

OPINION

on a dissertation work for the acquisition of an educational and scientific degree "PhD" in the scientific specialty 5 Technical Sciences, by professional direction 5. 2 Electrical Engineering, Electronics and Automation, scientific specialty "Application of the principles and methods of cybernetics in various fields of science".

Author of the dissertation: **M. Eng. Vasil Georgiev Tsvetkov**

Dissertation topic: **Enhancing the cognitive abilities of robots through optimization of their sensory system.**

Member of the scientific jury: **Assoc. Prof. Dr. Eng. Reneta Krasimirova Dimitrova**,
Technical University of Sofia, Faculty of Mechanical Engineering, Department of Discrete
Manufacturing Automation.

1. Relevance of the problem developed in the dissertation.

The dissertation examines issues related to the state of cognitive abilities of robots and how to adapt to new situations. The issue is topical and aims to study the interactions of robots and, accordingly, optimize their behavior by using data from multiple sensors simultaneously, combining different modalities to form a more comprehensive understanding of their surrounding environment.

2. Degree of knowledge of the state of the problem.

The doctoral student used and cited a total of 96 literary sources, such as 80 are in Latin and 16 in Cyrillic, which provides a very good basis for assessing the state of the problem considered in the dissertation. The review concludes with conclusions based on which the goal of the dissertation is formulated and the main tasks for achieving the set goal are determined.

3. Compliance of the chosen research methodology and the set goal and objectives of the dissertation with the contributions achieved.

The methodology used by the doctoral student is fully adequate to the goal set in the dissertation and is suitable for solving the problems formulated in chapter one. The doctoral student approaches the solving of the problems correctly, which is confirmed by the results achieved in the dissertation.

4. Contributions of the dissertation work.

The contributions of the dissertation are divided into Scientific-Applied and Applied Contributions, which prove the adequacy of the proposed approach, namely, an existing scientific problem is defined, which is proven with new methods and means. A solution is proposed, and new facts are also proven. The significance of the contributions consists in:

- A general classification of the currently existing sensors has been made from the point of view of their characteristics and their applicability in various technical systems.

- A methodology for designing an optimal sensor system intended for cognitive robots is proposed.
- Experimental results have been obtained in the study of optimally designed sensor modules.
- A mobile platform has been designed and implemented, suitable for use as a universal technical tool for testing the functional capabilities and technical characteristics of the developed optimal sensor systems of modules.
- Optimal sensor modules have been created such as: Sensor module for temperature measurement; Sensor module for measuring light intensity in the visible spectrum. In terms of software, the following modules have been created: initialization procedure for the selected optimal PIC microcontroller; software module controlling communication between the microcontroller and the smart sensor; module for visualization of a 7-segment display; software module for converting data packets received from the smart sensor into a format suitable for reading.
- A mobile application for Android has been developed, serving as a human-machine interface for controlling the mobile platform designed for cognitive robots.
- An evaluation of sensor parameters and states was performed, which is part of the process of designing an optimal sensor system for cognitive robots.

5. Assessment of dissertation publications:

The main achievements and results of the dissertation work have been published in 3 scientific publications in co-authorship with his scientific supervisor, 1 of which is referred to in Scopus. I believe that these publications fully present the results of the doctoral students' work, thus testing the main ideas in the dissertation work. The publications include key points of the dissertation work, which have been presented to a sufficiently large number of specialists dealing with similar problems to the ones under consideration.

6. Opinions, recommendations and notes.

I did not find any fundamental errors or incorrect use of other people's works in the dissertation. I have no critical remarks with which to dispute the applied and scientific-applied contributions of the doctoral student.

7. Conclusion

The dissertation work of M. Eng. Vasil Georgiev Tsvetkov is complete, very well-formed and sufficient in volume, examining a current problem and is the personal work of the doctoral student. The main tasks set have been fulfilled and sufficient applied and scientific-applied contributions have been obtained. The main results of the dissertation work have been published in prestigious journals.

On this basis, I believe that the dissertation fully meets the requirements of the current Law on the State Educational Service of the Republic of Bulgaria and the Regulations of TU-Sofia on the conditions and procedure for acquiring the educational and scientific degree "Doctor". I give a positive assessment and propose to the scientific jury to award **M. Eng. Vasil Georgiev Tsvetkov the educational and scientific degree "Doctor" in professional field 5.2. "Electrical Engineering, Electronics and Automation", scientific specialty "Application of the Principles and Methods of Cybernetics in Various Fields of Science"**

Date: 13.01.2025

Jury member:

/Assoc. Prof. Dr. Eng. Reneta Dimitrova/