

OPINION

By Assoc. Prof. PhD Nina Dobrinkova – IICT-BAS

on a dissertation for the award of an 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"
thesis title: "**Design of "Smart Houses" under the open system - OPENHAB "**

PhD candidate: **Victor Kanchev Danev**

By order No. 252/02.10.2023 of the Director of IICT-BAS corr. Mem. Sv. Margenov on the basis of Art. 4 paragraph. 2 of the Law on the Development of the Academic Staff in the Republic of Bulgaria and with the decision of the Scientific Council of IICT-BAS (protocol No. 10/27.09.2023) in connection with the procedure for acquiring an educational and scientific degree "doctor" in a professional direction 4.6 "Informatics and Computer Sciences" doctoral program "Informatics", for the PhD candidate Victor Kanchev Danev with a dissertation title: "Design of "Smart Houses" under the open system - OPENHAB" I have been appointed as a member of the Scientific Jury.

When evaluating the dissertation work, the conditions of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria (PPZRASRB) and the regulations on the specific scientific carrier development conditions in IICT for the implementation of the law are determining as follows:

1. The dissertation must contain scientific or scientific-applied results that represent an original contribution to science. The dissertation must demonstrate that the candidate has in-depth theoretical knowledge of the relevant specialty and the ability for independent research.
2. The dissertation must be presented in a form and volume corresponding to the specific requirements of the primary unit. The dissertation must contain: title page; content; introduction; exposition; conclusion – a summary of the obtained results with a declaration of originality and bibliography.

According to the PPZRASRB and the regulations on the specific scientific carrier development conditions in IICT, the minimum required number of points by groups of indicators for a PhD candidate to be awarded "doctor" in professional direction 4.6 "Informatics and computer sciences" are:

Group of indicators	Content	Брой точки
A	Indicator 1	50
G	Sum of indicators from 5 to 10	30

The scientific supervisor of the PhD candidate is Prof. Ph.D. Daniela Borisova.

General description of the presented materials

As a scientific jury member I have received:

1. Order No. 252/02.10.2023 of the Director of IICT-BAS, issued on the basis of Art. 4 paragraph 2 of ZRASRB and decision of the Scientific Council of IICT-BAS reflected in protocol No. 10/27.09.2023.

2. Dissertation text.
3. Abstract in Bulgarian and English.
4. List of printed scientific publications on the topic of the dissertation.
5. Copies of printed scientific publications on the subject of the dissertation.
6. Reference on the fulfillment of the minimum PhD award requirements of IICT.
7. Reference for registration in NACID.

The presented set of materials is in accordance with Article 8 of the Regulations on the specific carrier development conditions for acquiring scientific degrees and for occupying academic positions at IICT-BAS.

Topic importance

The dissertation thematically covers ICT (information and communication technologies) and in particular the development of the so-called IoT (Internet of Things). The relationship between ICT and IoT is presented as the integration of ICT technologies, the processing of data generated by IoT devices and the safety that data and communications must have in IoT networks. The current topic of smart houses based on Internet of Things (IoT) technology to automate various aspects in the home is developed in the dissertation. Smart houses and their beneficial impact on energy efficiency are clearly outlined. Undoubtedly, the design of "smart homes" and the integration of various technologies and open-type systems for their creation is an important topic in the fast developing IoT capabilities.

The object of research in the dissertation is based on an innovative open source methods for creating "smart houses" through the application of Internet of Things (IoT) technologies.

The subject of the research is open source home automation systems for "smart house" design and construction.

The object and the subject of the research determine one goal and five tasks defined and developed in the dissertation text.

Purpose and tasks of the dissertation

The purpose of the dissertation is stated on page 49, with outlining one objective, namely: **"project proposal to build a smart home using an open source software platform"**.

To achieve this goal, the author sets the following tasks:

1. To analyze IoT challenges and techniques applicable to designing systems using IoT,
2. To propose a multi-criteria decision-making model for choosing an open source platform for smart home design;
3. To propose a model for determining the competences of IoT specialists for the design and implementation of a smart home;
4. To propose an approach for building a smart home environment using open source software systems.
5. To conduct numerical experiments to validate the proposed models and approaches.

Dissertation structure

The dissertation has a volume of 130 pages, contains 177 cited sources and consists of: Introduction, 3 chapters, main achievements after each chapter and conclusion.

In the Introduction, the relevance of the problem is emphasized. The methodological parameters of the dissertation work are presented and the dissertation text structure is briefly explained.

In the first chapter, a theoretical analysis of the concepts of IoT (Internet of Things) used in the dissertation is made. The research directions and applications in which IoT technologies are developing and the application of multi-criteria analysis to build a "smart home" are presented. At the end of the first chapter, the goal and tasks to achieve the realization of the object and the subject of the dissertation work are defined.

In the second chapter, a methodology for modeling, design and application of the multi-criteria analysis in the realization of the systems building smart houses is presented. A smart home scenario is discussed in details illustrating the use of multi-criteria analysis. Challenges and controversies in the application of multi-criteria analysis in smart homes are structured. The necessary features of open source platforms that are applicable for home automation in smart houses are described.

In the third chapter, the architecture, software and hardware implementation of an IoT-based solution for smart home heating is presented. The results of the numerical experiments conducted with the proposed model for ranking open source home automation software platforms are also described. A group-based IoT competency determination model from key indicators, as well as simulation results and real-world experiments of the designed smart heating in a smart house, are also examined.

Knowing the state of the art in the IoT field

There is no doubt that the PhD candidate has learned a lot in the scientific field he is focused on with his dissertation achievements. The clearly defined goal, the well-formulated tasks, the meaningful description of the dissertation text, as well as the cited 177 sources, give me reason to believe that the PhD candidate knows well in theoretical and applied aspects the scientific field he is working on with his research.

Research methodology

The methodology for conducting the research, chosen by the PhD candidate, derives from the set goal and corresponds to the defined tasks. The author uses a combination of a model for ranking open source home automation software platforms and a model for determining IoT (Internet of Things) competencies based on sets of key indicators. The developed architecture is also implemented in open source home automation software with OpenHAB.

Contributions

The contributions in the dissertation are mainly applied-science ones and can be summarized as follows:

1. It is performed an analysis of IoT challenges and techniques applicable to designing home automation systems using IoT.
2. It is proposed a multi-criteria decision-making model for choosing an open source platform for smart houses design.
3. It is proposed a hardware solution as well as corresponding architecture to build an

effective control of smart house heating automation.

4. It is proposed a model of a digital twin of an apartment, which was used to conduct theoretical simulations of heating, taking into account various factors.
5. It is proposed a model for determining the competences of IoT specialists based on two groups of key indicators related to the acquired knowledge and teamwork skills.

Evaluation of the Dissertation's Publications

The PhD candidate has published 5 articles related to the subject of the dissertation. Three of the articles are in publications with an impact rank (20 points each), one is in a publication referenced in the world indexing and referencing system (SCOPUS) without an impact factor or impact rank (12 points) and one publication is not referenced in the world referencing and indexing system (0 points). Thus, according to the indicators from group G, the dissertation student has 72 points out of the required 30, which significantly exceeds the minimum requirements of the IICT-BAS for a PhD candidate to be awarded "doctor". The main results obtained by the dissertation were reported at 4 specialized international conferences.

Abstract

The abstract is presented in two versions in Bulgarian and English. In general, the abstract correctly reflects the content of the dissertation.

Critical notes

I have no major critical notes. I noticed 2 typos on page 49 in the definitions of the tasks 1 and 3 in the words "изполващи" - missing "з" and "реализрането" - missing "и". In some places, there is the use of foreign words that could be replaced with their Bulgarian equivalents or short Bulgarian descriptions. All these are notes of a technical nature and do not diminish the significance of the results achieved.

Significance of the dissertation work for science and practice

The work performed by the PhD candidate is sufficient in terms of volume and depth of research. Without a doubt, it is a practical oriented work. The developments made and the results obtained bring value for the scientific field and practical evolution in the research topic. In this sense, I find the presented research significant for both scientific and practical work performance.

Questions

I have the following question for the PhD candidate:

Can the developed model for smart heating in a smart house be upgraded with other functionalities to control more systems in the home, with the aim of better energy efficiency?

Personal opinion

I vaguely know the PhD candidate, but I know some of his scientific work, as he has presented his developments at group meetings in the Modelling and Optimization sector. I have very good impressions of his work. Overall, the dissertation is well written and structured. The goal and tasks

for its achievement are clearly set. Contributions are given as well structured descriptions, concisely and to the point. The PhD candidate has one independent publication, which is a guarantee that his personal contribution to achieving the results in the dissertation is substantial. It also shows that he can work independently and he started his scientific growth as independent researcher.

Conclusion

As a consequence of the above, it can be stated that all the requirements of the Law on the Development of the Academic Staff (ZRASRD), the Regulations for its Implementation (PPZRASRD) and the regulations on the specific scientific carrier development conditions in IICT. I can state that the level of this dissertation and the publications related to it significantly exceeds the minimum requirements.

The critical remarks I mentioned do not reduce the significance of the obtained results and the scientific value of my work.

All this gives me grounds for a positive assessment and I propose to the honorable Scientific Jury to award the educational and scientific degree "doctor" in professional direction 4.6 "Informatics and computer sciences" to Viktor Kanchev Danev.

15.11.2023
Sofia,

НА ОСНОВАНИЕ
331Д