

I. IDENTIFICATION DATA

Thesis name:	Vision-guided handling operations for assistive robots in un-structured environments
Author's name:	Zuzana Kožnarová
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Cybernetics
Thesis supervisor:	Prof. Dr.-Ing. Hartmut Bruhm
Supervisor's department:	Dept. of Engineering, Technische Hochschule Aschaffenburg (Germany)

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment <i>Evaluation of thesis difficulty of assignment.</i> Multitude of competencies and methods required: Analysis of user scenarios, user interface design, reliable recognition of object classes, robot arm control with ROS, grasp and path planning, inverse kinematics, working in a multi-language environment (German, English).	extraordinarily challenging
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Satisfaction of assignment <i>Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.</i> Goals achieved: <ul style="list-style-type: none"> - Analysis of typical application scenarios of assistance robots in hospitals and care facilities. - Selection and system integration of Kinect vision sensor (mechanical, electrical, software). - Concept for integration of robot arm and vision sensor with mobile platform. - Matching of Kinect FOV with work envelope of robot arm. - Calibration procedure for vision system and robot arm: Concept, design and making of calibration reference object, implementation and testing of the procedure - Selection of suitable algorithms for detection and localization of specific and generic objects in the camera image. - Movement planning for gripping and depositing detected objects. - Mathematical formulation, implementation and testing of inverse kinematics for the robot arm. - Implementation of the whole project under ROS. - Demonstration and testing of system capabilities, discussion of limitations. No shortcomings that are worth mentioning.	fulfilled
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Activity and independence when creating final thesis <i>Assess that student had positive approach, time limits were met, conception was regularly consulted and was well prepared for consultations. Assess student's ability to work independently.</i> The student worked independently and perfectly according to the project plan. She was always well prepared for the regular consultations with the supervisor. Feedback was accepted in a very constructive manner, and on the other hand she made many valuable suggestions regarding the project work.	A - excellent.
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Technical level <i>Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.</i>	B - very good.
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SUPERVISOR'S OPINION OF FINAL THESIS

The student has shown very good competencies in the fields of robot arm control, visual object recognition, software architecture, system engineering, calibration and testing. System concept development was supported by an extensive evaluation of relevant literature sources. The same holds for the analysis of the application scenario.

Formal and language level, scope of thesis

A - excellent.

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

The formal quality of the thesis is excellent. Formulations are fluent and the course of arguments can easily be followed by the reader. Figures have been used in a carefully considered manner.

Selection of sources, citation correctness

A - excellent.

Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.

The citations are formally correct according to the aforementioned criteria. The student performed literature research for all relevant aspects (application scenario, user interface design, vision and object recognition, arm control). The literature research work provided a sound basis for the subsequent system design and implementation. Related work of other researchers is adequately discussed.

Additional commentary and evaluation

Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

The goals of thesis have been fully achieved and in many respects over-fulfilled. Theoretical studies and implementation and testing activities were well-balanced. Results are convincing and have been demonstrated in live experiments as well as in documentation videos.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation.

I evaluate handed thesis with classification grade **A - excellent**.

Date: 2.6.2019

Signature:



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Thesis name:	Vision-guided handling operations for assistive robots in un-structured environments
Author's name:	Zuzana Kožnarová
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Control Engineering
Thesis reviewer:	Vladimír Smutný
Reviewer's department:	Czech Institute of Informatics, Robotics, and Cybernetics, CTU in Prague

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>Evaluation of thesis difficulty of assignment.</i>	
The assignment was challenging both for its breath as well as by the fact, that computer vision is not a part of the curriculum.	

Satisfaction of assignment	fulfilled
<i>Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.</i>	

Method of conception	partially applicable
<i>Assess that student has chosen correct approach or solution methods.</i>	
The general chosen approach was right one. The student identified the problems, proposed solution, found or designed the solution and implemented it. She performed experiments and documented them.	

Technical level	C - good.
<i>Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.</i>	
The student studied available literature, selected appropriate methods and implemented them. The technical description of the method contains errors as well as lack accuracy. The technical implementation is lacking the systematic approach student was taught during study. The examples are described below.	

Formal and language level, scope of thesis	C - good.
<i>Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.</i>	
The English language used is generally comprehensible but it is not perfect. The details of typography are missing but it does not hurt the comprehensibility. The references to the items in the text are not properly referenced, e.g. "see 5.2" without specifying "equation", "table", "figure".	

Selection of sources, citation correctness	C - good.
<i>Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.</i>	
The list of references is extensive but not all of them are properly cited. The problem is rather formal one. There are not clearly derived formulas in the text and the reference to the original work is missing. The problem is to distinguish between mistakes in the sources and errors introduced by the student.	

Additional commentary and evaluation.
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Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

The student in chapters 1-3 described the problem, surveyed the literature and technical equipment available. She specified the topics which she aims to solve. The quality of the text in this part is reasonable. When more mathematics is involved in chapters 4 and 5, the accuracy of description is far from sufficient. Some descriptions are not detailed enough some are plainly wrong. Whether some misconceptions penetrated to the implementation or whether the ideas were corrected during implementation and experimenting is not clear. There is a reasoning flaw in the equation 5.18 on the page 42, but as in the attached video the position of the manipulated box is a special one, it is not possible to decide whether its implementation is OK.

Here is a subset of issues in the text:

- On the page 15 there is mentioned rotation around x axes by angles alpha but DH notation mentioned in the text rotates generally around z axis and rotations in the figure 3.2 are around z axes with the angle theta.
- On the page 30 is the equation 4.1 The description of the variables totally lacks the information to what object the variables refer. There is no figure to explain them, nor it is the standard formula used to describe pinhole camera. The whole page continues in similar way.
- On the page 31 there is mentioned decrease in the error by 42.8 % and 45.1 %. The accuracy of these numbers certainly does not require three digits.
- The insufficient description can be documented e.g. on the equation 4.6. Each variable in the formula is described but meaning of the variable is not clear. Neither reference, drawing, nor detailed explanation is given.
- Page 36 provides examples of student's misunderstanding of the basic robotics terminology and concepts. There is nothing like origin of the joint, transfer matrix (e.g. page 40), etc.
- Explanation of the equations 5.1, 5.2, 5.3 does not match the formulas.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation. Please present apt questions which student should answer during defense.

The ambitious goal of the thesis was reduced to some meaningful and manageable subset. This subset was implemented. The description of the used mathematics is insufficient, mostly it is not supported by neither drawings nor references. Some formulas contain errors. I appreciate that the student tried to derive the formulas and implement them herself instead of making the thesis just compilation of available codes.

I evaluate handed thesis with classification grade **C - good**.

Questions for the defense

- Why there is a scale S in the equation 4.5 on the page 30?
- What are roll, pitch, and yaw angles described in equations 5.4 and 5.5 used for? What is their interpretation?
- Explain the equation 5.17 on the page 42.

Date: **3.6.2019**

Signature: