

OPINION

by: Prof. Nikolay Stoimenov, Ph.D.,

*on a dissertation for obtaining an educational and scientific degree
“Doctor (Ph.D.)”*

*member of the scientific jury by Order No.231/01.102025. of the Director of
IICT-BAS*

Author of the Dissertation thesis: mas. eng. Kristian Simeonov Dimitrov
Thesis of the Dissertation: „CYBER-PHYSICAL SYSTEMS FOR INTELLIGENT
MANAGEMENT OF ANIMAL HUSBANDRY
COMPLEXES“
Professional Field: 5.2. „Electrotechnics, Electronics and Automation“
Doctoral Program: „Automated information processing
and management systems“
Scientific Supervisor: Prof. Nayden Chivarov, Ph.D.

1. General characteristics of the dissertation.

The dissertation thesis presented to me for an opinion, by mag. eng. Kristian Simeonov Dimitrov, is 178 pages long and includes figures, tables, it is divided into 7 chapters, a conclusion, and a declaration of originality. A total of 167 references sources are cited, including internet addresses.

2. Relevance of the problem developed in the dissertation in scientific and scientific-applied terms.

The field in which the dissertation is developed is a contemporary and promising niche for technological integration in animal husbandry. The topic addresses the growing need to increase productivity and energy efficiency by controlling the microclimate in livestock farms. The development of such systems meets the increasingly stringent requirements for humane treatment of animals, coping with the effects of climate change, and compliance with environmental regulations for air quality.

3. Degree of knowledge of the state of the problem and creative interpretation of the reference sources.

The introduction to the dissertation, the literature review of 167 bibliographic sources, the description of cyber-physical systems (CPS), control and monitoring tools demonstrate the doctoral student's in-depth and detailed knowledge of the subject matter. The identified and

researched problems, as well as the applied modern solutions for the integration of control and management systems, are developed with precision and detail.

The objectives and tasks of the dissertation are formulated in a well-argued manner after analysis and systematization in the field of animal husbandry, aquaponics systems, and CPS for intelligent management of complexes for animal breeding.

4. Correspondence of the chosen research methodology and the set goal and tasks of the dissertation with the achieved contributions.

The dissertation examines the factors affecting the microclimate in livestock farms, the existing methods and means of controlling these factors, and the implementation of automated control systems that contribute to precise control of the indoor environment. The proposed approaches include the improvement of existing methods and techniques for analyzing, controlling, and improving the microclimate. The comprehensive use of existing methods and means and the experiments conducted show that the doctoral student has successfully implemented the chosen methodology, which is in line with the set goals and the achieved scientific and applied contributions.

5. Scientific and scientific-applied contributions of the dissertation.

I accept and appreciate the positively formulated contributions of the author, which are mainly oriented to scientific and applied nature.

The dissertation and the abstract are described as follows:

A new method for controlling the microclimate in poultry farms has been developed, based on calculating the temperature felt by the birds, which differs from the temperature in the room and depends on the temperature, humidity, and air velocity, as well as the age of the chickens.

A new method has been developed for automatic control of nitrates, nitrites, and ammonia in an aquaponics system by controlling the amount of feed supplied to the automatic feeder.

CPS has been developed for microclimate control in dairy, pig and poultry farms, built with cost-oriented components, with the final price being significantly lower than existing solutions on the market. This makes it easily accessible to small and medium-sized farms for which the initial investment in existing systems is prohibitive.

The developed CPS for microclimate management in poultry farms allows for fully autonomous control, whereby the system independently changes the parameters of the environment according to the age of the chickens and switches between the three ventilation modes without the intervention of personnel. Existing similar systems only offer a transition from minimum to transitional ventilation and vice versa. The proposed system also allows a transition to tunnel ventilation mode, thanks to the introduced method for measuring the temperature felt by the birds.

A CPS has been developed for environmental control in an aquaponics system that offers autonomous control of a much wider range of parameters compared to existing systems.

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transition to tunnel ventilation mode, thanks to the introduced method for measuring the temperature felt by the birds.

A CPS has been developed for environmental control in an aquaponics system, which offers autonomous control of a much wider range of parameters compared to existing similar systems, while also being able to send recommendations to staff on regulating the quantity of fish and plants to achieve and maintain balance.

The developed CPS for microclimate management in poultry farms was implemented and tested in a poultry farm in collaboration with Trakia University in Stara Zagora, contributing to a reduction in electricity costs and improved conditions for poultry farming. It is noteworthy that the results have been tested in a poultry farm in collaboration with Trakia University in Stara Zagora.

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6. Evaluation of the dissertation publications.

Five publications have been made in connection with the dissertation, with the doctoral student being the sole author of one of the publications and the first author of two of them. The materials have been published in international conferences and journals.

The publications reflect, present, and popularize parts of the dissertation. It can be concluded that the results have become known to the scientific community.

7. Opinions, recommendations, and remarks.

It is impressive that the publications presented are mainly in international open access journals and forums. The dissertation is detailed and precise, distinguished by its completeness and depth. The field of research offers potential for expanding the testing of the system and its development.

CONCLUSION

The author has made a precise and in-depth study in an actual and promising area. All the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation, as well as the specific conditions for obtaining scientific degrees and holding academic positions at the Institute of Information and Communication Technologies, in terms of scope, volume, abstract and quality of the dissertation are met. **My assessment is positive.** The results obtained prove the depth, and capacity of the candidate to conduct independent research and studies.

On the above grounds, I propose to the honorable Scientific Jury to award mag. eng. Kristian Simeonov Dimitrov with the educational and scientific degree “**Ph. D.**” in scientific field 5. “Technical Sciences”, professional field 5.2. “Electrotechnics, Electronics and Automation”, doctoral program “Automated information processing and management systems”.

20.11.2025.

Sofia

