponds to the directions of development of science and / or state programs	1.1 Compliance with priority areas for the development of science or government programs:	The dissertation corresponds to the tasks of the state program "Digital Kazakhstan" (December 12, 2017. Decree of the Government of the Republic of Kazakhstan No. 827)
		1) The dissertation was completed within the framework of a project or target program financed from the state budget (indicate the name and number of the project or program) 2) The dissertation was completed within the framework of another state program (indicate the name of the program) 3) The dissertation corresponds to the priority direction of the development of science, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the direction)	The dissertation corresponds to the priority direction of the development of science for 2021–2023:  4. Information, telecommunication and space technologies; minutes of the meeting of the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan dated April 29, 2020.
2.	Importance for science	The work <b>makes</b> / does not make a significant contribution to science, and its importance is well <b>disclosed</b> / not disclosed	In the dissertation work, models of the service space, the area of perception and user behavior are developed. A visualization model for monitoring car traffic in the VANET+SDN bundle is also proposed.
3.	The principle of self-reliance	Self-reliance level: 1) <b>high</b> ; 2) medium; 3) low; 4) no independence	The dissertation work of Chinibayev Y. G. is a research work in the direction of augmented reality. When writing a literature review and a theoretical base, one can note the author's systematic approach when writing a review of the literature and the

			theoretical foundations of the study, a systematic approach in developing the practical part.
4.	The principle of internal unity	4.1 Justification of the relevance of the thesis: 1) <b>justified</b> ; 2) partially substantiated; 3) not justified	The relevance of the dissertation is determined by the fact that the developed models, which together make up the methodology for assessing traffic when visualizing additional information, are part of the decision making support system.
		4.2 The content of the dissertation reflects the topic of the dissertation: 1) <b>reflects</b> ; 2) partially reflects; 3) does not reflect	The content of the dissertation is fully consistent with the topic of the work. The article presents an overview of existing solutions for the visualization of three-dimensional objects using augmented reality technology. The doctoral student proposed three models to define the space, area of perception and user behavior. The conclusion of the dissertation work was formulated consistently with the test results.  In the course of the dissertation work, the content and structure of the research stages are arranged in a logical order and determine the topic of the dissertation.
		4.3. The purpose and objectives correspond to the topic of the dissertation: 1) <b>comply</b> ; 2) partially correspond; 3) do not match	Correspond - the purpose of the study is to develop a set of models for assessing augmented reality traffic, as well as assessing the quality of perception of augmented reality applications by the user. The completed tasks allowed to achieve the goal of the dissertation work.
		4.4 All sections and provisions of the dissertation are logically interconnected: 1) <b>are fully interconnected</b> ; 2) the relationship is partial; 3) there is no relationship	The dissertation consists of an introduction, four sections, a conclusion and a list of references. All sections are interconnected.

		<p>4.5 The new solutions proposed by the author (principles, methods) are argued and evaluated in comparison with the known solutions:</p> <ol style="list-style-type: none"> <li>1) <b>there is a critical analysis</b>;</li> <li>2) partial analysis;</li> <li>3) the analysis is not one's own opinions, but quotes from other authors</li> </ol>	<p>The proposed solutions are substantiated by a critical analysis of existing solutions. The results are presented in the dissertation in tables and graphs.</p>
5.	The principle of scientific novelty	<p>5.1 Are scientific results and provisions new?</p> <ol style="list-style-type: none"> <li>1) <b>completely new</b>;</li> <li>2) partly new (25–75% are new);</li> <li>3) not new (less than 25% are new)</li> </ol>	<p>The author has developed new models of the service space, the area of perception and user behavior, in which the predicted area of user perception is represented as an ellipse, built based on the probable user coordinates and the probable area of user perception of data, which makes it possible to provide an efficiency of at least 25% greater than when using other figures.</p>
		<p>5.2 Are the conclusions of the dissertation new?</p> <ol style="list-style-type: none"> <li>1) completely new;</li> <li>2) <b>partially new</b> (25-75% are new);</li> <li>3) not new (less than 25% are new)</li> </ol>	<p>The conclusions are partially new, due to the fact that the developed models offer a new look at the already existing solutions in the field of visualization through augmented reality technology.</p>
		<p>5.3 Technical, technological, economic or managerial decisions are new and justified:</p> <ol style="list-style-type: none"> <li>1) completely new;</li> <li>2) <b>partially new</b> (25-75% are new);</li> <li>3) not new (less than 25% are new)</li> </ol>	<p>Technical, technological solutions are partially new, as the author used existing technological solutions, but using the created models.</p>
6.	Validity of the main conclusions	<p>All key findings are based/not based on scientifically sound evidence, or reasonably well-founded (for qualitative research and arts and humanities courses)</p>	<p>Theoretical research carried out as part of the thesis is published in international editions (Journal of Theoretical and Applied Information Technology E-ISSN 1817–3195 ISSN 1992–8645 Vol.99 November 2021 No 21. pp 5268-5275 (Percentile -36% General Computer Science , CiteScore - 1.3) (<a href="http://www.jatit.org/volumes/Vol99No22/4Vol99No22.pdf">http://www.jatit.org/volumes/Vol99No22/4Vol99No22.pdf</a>)</p>

			), in publications recommended by the Higher Attestation Commission (Herald of the Kazakh-British technical university ISSN1998-6688. Vol.15, No4 (2018), The Bulletin of KazATC. ISSN - Vol.107, No4 (2018). Vestnik KazNITU named after K. Satpaev. - 2018. - No4 (128)) and discussed at international conferences (Procedia Computer Science 56 (1): 477-483 doi: 10.1016/j.procs.2015.07.186).
7.	Basic provisions for defense	<p>The following questions need to be answered for each position separately:</p> <p>7.1 Is the position proven?</p> <p>1) <b>proven</b>; 2) rather proven; 3) rather unproven; 4) not proven</p> <p>7.2 Is it trivial?</p> <p>1) yes; 2) <b>no</b></p> <p>7.3 Is it new?</p> <p>1) <b>yes</b>; 2) no</p> <p>7.4 Level to apply:</p> <p>1) narrow; 2) medium; 3) <b>wide</b></p> <p>7.5 Is it proven in the article?</p> <p>1) <b>yes</b>; 2) no</p>	<p>7.1. – the provisions are proved by the developed models and their application in practice.</p> <p>7.2. - is not trivial, because the provisions are based on the models of the service space, the area of perception and user behavior developed by the author.</p> <p>7.3. - is new, as the developed models offer a new approach to the visualization of information provided to the user.</p> <p>7.4. - the level of application is very wide, due to the fact that in almost all areas of life it is necessary to visualize information for better perception.</p> <p>7.5. – proven in the articles: “Development of an interactive information system using augmented reality means”, “Development of the augmented reality applications based on ontologies”, “The method of visualization of 3D objects using augmented reality technology based on markers”, “Analysis of visualization method of 3D objects in Augmented Reality»</p>
8.	The principle of certainty.	<p>8.1 The choice of methodology - is the methodology justified, is it described in sufficient detail</p> <p>1) <b>yes</b>; 2) no</p>	<p>The choice of methodology is based on the augmented reality traffic model. It, in turn, consists of three models - space, environment and user behavior, which are described in detail in the thesis.</p>

	Reliability of sources and information provided	8.2 The results of the dissertation work were obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies: 1) <b>yes</b> ; 2) no	The results of the dissertation work were obtained using mathematical and algorithmic methods of data processing, using computer technologies (Computer vision, Big data, IoT).
		8.3 Theoretical conclusions, models, identified relationships and patterns are proven and confirmed by experimental research (for areas of training in pedagogical sciences, the results are proven on the basis of a pedagogical experiment): 1) <b>yes</b> ; 2) no	The reliability of the theoretical results of the study is confirmed by scientific data, experimental studies and industrial tests in real conditions.
		8.4 Important statements are supported / partially confirmed / not supported by references to current and reliable scientific literature	Important statements are supported by references to relevant and reliable scientific literature in all sections of the dissertation.
		8.5 Used literature sources are sufficient / not sufficient for a literature review	The used literature sources consist of 70 titles.
9	Principle of practical value	9.1 The dissertation has a theoretical value: 1) <b>yes</b> ; 2) no	The results obtained in the work can be used in research and when writing scientific articles, due to the fact that new theoretical conclusions have been obtained.
		9.2 The dissertation is of practical importance and there is a high probability of applying the results obtained in practice: 1) <b>yes</b> ; 2) no	Applied results have been experimentally confirmed in real conditions, which makes them applicable in practice.
		9.3 Are the practice suggestions new? 1) completely new; 2) <b>partially new</b> (25-75% are new); 3) not new (less than 25% are new)	Partially new, as existing technological solutions were used, using the developed models.
10.	Quality of writing and design	Quality of academic writing: 1) high; 2) <b>average</b> ;	The quality of writing and design of the dissertation work is average, the structure and design rules are observed.

	3) below average; 4) low.	
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Recommendations and remarks:

1. To describe the developed models and their applications in more detail.
2. To finalize the practical part of the information system.

**Conclusion:**

intercede to the Committee for the award of a PhD degree to a doctoral student.

**Official reviewer**

Candidate of physics -  
mathematical sciences, Ass. Prof.  
(Academic degree, title, place of work)

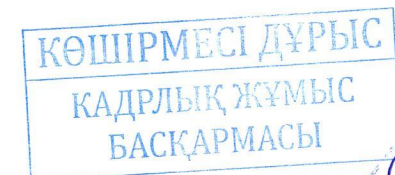
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(full name)

Maelina Mansurova

*Copies of the comments of official reviewers are handed over to the doctoral student no later than 5 (five) working days before the dissertation defense.*



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