THESIS SUPERVISOR'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Robotic Object Manipulation in Virtual and Physical Environment**
Author's name:	**Bc. Ondřej Švec**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Cybernetics
Thesis reviewer:	Ing. Tomáš Jochman
Reviewer's department:	Czech Institute of Informatics, Robotics and Cybernetics

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **extraordinarily challenging**

How demanding was the assigned project?

The topic of the thesis posed a huge challenge and was a very difficult topic. The thesis required the student to explore a new area of industrial metaverse, which was very time-consuming. He had to apply advanced knowledge of programming and algorithmization within the thesis.

Fulfillment of assignment **fulfilled**

How well does the thesis fulfill the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.

The submitted thesis fully meets the assignment. All the main tasks have been achieved. The thesis has been extended in many minor software parts that improve, simplify, and automate the use of the resulting solution, which was not in the original assignment.

Activity and independence when creating the final thesis **A - excellent.**

Assess whether the student had a positive approach, whether the time limits were met, whether the conception was regularly consulted, and whether the student was well prepared for the consultations. Assess the student's ability to work independently.

The student demonstrated excellent independent work and creativity in the creation of the thesis. He regularly participated in consultations and came up with new ideas and solutions.

Technical level **A - excellent.**

Is the thesis technically sound? How well did the student employ expertise in his/her field of study? Does the student explain clearly what he/she has done?

The technical level of the work is at a very high level. The student applied knowledge from robotics, computer vision, and other related fields. In addition to this knowledge, he spent a large part of the thesis familiarizing himself with the documentation of the NVIDIA Omniverse platform for developers and researchers. The clarity and explanation of each step is of a good standard. The data flow diagram that addresses the link between academia and industry is the greatest contribution to the proposed methodology. I would also like to highlight the implementation part, which was very time-consuming.

Formal level and language level, the scope of the thesis **B - very good.**

Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?

The terms used correspond to the standards of the problem addressed. The level of the English language is at a good level. The scope of the thesis has been met and the thesis is well structured. The presentation of the results is convincing and demonstrates the actual possibilities of simulation in a photorealistic environment and its comparison with the real world. In some places, the images do not correspond appropriately with the text flow and in one table the formatting is not well chosen.

Selection of sources, citation correctness	**A - excellent.**
Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?	
Within the chapter describing the background of the problem addressed, research articles are appropriately chosen and properly cited. The originality of the work is evident as it is a unique solution that has not been presented before. The uniqueness of the solution is supported by the fact that algorithms from the academic environment are deployed on industry-used hardware and software components.	

Additional commentary and evaluation (optional)
Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.
The result of the thesis is a solution that works in both real and virtual environments. The novelty has already been highlighted, as well as the impact that the future deployment of an industrial metaverse with an overlap to academia will have. As the student himself mentions and suggests, there is still a lot of potential to improve the functionality of the workplace. Specifically, the results of the accuracy of finding the 6D position of objects. In the future, it will be interesting to include a depth camera in the solution, which can significantly improve the results. However, due to time constraints, it was not possible to implement the depth camera in this work. The student demonstrated excellent software development skills.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

Overall, the presented solution of the thesis was very interesting and I believe it will be an inspiration for many other theses and projects.

The grade that I award for the thesis is **A - excellent.**

Date: **30.5.2024**

Signature: