

OPINION

by Dr. Vladimir Vassilev Monov,

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ABOUT

dissertation work for obtaining the educational and scientific degree "doctor"

field of higher education: 4. "Natural sciences, mathematics and informatics"

professional direction 4.6: "Informatics and Computer Science"

doctoral program: "Informatics"

Author: M.Sc. Ivan Stanimirov Stoyanov

Title: "Research on creating a virtual operator in an infrastructure for intelligent agriculture"

Scientific supervisor: Prof. Dr. Asya Stoyanova-Doycheva,

Plovdiv University "Paisiy Hilendarski"

1. General description of the procedure and the presented materials

By order No. RD-21-1093 dated 19.05.2023 of the Rector of Plovdiv University "Paisiy Hilendarski", I have been appointed as a member of the Scientific Jury for the defense of the dissertation. By decision of the Scientific Jury from a meeting held online in the period 20.05.2023–21.05.2023, my participation in the work of the Scientific Jury was determined by preparation of an opinion on the dissertation.

The set of materials presented by M.Sc. Ivan Stanimirov Stoyanov is in accordance with Article 36 (1) of the Regulations for the Development of the Academic Staff of the Plovdiv University and includes the following documents:

- request to the Rector of the PU to disclose the procedure for the defense of a dissertation work;
- CV in European format;
- protocol from the Departmental Council related to reporting the readiness to open the procedure and preliminary discussion of the dissertation work;
- dissertation work;
- abstract;
- list of scientific publications on the topic of the dissertation;
- a complete list of the doctoral student's scientific publications;
- copies of scientific publications on the topic of the dissertation;
- declaration of originality and authenticity of the attached documents;
- certificate of fulfillment of the minimum national requirements for acquiring the educational and scientific degree "doctor".

The doctoral student has also attached official notes for participation in a research project with the Fond of Scientific Research of the Ministry of Education and Science and participation in the National Scientific Program "Intelligent Crop Production".

The attached documents meet the regulatory requirements set by the ZRASRB and the Rules for its implementation for the acquisition of the educational and scientific degree "doctor".

2. Relevance of the dissertation topic

The dissertation is dedicated to the development of modern information technologies and intelligent methods with the use of artificial intelligence aimed at the development of efficient, high-productivity and ecological agricultural systems. The dissertation topic is in accordance with the international trends of scientific research in this field and is directly related to the perspectives of the development of intelligent agriculture in our country, laid down in the Strategy for the Development of Artificial Intelligence in Bulgaria until 2030 and the National Scientific Programs "Intelligent Crop Production" and Intelligent Animal Husbandry'. All this undoubtedly determines the current nature of the conducted research and the usefulness of the scientific and scientific-applied results obtained in the dissertation.

3. Knowledge on the state of the problem

The introduction and the first chapter of the dissertation contain a detailed overview of the approaches and modern technological solutions used to build a computerized infrastructure of intelligent agriculture. A substantive analysis of the issues in the following areas related to the topic of the dissertation was made: *Cyber-physical and cyber-physical-social systems, the ViPS reference architecture, Platforms for precision and intelligent agriculture, Personal assistants*. The Virtual-Physical Space (ViPS) architecture, which served as the basis for the development of the specialized platform for intelligent agriculture presented in the dissertation, is examined in detail. The overview and analysis made show a thorough knowledge of the matter and current problems in the researched area, on the basis of which the purpose and tasks of the dissertation work are formulated.

4. Research methodology

The methodology of the conducted research is clearly stated in the dissertation and is distinguished by logical justification and specifically formulated steps aimed at the development of a model and architecture of a modern platform for intelligent agriculture. The obtained results show that the doctoral student successfully used the chosen approach and research methods in accordance with the set goal and the achieved results.

5. Characterization and evaluation of the dissertation work and contributions

The dissertation has a volume of 120 pages and consists of an Introduction, 5 chapters, Conclusion, Lists of publications and projects with the participation of the doctoral student and Referenced literature. According to the requirements, a Declaration of originality and reliability of the obtained results is attached to the dissertation. The list of bibliographic sources includes 164 titles, including sources from Bulgarian and foreign authors, as well as Internet sites. The list of publications on the dissertation topic contains 2 titles.

The individual chapters of the dissertation are developed in detail and systematically and present the author's solutions to the tasks and the obtained results. In essence, they present the developed theoretical framework of an event model, the improved architecture of the software platform

for intelligent agriculture ZEMELA, the developed model of a personal assistant designed to support farmers working in the conditions of intelligent agriculture, as well as the program implementation of a prototype of personal assistant implemented in the multi-agent programming environment JaCaMo.

I accept and positively evaluate the contributions stated in the dissertation and the abstract. In my opinion, they can be defined as scientific and scientific-applied as follows:

Scientific contribution: A new concept of an abstract event machine is developed, the theoretical formalization of which is realized with the apparatus of cellular automata.

Scientific and applied contributions:

- The ZEMELA software platform for smart agriculture has been improved with the proposed new repository structure for specialized knowledge and data.

- Reference architecture of a personal assistant with a specialized purpose for working in the conditions of intelligent agriculture has been developed.

- A prototype of the personal assistant was developed, implemented by means of the JaCaMo development framework.

The listed contributions are directly related and fully meet the set goals and objectives of the dissertation work.

6. Opinion, recommendations and remarks

In general, the dissertation work is distinguished by an in-depth analysis of the researched problems, as well as the use of an appropriate methodology for their solution. As a result of the conducted detailed and systematic research, the doctoral student has proposed original scientific and scientific-applied results and useful practical solutions.

Minor remarks of a formal nature can be indicated regarding the title of the list of used literature ("Referenced literature" should be "Bibliography" according to PP ZRASRB), as well as regarding the lack of complete bibliographic data for some of the literature sources. These remarks are viewed as a technical omission and do not address the value of the results and contributions in the dissertation.

My recommendation to the doctoral student refers to continuation of the research and publication activity, as well as further refinement of the developed personal assistant prototype and its practical use in the activities carried out under the National Scientific Program "Intelligent Crop Production".

7. Assessment of the publications and personal contribution of the doctoral student

The list of publications on the dissertation topic contains titles of 2 works, published in the period 2021-2022. The publications are co-authored, in English and are issued in editions indexed in the Scopus and Web of Science databases. The publications reflect essential parts and main results of the conducted research and meet the requirements for acquiring the educational and scientific degree "doctor". Additionally, a complete list of the doctoral student's publications, containing 16 titles, is presented, as well as a list of noticed citations, including 13 citations. From these, it is evident that the

results of the author's overall scientific and research activity have become known and aroused interest in the scientific community on the subject under consideration.

Acquaintance with the dissertation and the publications on the dissertation topic gives me grounds to consider that the dissertation work and the contributions to it are personal work of the doctoral student. I am not aware of any plagiarism.

8. Abstract

The abstract is 32 pages in volume and meets the requirements for its formatting. Its content corresponds to the content of the dissertation and accurately presents the main results of the dissertation work. An abstract of the dissertation in English in a volume of 30 pages is also presented.

CONCLUSION

The dissertation contains scientific and scientific-applied results, which represent an original contribution to science and meet all the requirements of ZRASRB, the Rules for its implementation and the relevant rules of Plovdiv University "Paisiy Hilendarski". Doctoral candidate Ivan Stanimirov Stoyanov possesses in-depth theoretical knowledge and professional skills in the scientific specialty "Informatics", demonstrating qualities and skills for independent conduct of scientific research.

I confidently give my positive assessment of the presented dissertation work and the results and contributions obtained in it. I propose to the honorable Scientific Jury to grant the educational and scientific degree "doctor" to M.Sc. Ivan Stanimirov Stoyanov in the field of higher education: 4. "Natural sciences, mathematics and informatics", professional direction 4.6. "Informatics and Computer Science", Doctoral Program "Informatics".

01.06.2023

Opinion prepared by:

/Prof. Dr. Vladimir Monov/