

R E V I E W

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

*Institute of Information and Communication Technologies at the Bulgarian
Academy of Sciences*

on a dissertation for obtaining an educational and scientific degree

“Doctor (Ph.D.)”

member of the scientific jury by Order No.33/21.01.2024. of the Director of IICT

Author of the Dissertation thesis:

mas. eng. Stanislav Yovchev Yovkov

Thesis of the Dissertation:

**„Multi-Functional Learning Mobile
Robotized Platform“**

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.

By decision of the Scientific Jury from a meeting held on 05.02.2024, I have been designated as a reviewer of the dissertation work. As a member of the Scientific Jury, I have received the following materials:

1. Dissertation work for obtaining the educational and scientific degree "doctor";
2. Abstract of a dissertation work in Bulgarian;
3. Abstract of a dissertation work in English;
4. Full-text copies of publications related to the dissertation work;
5. Certificate of fulfillment of the minimum requirements of the IICT for the educational and scientific degree "Ph.D.".

The submitted dissertation topic with the author mag. eng. Stanislav Yovchev Yovkov, is 116 pages long, structured in 4 chapters, conclusion, scientific and applied contributions, bibliography, declaration of originality and list of publications on the dissertation topic. 75 literature reviews are cited, including internet addresses. The dissertation contains tables and more than 100 figures divided into chapters.

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

The main aim of the dissertation is the research, development and management of educational mobile robots that can be used in the preparation of students. The relevance of the topic also comes from the introduction of STEM (Science, Technology, Engineering and Math) education in the school environment, in which one of the directions is "Robotics and Cyber-Physical Systems". The implementation of educational mobile robotics in schools, universities, specialized courses and trainings is proof.

The scientific and applied nature of the dissertation work is expressed in a mobile robot control system, approaches to creating algorithms and comparative analysis.

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

The introduction of the dissertation, the long literature review, the attention paid to the development of robotics, the discussion and classifications of different types of navigation and propulsion systems show a thorough detailed knowledge of the subject by the author. An analysis of the market share for learning robots is made. The benefits of learning robotics in education are discussed. Issues identified and explored, as well as contemporary solutions for integrating new methods into educational mobile robotics, are developed with precision and detail.

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

The aims and objectives of the thesis are formulated after a detailed analysis and systematization in the field of educational mobile robotics. The overall objective formulated is to investigate and create algorithms and control systems for learning mobile robots to be autonomous or tele-controlled.

To achieve the goal, the following tasks are formulated:

- Structure a control system for learning mobile robots;
- Innovative approaches to design algorithms for a dual-mode learning mobile robot capable of performing tasks such as line following, obstacle avoidance, maze and confined space egress, manual control and machine vision;
- Comparative analysis of algorithms of learning mobile robots;
- Conduct experiments based on the algorithms developed;
- Analysis of the obtained results.

The research methodology in this dissertation includes the analysis of robot types, navigation and control methods, solving various problems of learning robots. The analysis made provides a basis for the selection of methods to be implemented. Appropriate hardware devices are selected for the implementation of the methods, and then algorithms are developed to enable control and navigation of the learning mobile robots.

It can be concluded that the author has chosen an appropriate research approach and methodology according to the aims and objectives set in the thesis.

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

I accept the contributions formulated by the author, which are of scientific and applied nature. Some rounding and refinement could be done. The orientation of the research towards implementations for specific users makes a good impression.

In summary, the contributions can be listed as follows:

- Investigation and analysis of methods and algorithms for control and navigation of learning robots in scenarios such as obstacle overcoming, maze search, confined space egress, and line following;
- Investigation and analysis of methods and algorithms in robot teleoperation;
- Perform comparative analysis of robots with different navigation and propulsion system;
- Implemented methods and algorithms for line tracking and object tracking of robot performing navigation using HUSKYLENS intelligent camera;

- Developed an interface for devices under Android operating system based on the MIT App Inventor, designed for telecontrol of a learning mobile robot using Bluetooth communication.

6. Evaluation of the degree of personal involvement of the Ph.D. student in the contributions

I know personally the Ph.D. student mag. eng. Stanislav Yovkov and I have direct impressions both from his independent work and from his work in the team in which he participates. This gives me reason to believe that the thesis and its contributions are his personal work, obtained under the direct guidance of his supervisor.

7. Assessment of the publications on the dissertation.

In the submitted documents for the competition there are 6 publications on the dissertation topic, of which 1 independent and 5 co-authored. The Ph.D. student is listed first in five of them, which shows his commitment and main contributions in these publications. Four of the publications are in English and two in Bulgarian. The publications appear in prestigious national and international journals, and three of them are refereed in the Scopus database. All publications under the thesis are in the period 2021-2023 and in terms of volume and quality meet the requirements for the Ph.D. degree. It can be concluded that with the publications made, the results of the dissertation have become available to our and international scientific community. It is a good impression that half of the publications are in refereed databases.

8. Significance of the dissertation results in science and practice

In this dissertation, researches and results related to learning mobile robots and tele-controlled robots are carried out. Experimental studies have been performed to illustrate the advantages of the developed methods. Overall, the dissertation contains contributions of a scientifically applied nature that relate to the development of new and the improvement of existing methods and approaches, as well as the application of useful practical solutions.

9. Assessment of the compliance of the abstract with the requirements for its formatting

The abstract is presented in Bulgarian and English and meets the requirements for its formatting. Its content corresponds to the content of the dissertation and accurately presents the main results of the dissertation.

The previously submitted Bulgarian copy lacked an English translation of the abstract.

10. Assessment of the fulfilment of the minimum national requirements and additional requirements under Art. 1a, para. 2 of the Regulations for implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria

According to the Regulations for implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria for obtaining a PhD in professional field 5.2 "Electrical Engineering, Electronics and Automatics" a minimum of 50 points in indicator A and 30 points in indicator group Γ is required. The same number of points is also required in the Regulations on the Specific Conditions for the Acquisition of Scientific Degrees and Academic Positions at the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences (IICT-BAS). From the submitted Report from the author on the fulfilment of the requirements for obtaining the PhD degree, it is evident that the Ph.D. student fulfilled the requirement under indicator A, and scored 61.34 points under group Γ indicators, which significantly exceeds more than twice the required minimum number of points.

The candidate has indicated the data shown in Table 1 in the submitted statement of fulfilment of the minimum requirements of the IICT for a Ph.D.

Table 1. Candidate details.

Group indicator	Indicator	Number of points	Number of points of the Ph.D. Student
A	1. Dissertation for the educational and scientific degree "Ph.D."	50	50
Γ	Sum of indicators 7 to 9	Min. 30	61.34
	Total:	80	101.34

In the report thus submitted by the Ph.D. student, I report the following inaccuracies in indicator group Γ . The sum of the scores for indicator Γ , in which the candidate has indicated 51.34 points, has not been reported 10 points. Despite this inaccuracy, the candidate meets and exceeds the IICT requirements with a total of 101.34 points.

11. Opinion, recommendations and comments

The dissertation is developed in detail and represents a complete scientific research work. The doctoral candidate has carried out a thorough and systematic study of the problem and has proposed original scientific and applied results that fully meet the stated goal and objectives of the dissertation.

I have no substantive criticisms of the dissertation and the results presented. Of an editorial and technical nature, inaccuracies, untranslated and poorly formatted figures and their

description, lack of notations for mathematical symbols, missing notations and inaccuracies in tables and their description, as well as spelling errors in the text can be noted.

These remarks are not substantive and do not detract from the value of the contributions made in this thesis.

My recommendation to the Ph.D. student is to publish the results in prestigious international journals. In terms of style, more attention should be paid to the arrangement, style, structure, numbering of figures and tables.

CONCLUSION

I appreciate the work done and the results obtained in this thesis. The dissertation meets all the requirements of the Law on Information and Communication Technologies, 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. I confidently propose to the esteemed Scientific Jury to award the degree of Master of Science in Communications and Information Technology to Eng. Stanislav Yovchev Yovkov the educational and scientific degree "Ph.D." in the field of higher education.

Sofia

13.03.2024.

