# REVIEW

**by Prof. Dr. Georgi Petrov Dimitrov**

**University of Library Science and Information Technology**

**on dissertation for the award of the educational and scientific degree "PhD"**

**in the field of higher education 4. Doctor of Philosophy in Ph. D. in Natural Sciences,**

**Mathematics and Informatics, professional field 4.6 Informatics and Computer Science,**

**Doctoral Programme Informatics**

**Author: Viktor Kanchev Danev**

**Topic: 'DESIGNING "SMART HOUSES" UNDER AN OPEN SYSTEM OPENHAB"**

**Scientific supervisor: Prof. D.Sc. Daniela Borissova**

### 1. General description of the presented materials

By the order of the Director of IICT Sv. Margenov 252/22.10.2023 I have been appointed as a member of the scientific jury for providing the procedure for the defense of the dissertation thesis on "Design of "Smart Houses" under open system OPENHAB" for the acquisition of the educational and scientific degree 'Doctor' in the field of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.6 Informatics and Computer Science, doctoral programme Informatics. The author of the thesis is Viktor Kanchev Danev - PhD student in full-time form with scientific supervisor Prof. D.Sc. Daniela Borissova.

The set of materials presented by Viktor Kanchev Danev is in accordance with the Pravvilnik for the specific conditions for the acquisition of scientific degrees and for the occupation of academic positions in IICT-BAS.

### 2. Relevance of the topic and appropriateness of the set goals and tasks

The dissertation work is undoubtedly dedicated to a topical subject, namely "Designing "Smart Houses" under open system Orenhab".

**The main objective of the dissertation is:** To propose a smart home project using an open source software platform.

**To achieve the main objective the following tasks are set:**

1.  To analyze the IoT challenges and the techniques applicable to design IoT systems,

2.  To propose a multi-criteria decision-making model for selecting an open source platform for smart home design;

3.  To propose a model for defining competencies of IoT professionals for smart home design and implementation;

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.

I believe that the aims and objectives defined by the PhD student, as well as the subsequent development of the thesis, are undoubtedly relevant and of a high level of applicability.

### 4. Knowledge of the problem

The dissertation contains 130 pages as well as a considerable number of cited sources - 177 in total.

The list of author's publications on the subject consists of 5 titles.

All this is to me a proof of the thorough research done by the PhD student.

### 5. Research methodology

The results presented in this dissertation attest to the choice of a methodologically sound approach for solving the research tasks. In the dissertation, a theoretical approach to solving the problem has been investigated and practically developed, and the results obtained demonstrate that these methods can be successfully used to obtain new results.

The conclusions of the review and analysis are well systematized and the aim and objectives of the dissertation are presented in a justified and motivated manner. It can be concluded that the author has chosen and applied the necessary research methodology according to the stated aim and objectives.

### 6. Characteristics and evaluation of the dissertation

The presented dissertation consists of an introduction, three chapters and a conclusion, a list of the literature used, a list of the author's publications on the topic, appendices and a declaration of originality.

**In Chapter 1. Analysis of IoT Challenges and Techniques Applicable to the Design of Systems Using IoT**, an overview of IoT technologies, standards and applications is presented.

Different aspects of the smart home as part of the IoT paradigm are discussed. The advantages and disadvantages of commercial software and open source software platforms for use in home automation are analyzed.

A review of multi-criteria decision-making methods in selecting appropriate alternatives for dealing with conflicting criteria accompanying decision-making on complex problems is presented.

**In Chapter 2. Modeling and designing smart houses using a multi-criteria decision-making approach**, the proposed models for evaluating and ranking the possible alternatives in smart home design decision making with MCDM techniques are described, which allow informed decision making, prioritization of alternatives and optimization of different aspects in the context of smart homes. A decision-making model for selecting an open source software platform for designing IoT-enabled home automation is presented. For this purpose, the main characteristics of the platforms are identified and used as evaluation criteria.

**In Chapter 3. Numerical testing of the proposed models**, the numerical experiments conducted on the proposed models for the implementation of a smart home are presented. The implemented intelligent heating project using the open source home automation software OpenHAB is described. The automation architecture for IoT-based smart home heating is presented, as well as the software solution for this automation. The numerical results of the conducted testing of the proposed mathematical multi-criteria model for the assessment and ranking of competences required for IoT projects are described using two sets of key indicators.

In the Conclusion, the results obtained are summarized and some directions for future research related to different aspects of smart home creation are indicated

**6.      Contributions and relevance of the development to science and practice**

I accept the scientific and applied contributions formulated as follows:

- An analysis is made of the challenges in the field of IoT and the techniques applicable in designing home automation systems using IoT.

- Proposed a multi-criteria decision-making model for selecting an open-source platform fabric for smart home design.

- Proposed a hardware solution as well as a corresponding architecture to implement an efficient heating automation control of a smart home.

- A digital twin model of an apartment is proposed and used to conduct theoretical simulations of the heating considering various factors.

- A model has been proposed to determine the competencies of IoT professionals based on two sets of key indicators related to the acquired knowledge and teamwork skills.

### 8. Assessment of the dissertation publications

Results of the dissertation research are presented in 5 (five) publications. Three of the publications are with SJR.

### 9. Personal participation of the PhD student

After reading the materials presented by the PhD student, I have the impression that, the results presented in the thesis are his personal work, of course under the supervision of the supervisors. The achieved scientific and applied results were obtained in the implementation of the set tasks as a result of the scientific supervision and are the personal work of the doctoral student.

### 10. Abstract

The abstract contains 33 pages and presents in detail the relevance and motivation for work on the chosen topic, as well as the content of the dissertation by chapters. The abstract does not accurately reflect the structure of the dissertation, e.g. the dissertation has 130 pages, but 123 are given, 126 sources are cited, and there are actually 177, etc.

### 11. Critical comments and recommendations

From the references presented, I am left with the impression of the candidate's research interests and pursuits in a variety of topics.

Technically, the dissertation is well designed. The research is thorough and covers important aspects of the given problems.

I have no critical remarks.

**12. Personal impressions**

I have personally known the PhD student Viktor Kanchev Danev for 5 years, and I am convinced that he is an excellently prepared and highly competent specialist, a successful participant in scientific research projects and a professional with experience in the field of Information Technology.

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

I have no recommendations.

I hope that the excellent results achieved will find wide application in education.

CONCLUSION

The dissertation contains scientific, scientific 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 (LADAB), the Regulations for the Implementation of the LADAB and the relevant Regulations on the Specific Conditions for the Acquisition of Scientific Degrees and for the Occupation of Academic Positions at the IIT-BAS.

The dissertation work shows that the PhD student Viktor Kanchev Danev possesses in-depth theoretical knowledge and professional skills in the scientific specialty of Informatics and Computer Science, 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, abstract, results and contributions, and I propose to the honorable scientific jury to award the educational and scientific degree "Doctor" to Viktor Kanchev Danev in the field of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.6 Informatics and Computer Science, doctoral programme Informatics.

18.11.2023 г.                                    Rev    На основание

                                                      ЗЗЛД