O P I N I O N

by **Associate Professor Vanya Angelova Ivanova, PhD,**
University of Plovdiv "Paisii Hilendarski", Plovdiv

of a dissertation for awarding the educational and scientific degree "**Doctor**"
Field of higher education: 4. Natural Sciences, Mathematics, and Informatics,
Professional field: 4.6 Informatics and Computer Science
Doctoral program: Informatics

Author of the dissertation: Evgeny Vladimirov Valchev

Topic: IoT Environment for Intelligent Livestock

Scientific supervisors: Prof. Stanimir Nedyalkov Stoyanov, PhD, and
Prof. Todorka Atanasova Glushkova, PhD

1. General Presentation of the Procedure and the Doctoral Student

By order № RD-22-772, dated 27 March 2025, of the Rector of the University of Plovdiv "Paisii Hilendarski", I have been appointed as a member of the scientific jury to participate in the procedure for the defense of the dissertation titled "IoT Environment for Intelligent Livestock" for acquiring 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 program: Informatics. The author of the dissertation is Evgeny Vladimirov Valchev – a full-time doctoral student at the Department of Computer Systems, with scientific supervisors Prof. Stanimir Nedyalkov Stoyanov, PhD, and Prof. Todorka Atanasova Glushkova, PhD, from the University of Plovdiv "Paisii Hilendarski".

The set of materials presented by the doctoral student complies with Article 36 (1) of the Law on the Development of the Academic Staff of the University of Plovdiv and includes the following documents on electronic media:

- Application form to the Rector to initiate the procedure;
- CV in European format;
- A protocol from the preliminary discussion in the department and the opinion of the scientific supervisors regarding readiness for the preliminary discussion;

- An abstract in Bulgarian and English;
- A declaration of originality and authenticity of the attached documents;
- A certificate of compliance with the minimum national requirements;
- A list of publications;
- The dissertation;
- Copies of the publications related to the dissertation topic;
- A document confirming the fee payment, as per the tariff.

The doctoral student has submitted 2 publications in English, both of which are indexed in SCOPUS.

This set of documents complies with the requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria, the Rules for its implementation, and the Law on the Development of the Academic Staff of the University of Plovdiv "Paisii Hilendarski". The dissertation was discussed and approved for defense at a department meeting on 28/31 March 2025 at the Department of Computer Systems at the Faculty of Mathematics and Informatics of the University of Plovdiv. The procedure for defending the educational and scientific degree "Doctor" is organized by the law. The dissertation and the author's abstract meet the requirements of the Rules on the Conditions and Procedure for Acquiring Science Degrees and Holding Academic Positions at the University of Plovdiv.

The doctoral student, Evgeny Vladimirov Valchev, received his bachelor's degree in 2016, majoring in Business Information Technology at the University of Plovdiv "Paisii Hilendarski," and a master's degree in "Business Informatics with English" from the same university in 2019. Since 2021, he has been enrolled in the doctoral program in Informatics at the University of Plovdiv "Paisii Hilendarski", Faculty of Mathematics and Informatics, Department of Computer Systems, and has been granted the right to defend his dissertation.

2. Relevance of the Topic

The topic of the dissertation, "IoT Environment for Intelligent Livestock," is highly relevant in the context of the digitalization of agriculture. By combining technologies such as IoT, cyber-physical and social systems, artificial intelligence, and machine learning, the dissertation addresses issues directly related to the sustainable development and optimization of livestock farming. The research fully aligns with national and European priorities in the agricultural sector and responds to the need for

intelligent technological solutions in real-world environments.

Particularly valuable is the focus on pasture-based cattle farming, where technological intervention is challenging due to the nature of the conditions. The proposed solutions demonstrate how the integration of digital technologies can overcome challenges such as remoteness, lack of connectivity, and the need for constant monitoring. Thus, the topic holds not only theoretical but also significant practical value.

3. Knowledge of the Research Problem

The doctoral student demonstrates a deep understanding of the state of the problem and current research trends. A clear motivation for the choice of topic is presented, taking into account the technological and practical challenges of applying intelligent platforms in livestock farming. The review of existing solutions and their critical discussion shows an analytical approach and the ability to formulate specific goals and tasks.

The dissertation includes a solid review of the scientific literature, including reference architectures and methods from CPSS and ML, which enrich the research framework. The author skilfully analyses not only the technological but also the biological aspects of animal behaviour, demonstrating an interdisciplinary approach and competence in applying modern methods.

4. Characterization and Evaluation of the Dissertation and Contributions

The dissertation consists of 133 pages, and the references include 111 sources. The dissertation is structured into an introduction, three chapters, a conclusion, results of the scientific research, research dissemination (projects, conference papers, and publications), a declaration of originality, and a bibliography.

The introduction outlines the research problem, the goals and objectives of the dissertation, as well as the methodology used.

Chapter one discusses the motivation for the research and the state of the problem. The need for IoT environments in intelligent livestock farming is presented, and existing technological solutions, including IoT platforms and cyber-physical and social systems, are analysed. Special attention is given to the reference architecture ViPS and its adaptation to the researched field.

Chapter two focuses on the design and construction of the IoT platform. The software architecture, sensor network, IoT devices, and tools for collecting, processing, and visualizing data are described in detail. Several successive prototypes of the system are presented, developed, and tested under the chosen methodological approach.

Chapter three contains the results from the implementation of the prototypes, analysis of the collected data, and comments on their interpretation. Behavioural analysis models of the animals are described, and ideas for future expansion of the system are presented, including algorithms for predicting behaviour in pasture-based farming.

The conclusion summarizes the main results and contributions of the dissertation.

5. Evaluation of the Publications and the Doctoral Student's Personal Contribution

The doctoral student has published two scientific articles related to the dissertation topic, both indexed in the international SCOPUS database. This indicates a high standard of research activity and recognition from the international academic community. The doctoral student's contribution is evident in the design and implementation of sensor network prototypes and devices, software modules for data collection and processing, as well as in the development of functional components of the IoT platform, including a virtual operations centre. He also played an active role in developing the methodological framework and analysing the obtained results.

The publications reflect key aspects of the dissertation research and contribute to the international scientific discourse on the topic. They are thematically focused, methodologically sound, and present both results from real experiments and architectural and technological solutions applied in the developed platform. The author's contribution is visible in the creation, testing, and validation of specific system components.

The submitted publications effectively disseminate the research findings and demonstrate the doctoral student's ability to work productively in a research team, take initiative, and assume responsibility in the implementation of scientific projects. Evgeny Valchev's contribution to the development and publication of research is indisputable.

Both the number and the content of the publications fully meet the requirements of the Rules on the Conditions and Procedure for Acquiring Science Degrees and Holding Academic Positions at the University of Plovdiv "Paisii Hilendarski," as they present key results of the dissertation to a specialized academic audience.

6. Abstract

The abstract has been prepared according to the established requirements. It clearly and consistently reflects the structure, content, and main contributions of the dissertation. The writing style is scientifically sound, striking a good balance between technical terminology and accessibility.

The abstract fulfils its purpose as a concise and synthesized presentation of the research's main objectives, tasks, methodology, and results. The language used is precise, and the structure of the text

is logical, enabling easy navigation through the content and achievements of the dissertation.

7. Critical Remarks and Recommendations

I have no critical remarks regarding the submitted documents and materials.

The dissertation is comprehensive and well-structured. The research examines a wide range of aspects related to the system's functioning, including behavioural, sensor-based, technical, and analytical components. It is commendable that the doctoral student plans to develop economic models and forecasting capabilities in future work, which would contribute to a more comprehensive assessment of the platform's impact in real farming environments.

In future developments, it would be beneficial to place greater emphasis on quantitative evaluations of the system's effectiveness, such as time savings, cost reductions, or animal health indicators. The dissertation already includes experimental results and analyses that lay a solid foundation for this line of inquiry. Expanding the application to other types of livestock or different agricultural environments would be a logical continuation of the current research and would enhance its practical value and relevance.

CONCLUSION

The dissertation contains scientific-applied and applied results, which represent an original contribution to science and meet all the requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Rules for the Implementation of the ADASRB, and the Rules on the Conditions and Procedure for Acquiring Science Degrees and Holding Academic Positions at the University of Plovdiv "Paisii Hilendarski".

The dissertation demonstrates that the doctoral student Evgeny Vladimirov Valchev possesses deep theoretical knowledge and professional skills and shows the qualities and ability to conduct independent scientific research.

For the above reasons, I confidently give a **positive evaluation** of the research presented in the reviewed dissertation, abstract, achieved results, and contributions. **I recommend that the esteemed scientific jury award the educational and scientific degree "Doctor"** to Evgeny Vladimirov Valchev in the field of higher education: 4. Natural Sciences, Mathematics, and Informatics, professional field: 4.6 Informatics and Computer Science, doctoral program "Informatics".

20th April 2025 Reviewer: .....

Assoc. Prof. Vanya Ivanova, PhD