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REVIEW

by assoc. prof. PhD Grigor Raykov Velev,

on the PhD thesis of
eng. Lili Tzvetanova Pavlova

on topic „**Visualization of an electronic battlefield with elements of augmented reality**"

for obtainment of an educational and scientific degree "**Doctor of Philosophy**"

in the PhD program "Automated systems for information processing and management",
professional field 5.2 "Electrical engineering, electronics and automation",
in the domain of higher education 5. "Technical sciences"

Sofia
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1. Relevance and significance of the developed scientific problem

The ability to overlay additional digital information onto the end user's field of view is used in specific military applications. Enhanced visual perception of the environment is able to improve situational awareness and understanding of the tasks at hand. The final effect aims to reduce reaction time in critical situations and shorten decision-making time.

In the submitted thesis, research is focused on creating a model of an advanced electronic battlefield with basic visualization and augmented reality components, with a subsystem for identifying an object in the field of view of an observer using an inertial sensor. The possibilities for identification of objects from the order of battle and military infrastructure objects depending on their distance to the observer have been investigated.

2. General characteristics and structure of the dissertation work

The paper consists of 162 pages, of which 150 pages are the main part and the rest are appendices. Its structure consists of an introduction, three chapters, contributions, a conclusion and a bibliography. In the main part of the dissertation, 68 figures and 5 tables are attached. The bibliography includes 111 titles in Bulgarian and English.

The purpose of the dissertation research is defined in the introduction, and the tasks leading to the fulfillment of the purpose are set.

Limitations in the development of the dissertation work are set in the first chapter, within the scope of the subject of the present scientific research and available material provision. A study of modern achievements in theory and practice in the transition to software solutions with the application of augmented reality for supporting the activity in field conditions has been made.

An overview of existing data storage and exchange systems is carried out in the second chapter. Command and control systems and their functional features are reviewed, as well as recommended databases. In the chapter, an algorithm is proposed and experimental results are given for access to centralized and local databases. The necessity of applying systems for digital filtering of sensor data is brought out in the third chapter. A mathematical apparatus is given to clarify the operation of two types of digital filters. A selection of information structures was made to reflect the terrain, as well as various objects from the order of battle. A study was conducted on the influence of digital filters on the degree of applicability of artificial reality in field conditions. Numerical data on the range of stable identification of objects from the order of battle are given.

In the conclusion, the achieved scientific-applied and applied contributions in

the dissertation work are formulated.

3. Evaluation of the scientific results and contributions of the dissertation work

The candidate's contributions can be defined as scientific-applied and applied contributions. They are a logical result of the scientific and applied research presented in the main part of the dissertation. I accept the results defined by the author as development and enrichment of existing knowledge and application of scientific achievements to solve important practical tasks related to visualization in augmented reality systems.

I believe that the dissertation work and the results obtained in it are credible and are the result of the conducted scientific research, studies, analyzes and experiments with the prototype of an autonomous platform developed especially for this purpose.

4. Evaluation of dissertation publications and authorship

The attached list of publications related to the dissertation consists of four titles are indicated that present the achieved results of the work to the scientific community. The candidate is the sole author in two of them. One of the publications is in English, presented at an international conference, published in a peer-reviewed open access journal.

All publications correspond to the topic of the dissertation work and reflect the results achieved in the research.

5. Opinion on the presence or absence of plagiarism

I have not noticed any plagiarism in the author's work. The content and manner of writing show a characteristic style of presentation of the text and emphasize its uniformity.

6. Literary awareness and competence of the autor

The author used 111 literary sources in his work on the dissertation work. Of these, 29 are in Bulgarian and 82 are in English. Most of the cited publications are from the last 10 years. The indicated literary sources are reflected in the main text of the dissertation work and are appropriately used by the author in the exposition.

In two of the literature sources the candidate is the author of the publication, and in two others he is a co-author.

7. Evaluation of the autoref

The presented abstract of the dissertation consists of 40 pages in Bulgarian. The

author's abstract was developed in accordance with the dissertation work and adequately reflects the results achieved by the author in the research.

8. Critical notes and recommendations

I make the following critical comments on the layout of the dissertation:

• the stated conclusions and results are merged in some places and it is necessary to distinguish them in an appropriate way;

• to make a list of figures and tables;

• there are some minor editorial notes and grammatical errors in the text of the dissertation (eg p. 46, etc.).

The critical remarks I have indicated are not essential for the overall good evaluation of the dissertation work and do not affect the results achieved in it.

9. Personal impressions

I know Eng. Lili Pavlova as a long-time colleague from the Defense Institute. During conversations with her on issues related to his work on the current dissertation, she demonstrates the necessary level of competence in the field of scientific research she conducts. I believe that the candidate has the necessary potential for development as a young scientist in her chosen scientific specialty.

10. Conclusion

As a result of the analysis, I define the dissertation work of Eng. Lily Pavlova as meeting the content, volume and structure of the requirements of the "Regulations on the conditions and procedure for acquiring scientific degrees at the Institute of Defense" and Law for the Development of the Academic Staff for the acquisition of the educational and scientific degree "PhD".

11. Evaluation of the PhD thesis

I give a positive assessment of the PhD thesis and propose to the scientific jury to award **to Eng. Lili Tsvetanova Pavlova** the educational and scientific degree "PhD" in the doctoral program "Automated systems for information processing and management", professional field 5.2 "Electrical engineering, electronics and automation", domain of higher education 5. "Technical sciences".

22 of August 2024   **Assoc. prof. PhD**   **Grigor Velev**