THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Development of a Human-Robot Control System Based on Virtual Reality for Swarms of UnmannedAerial Vehicles (UAVs)**
Author's name:	**Pajtaš Andrej**
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Cybernetics
Thesis reviewer:	Ing. David Sedláček, Ph.D.
Reviewer's department:	Department of Computer Graphics and Interaction, FEE, CTU

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **challenging**

How demanding was the assigned project?

For the Bachelor's thesis, the requirements for the literature search specified in the assignment are more extensive. At the same time, I do not assume that the student will become familiar with the issues of game development or virtual reality during his studies.

Fulfilment of assignment **fulfilled**

How well does the thesis fulfil 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.

There are mandatory and optional points in the assignment. All mandatory points have been fulfilled.

Methodology **partially applicable**

Comment on the correctness of the approach and/or the solution methods.

The student designed a system connecting VR devices with a system for control and simulation of multiagent UAVs (MRS platform). It visualizes in VR the position of each UAV, and allows controlling them with selected tools.
The VR user interface design is straightforward and focuses on technical feasibility rather than usability. Some decisions on UI design will need to be changed in the future.
The proposed interfacing (communication within systems) in the thesis is mainly addressed from the VR to the MRS platform and no longer back. For example, it needs to be clarified how to work with different coordinate systems (if needed - real-world coordinate system, virtual world coordinate system, octomap coordinate system), UAVs are visible in VR at some positions, but it needs to be clarified if they are also in proper height and oriented correctly. The environment map is not visualized in VR, although the system (octomap) provides it.
It is a pity that there has not been a more thorough comparison of the work with a similar VR approach (e.g. with [12]). The student only compared more rigorously (as required by the assignment) with the work of [16].

CTU CZECH TECHNICAL UNIVERSITY IN PRAGUE

THESIS REVIEWER'S REPORT

Technical level **B - very good.**

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

The technical level of the work is adequate.

Formal and language level, scope of thesis **C - 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 thesis is written in reasonably good English, and I found no significant typos or errors. The LaTeX system was used for writing, which provides all the formal requirements.

The KOS system does not include a project or an executable version of the program. There are also no links to repositories with the project in the thesis. Upon request, the student provided me with the project directory (Unity + ROS), a built VR application, and a video of the application in addition to the text of the thesis. I consider it a mistake that these resources are not available.

The Unity project directory maintains a common structure, the C# source code is commented to a reasonable extent, but the files are not signed by the author.

Selection of sources, citation correctness **B - very good.**

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?

Given the topic of the assignment, I would have expected more references to the VR literature; on the other hand, many items of literature were required in the assignment.

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.

Recommendations for future improvements to the VR environment with respect to user comfort:

- Using a linear beam to point to distant locations on the ground is impractical - parabolic beams are used.
- I positively evaluate the positioning of the GUI panel to the user's waist. Still, it turns out that fixed GUIs are not suitable.
- The visualization of UAVs needs to be supplemented when they are further away from the user (e.g. non-isomorphic magnification or a pointer like an arrow).

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

Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.

Overall, I think the thesis is an interesting attempt to use VR to control UAV swarms, but unfortunately, I feel the thesis only partially exploits the potential of this topic.

The grade that I award for the thesis is **C - good.**

Date: **8.6.2023** Signature: David Sedláček