

## REVIEW

on a dissertation work for the acquisition of an educational and scientific degree "PhD"

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**Topic:** "Multipurpose Tele-operated Service Robot"  
**Field of higher education:** 5. Technical sciences  
**Professional Field:** 5.2 Electrical engineering, electronics and automation  
**Doctoral Program:** Application of the principles and methods of cybernetics in various fields of science  
**Scientific Supervisor:** Prof. Nayden Chivarov, Ph.D.  
**Member of scientific jury:** Assoc. Prof. Stanislav Gyoshev, Ph.D.  
order No. 32/31.01.2024 of the director of IICT-BAS  
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The dissertation is 143 pages long with an Introduction, 3 Chapters and a Conclusion. 94 literary sources are cited, of which 3 are in Bulgarian. There are 131 figures.

In connection with the dissertation, 5 publications are presented (1 of which is independent). Of these, 2 are at international conferences abroad visible in SCOPUS: 1. Stoev, P., Chikurtev, D., Stefanov, T., Dimitrov, D. & Vitanova, D. (2023). *Remote Control of a Teleoperated Multi-Purpose Mobile Robot Platform Using a Web-Based Graphical Interface, via MQTT and Web Sockets. The 3rd International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME) 2023*, DOI: 10.1109/ICECCME57830.2023.10252491; 2. Nayden Chivarov, Denis Chikurtev, Petko Stoev, Vasil Lozanov, Stefan Chivarov. *ROBCO Drone - Service Robot for Transport and Delivery of Grocery Products, 7th International Conference on Engineering and Emerging Technologies 2021 – ISTANBUL – TURKEY*, DOI: 10.1109/ICEET53442.2021.9659729.

The dissertation investigates multi-purpose tele-controlled robots with the ability to work with different modules according to the need in different work environments.

As a member of the jury I have received:

1. Order No. 32 of 31.01.2024 of the Director of IICT-BAS. 2. Attestation of the doctoral student. 3. List of dissertation publications. 4. Certificate of fulfillment of the minimum requirements of the ICT for acquiring the educational and scientific degree "PhD". 5. Full text of the dissertation publications. 6. Abstract in Bulgarian and English. 7. Dissertation

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

The dissertation is up-to-date and in a promising field, as some key trends and directions in robotics related to: construction, agriculture, telemedicine and health care, education, remote studies, etc. are well described. At the time of my last update in January 2022, robotics and technological development in general are an important part of European Union (EU) development strategies. The EU has ambitious plans aimed at promoting innovation and competitiveness in the field of technology, including robotics, and the thesis cites the EU's main strategic goals of which robotics is a part: "The UN 2030 Agenda", "Industry 4.0", "Industry 5.0", "Horizon Europe" program, etc. This determines the relevance and usefulness of the research in a scientific and applied sense.



## **2. Degree of knowledge of the state of the problem and creative interpretation of literary material.**

The introduction and the literature survey are a total of 60 pages, made with great detail, which shows a thorough knowledge of the subject by the author. A comprehensive analysis of the application, main characteristics, mechanical systems, compatibility, design and ergonomics, communication and tele-control of the multi-purpose mobile robots was also done.

The conclusions of the review and analysis are appropriately systematized. On this basis, the aim and tasks of the dissertation work are formulated in an argumentative manner.

It makes a good impression that the work is aimed at real-life applications.

## **3. Correspondence of the goal and tasks with the achieved results.**

The overview, analysis and conclusions of the theoretical studies, existing methods and tools for engineering expert analysis made and implemented by the doctoral student, provide an opportunity to develop and apply approaches, to solve the set goals and tasks of the dissertation work. By applying innovative approaches and calculation procedures, modern solutions are realized. From well-formulated, justified and motivated goals and tasks, the doctoral student has contributed to the realization of the dissertation work and real contributions. The obtained results show that the doctoral student has successfully chosen the research apparatus for obtaining new results with scientific-applied and applied contributions.

The main goal of the dissertation work is the development of a multi-purpose tele-controlled service robot to improve working conditions and support the labor activity of people in various working environments, namely hospitals, warehouses

1. Taking into account the set goal, the following tasks have been formulated:
2. Getting to know the main characteristics and specific features of tele-controlled service robots.
3. Designing the main components of the mechanical design of the robot
4. Choice of drive, actuators and sensor system of the robot
5. Development of industrial design of the robot
6. Development of remote control
7. Control the robot modes of the multi-purpose robot

## **4. Characteristics of the dissertation work.**

I am familiar with the dissertation work presented to me, as well as with its presentation by the doctoral student at the preliminary defense held. Compared to the preliminary version, a positive development and improvement of the overall content of the dissertation can be noted, taking into account the remarks and recommendations made.

In Chapter 1, a literature review and classification of the types of service robots is made, the methods of their management are analyzed. The chapter ends with conclusions that clearly describe what the functions and construction of the robot should be.

Chapter 2 describes in detail the design of a multi-purpose service robot, as well as various modules for it. Actuator and sensor systems satisfying the functions of the robot and achieving its multi-purpose functions are proposed.



In Chapter 3, the different ways of controlling the robot are described in detail, with precise software and hardware solutions for their implementation.

The final part of the dissertation summarizes the obtained results and lists the contributions that are essentially defined as scientific and applied. The dissertation is distinguished by an in-depth analysis of the researched problems, as well as the use of appropriate methodology and algorithms for their solution. The theoretical statements and mathematical description of the specific tasks are presented, based on which the corresponding algorithmic assurance was developed. The numerous experiments conducted and the analysis of the experimental data confirm the correctness of the chosen approach and the applicability of the obtained results.

#### **5. Scientific and scientific-applied contributions of the dissertation work.**

I accept the contributions formulated by the author, which are of a scientific-applied nature. The specified scientific and scientific-applied contributions can be attributed to the groups: proving with new means essential new aspects of already existing scientific fields, problems, theories, creating new classifications, methods, constructions, technologies and obtaining confirmatory facts and enriching existing knowledge with practical application.

#### **6. Assessment of the degree of personal participation of the doctoral student in the contributions**

With the thus formulated and practically proven contributions of the doctoral student, I accept that he has fulfilled the main goal and tasks of his dissertation work. I have direct impressions of his work and the team in which he works, which gives me reason to consider that the dissertation work and its contributions are the personal work of the PhD student, obtained under the direct supervision of his supervisor.

#### **7. Significance of the results of the dissertation work in science and practice**

For the dissertation, methods, techniques and algorithms are proposed for improving service robot control systems. Simulation studies of the obtained results are presented, which demonstrate their advantages and practical applicability. In general, the obtained results contain contributions of a scientifically applied and applied nature, which refer to the development of new and the improvement of existing methods and approaches, as well as the application of practical solutions for specific implementations in the field of service robotics.

#### **8. Evaluation of compliance of the abstract with the requirements for its design and publications on the dissertation work**

The abstract is 42 pages long 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 work.

The number and quality of the magazine's publications make a very good impression. Eng. Stoev, related to the dissertation. They are 5 in number, 3 of them c SCOPUS visible.

## 9. Opinions, recommendations and remarks

The dissertation is developed in detail and represents a completed scientific research work. The author has carried out a thorough and systematic study of the problem and has proposed original scientific and applied results and useful practical solutions. The obtained results fully correspond to the set goal and tasks of the dissertation work.

As an additional noticed omission, we can note the not quite precise formatting of the list of used literary sources. Some of the entries in the list have incomplete bibliographic data. Also, not a small number of the sources used are electronic sites (21 out of a total of 94 cited sources), and in some cases they have an advertising-informative character rather than a scientific content. My recommendation to the author is to continue his research activity in the current and prospective field of service robotics and presenting the results in prestigious international journals.

## Conclusion

I positively assess the work done and the results obtained in the dissertation. The dissertation fulfills all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria. The Regulations for its application, as well as the specific conditions for acquiring scientific degrees and occupying academic positions at the Institute of Information and Communication Technologies. I strongly suggest to the respected Scientific Jury to give the mag. Eng. Petko Ivanov Stoev the educational and scientific degree doctor in the field of higher education: 5. Technical sciences, professional direction: 5.2. Electrical engineering, electronics and automation.

Sofia,  
11.03.2024 г.

Review

