

## REVIEW

**By Dr. Eng. Nevena Stoyanova Mileva – Professor at Plovdiv University "Paisii Hilendarski"**

*(n.c., name, surname, surname – Acad. Dl. in the higher school or scientific organization)*

of a dissertation on the award of the educational and scientific degree "**Doctor**"

by: field of higher education 5. Technical sciences

professional field 5.3. *Communication and computer engineering*

doctoral program "*Automation of areas of the non-material sphere (medicine, education, science, administrative activity, etc.)*"

**Author:** *Veselin Zdravkov Mengov*

**Topic:** *System for remote access to training resources in the field of telecommunication and information systems*

**Scientific supervisor:** *Assoc. Prof. Sotir Ivanov Sotirov, PhD - Plovdiv University "Paisii Hilendarski"*

*(Acad. Dl., N. Sc., First Name, Middle Name, Last Name – Higher School or Scientific Organization)*

### 1. General description of the materials submitted

By Order No RD-21-2152/23.11.2023 of the Rector of Plovdiv University "Paisii Hilendarski" I was appointed a member of the scientific jury under a dissertation procedure on "System for remote access to training resources in the field of telecommunication and information systems" for acquiring the educational and scientific degree "Doctor" in the field of higher education: 5. Technical sciences, professional field 5.3. Communication and Computer Engineering, doctoral program "Automation of areas of the non-material sphere (medicine, education, science, administrative activity, etc.). The set of paper materials presented by the PhD student is in accordance with Article 36 (1) of the Rules for the Development of the Academic Staff of Plovdiv University and the Rules for the Implementation of the Law on Implementation of the Law on Combating Organized Crime in the Republic of Bulgaria.

The author of the dissertation is Mag. Veselin Zdravkov Mengov – full-time PhD student at the ECIT Department, supervised by Assoc. Prof. Dr. Sotir Ivanov Sotirov Sotirov from Plovdiv University "Paisii Hilendarski".

The set of paper materials presented by Veselin Zdravkov Mengov **is** in accordance with Article 36 (1) of the Rules for the Development of the Academic Staff of the University of Plovdiv, includes the following documents:

- an application to the Rector of Plovdiv University for disclosure of the procedure for the protection of a dissertation;
- CV in European format;
- minutes of the Department Council related to reporting readiness for opening the procedure and preliminary discussion of the dissertation;
- dissertation;
- abstract;
- a list of scientific publications on the topic of the dissertation;
- copies of scientific publications;
- a list of citations noticed;
- a declaration of originality and authenticity of the attached documents;
- a reference to compliance with the minimum national requirements;
- document for paid fee according to the tariff.

The PhD student has attached six publications on the topic of the dissertation.

## **2. Brief biographical data about the PhD student**

The Ph.D. Mag. Veselin Zdravkov Mentov was born in 1980 in Plovdiv, Plovdiv region. Plovdiv. He graduated from the Technical School of Electrical Engineering and Electronics - Plovdiv in 1998. He received a bachelor's degree in informatics at Plovdiv University "Paisii Hilendarski", Faculty of Mathematics and Informatics in 2010, where he also acquired his master's degree in software technologies in 2015. In the period since 2007. by 2022. He works as an expert in the Information Department at the Agricultural University of Plovdiv. From 2022. To date, he is an assistant professor at the Department of EKIT at the Faculty of Physics and Technology of Plovdiv University Paisii Hilendarski, where he conducts laboratory exercises in the disciplines: "Computer Networks", "Embedded Microprocessor Systems", "Software Development Practicum", "Analog Circuit Engineering" and seminar exercises in "Analog Circuit Engineering".

## **3. Topicality of the topic and appropriateness of the objectives and tasks set**

The presented text of the dissertation is on a topic that is undoubtedly very topical due to the fact that in recent years the conduct of remote laboratory experiments with the possibility of real access to laboratory equipment has become an increasingly necessary method of learning, especially in the technical sciences. Another reason for this is the possibility of providing access to expensive experimental equipment from anywhere in the world, which also implies the possibility of sharing laboratories. Students acquire practical knowledge by having the opportunity to conduct real experiments at any time and from anywhere. Much of the recent research related to training problems shows that laboratories with remote access significantly increase the efficiency of the

learning process in distance learning mode. This determines the increased interest in the introduction of training with remote access in the field of technical sciences and accordingly determines the topicality of the topic of the dissertation.

The main objective of the dissertation is to create a system for remote access to training resources in the field of telecommunication and information systems. To achieve the goal, the doctoral student has formulated six research tasks that fully meet the requirements for conducting the relevant scientific research. On this basis, I appreciate the topic as very relevant for providing adequate and modern engineering training in the field of telecommunications and information technology in distance learning mode. I accept the main purpose and tasks as adequately formulated.

#### **4. Knowledge of the problem**

The dissertation submitted for review has a total volume of 147 pages, contains two appendices. PhD student Veselin Zdravkov Mengov has cited 99 literary sources, many of which have been published in the last 5 years. The literature review is focused on an analysis of the technologies and methods for realization of some of the most famous distance learning laboratories. The current state of the problem is reviewed and existing technical solutions in this field are studied. I must emphasize that the review made is sufficiently detailed, the analysis is thorough and this gives me a firm reason to note that the PhD student has formulated the purpose and the resulting tasks, having become thoroughly acquainted with the latest trends and developments in the field of systems for remote access to training resources.

#### **5. Methodology of the study**

The chosen methodology in the dissertation works corresponds to the set goal. To implement the software of the remote laboratory, the programming languages were used: Python, JavaScript, HTML, CSS.

Algorithms have been created to communicate with measuring instruments and devices. The realization of the hardware part of the system is based on the Arduino Uno microcontroller development board, for which the PhD student has developed a specialized firmware.

A relational MySQL database has been developed that stores information about students and their schedule of access to the lab server. A pilot experiment was conducted with students from engineering specialties of the Faculty of Physics and Technology of Plovdiv University, who performed laboratory exercises through the developed system. The feasibility and effectiveness of the developed system for remote access to training resources have been clearly proven by surveying students, and an analysis of the results obtained is presented.

## **6. Characterization and evaluation of the dissertation**

The dissertation has a total volume of 147 pages – it consists of an introduction, six chapters, a conclusion, a declaration of originality of the results, a list of publications on the topic and a bibliography that includes 99 sources.

The introduction aims to substantiate the topicality of the dissertation problem.

In the first chapter is made an overview and analysis of the systems for remote access to training resources, software technologies and hardware solutions used to implement them. As a result of the analysis made, the approach to realize the software of the system and the type of remote laboratories managed by the system was chosen. At the end of the chapter, the objective of the study and the resulting 6 tasks are defined.

In a second chapter the software model used for the design and development of the implemented system for remote access to training resources is described. The PhD student uses a variant of the classic cascading model, which includes all stages from the design of the software to its integration. A general architecture of the system and the remote laboratories within it is presented. An approach to manage access to remote laboratories using the time slot method has been chosen.

A third chapter is devoted to the specialized software for the management of remote laboratories integrated into the system. Within this chapter, the software for managing the laboratory server is presented, examining its individual components and the mechanisms interaction between them. All technologies and libraries used for communication between imaging devices and laboratory layout are described. The development of the user interface through which students perform laboratory experiments is described in detail. The functions connecting the laboratory server and the database of the system are presented.

The fourth and fifth chapters describe the theoretical formulation and methodology for conducting the laboratory exercises integrated into the system, as well as the hardware implementation of the laboratory models managed by the software.

In the sixth chapter the results of a pilot experiment of students with the system are described. The results obtained from the experiment have been analysed and presented graphically and tabulated. They confirm the effectiveness of the proposed system.

## **7. Contributions and relevance of development to science and practice**

In the presented dissertation there is a correspondence between the goal, the tasks set for its realization, the presented results of the theoretical and experimental developments carried out. The dissertation paper contains results from which the doctoral student has defined scientific, applied and applied contributions.

I agree with the contributions to the dissertation described by Veselin Mengov in the autoabstract and accept them as such.

The scientific and applied contributions are as follows:

- An approach to implement a web-based system for access to training resources is proposed.
- An architecture of a system for remote access to training resources is presented.

The applied contributions presented in the dissertation are:

- The software of the system for access to training resources has been implemented.
- The software and hardware to the remote laboratories integrated into the system has been implemented.
- A method for remote access to laboratory equipment through a web interface has been designed and implemented.
- An analysis of the opinions of users (students and lecturers) is made and results of the use of the system are presented.

## **8. Assessment of publications on the dissertation**

The author has submitted a list of 6 publications, all of which are in English. There is one independent publication, five in co-authorship. One of the publications is indexed in the SCOPUS databases, the others are presented in refereed international conferences which are in the process of being indexed in the Web of Science's database. All publications are related to the subject of the dissertation.

There are 6 citations related to the presented publications.

The review of the publications shows that the necessary publicity of the results of the scientific research done in the dissertation is ensured. Their number is sufficient and complies with the accepted requirements.

The publications are on the topic of the dissertation and show in-depth knowledge of the matter, including on the basis of personal experience; knowledge of theory; structure, style and language that prove opportunities for academic work.

## **9. Personal participation of the doctoral student**

Of the six dissertation publications presented, reflecting in essence the results of the development, in five the doctorate ranks first, and in one is an independent author. The publication activity clearly shows that during his training as a PhD student Veselin Mengov has undoubtedly gained experience and confidence in self-directed solving scientific and practical tasks.

This testifies to the essential contribution of the doctoral student to the results obtained.

## **10. Doctoral Abstract**

The review of the dissertation auto referee shows full compliance with the requirements for its preparation. It has a volume of 33 pages. and reliably reflects in a shorter form the content of the dissertation, containing a general characteristic of the dissertation, purpose and tasks, results of the literary study, the main accents of the doctoral student's development, defined contributions contained in the dissertation.

The autoreferate is made in accordance with the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the Implementation of the Law on the Implementation of the Law on Academic Staff "Paisii Hilendarski" and reflects the main results achieved in the dissertation.

## **11. Critical remarks and recommendations**

The PhD student has complied with the remarks and recommendations made during the preliminary discussion procedure before the Department Council of the Department of ECIT at the University of Plovdiv. I have some rather recommendations to the dissertation, which can be summarized in the following:

- simultaneously with the "cascading model", as the doctoral student calls it and uses in his development, the so-called Agile method of software development could be presented because of its wide distribution and proven advantages in process management;

- in the chapters of the dissertation, which present the specific development and implementations, there is an inaccuracy with the definition of what type of training is the proposed system, namely: development of training resources for remote access, and not in general for distance learning. In this regard, I would like the PhD student to define exactly what is meant by training resources for "remote access to a laboratory";

- I have a question related to the description of the functionality of the system: is there a possibility in the developed system at least four of the described functionalities to be provided to the so-called "time-slots system" (or similar);

- what other processes could be explored with the developed remote access system – without, or with minimal modifications, and what they are;

- in terms of defining the contributions – it should be clearly stated in the main contribution that it is a developed system for creating and using training resources for remote access to a laboratory, which is especially valuable in the dissertation.

## **12. Personal impressions**

I also know the PhD student as a colleague in the Department of EUTI. Extremely modest, focused and executive. It shows opportunities for research and creativity, which qualities I believe will improve with the acquisition of a doctorate.

## **13. Recommendations for future use of dissertation contributions and results**

The work should continue towards expanding the possibilities to explore other processes with the provided opportunities for remote access, that is, I see the development in the expansion of the remote access laboratory – new exercises and new areas where it is applicable. In this regard, the question asked by me in the recommendations is also concerned.

## CONCLUSION

The dissertation *paper contains scientific, applied and applied results that represent an original contribution to science and meet all the* requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria (RASRB), the Regulations for the Implementation of the Law on Implementation of the Law on Combating Organized Crime "Paisii Hilendarski".

The dissertation works show that the PhD student Veselin Zdravkov Mengov **has** in-depth theoretical knowledge and professional skills in the scientific specialty "Automation of areas of the non-material sphere (medicine, education, science, administrative activity, etc." by **demonstrating** qualities and skills for independent scientific research.

Due to the above, I confidently give my positive *assessment of the conducted research, presented by the above-reviewed dissertation, autoreferat, results and contributions,* and I propose to the honorable scientific jury to *award the educational and scientific degree "Doctor"* of Veselin Zdravkov Mengov in the field of higher education: 5. Technical sciences, professional field 5.3. Communication and Computer Engineering, doctoral program "Automation of areas of the non-material sphere (medicine, education, science, administrative activity, etc.)".

Jan 31, 2024

Reviewer:.....

(signature)

Prof. Dr. Ing. N. Mileva

(ac. dl., n. st., name, surname)