THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Applying Computer Vision, and Machine Learning Techniques for Modelling and Simulation of Autonomous Car**
Author's name:	**Bc. Allam Omar Alif Abdelhakim**
Type of thesis:	master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Instrumentation and Control Engineering
Thesis reviewer:	Ing. Martin Vitoušek
Reviewer's department:	Department of Instrumentation and Control Engineering

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **ordinarily challenging**

How demanding was the assigned project?

The assigned project was ordinarily challenging, as it required the right choice of existing tools, their application, and the integration into a cohesive system.

Fulfilment of assignment **unfulfilled**

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.

The thesis does not fully fulfill the assigned tasks as follows:

1. **Research on related machine learning and computer vision techniques for autonomous cars:** The research conducted for the first point was reasonably well-executed but could have been improved by omitting certain non-essential topics like PID Control part. Instead, the student could have enriched this section by providing examples of operational solutions and alternative implementations in similar contexts.

2. **Research of feasible applications of car driving simulation:** This point remains unfulfilled, as the student investigated *simulation applications (programs)* instead of the intended exploration of *applications for car driving simulation*.

3. **Design and Implementation for a model of the self-driving car:** The student did not correctly fulfill this task. Instead of designing a new model as expected, they utilized an existing model with minimal modifications. This does not demonstrate the necessary level of effort for a master's thesis. A more comprehensive approach, including model comparison and improvement, should have been undertaken.

4. **Integration and deployment of the trained model within the simulation:** While this task may have been partially fulfilled, the thesis lacks a proper explanation and presentation of this integration and deployment, rendering it unverifiable.

5. **Testing of the model in simulation:** Similar to the fourth point, there is a reference to testing, but no concrete evidence or meaningful results are presented in the thesis.

Overall, the thesis falls short in adequately addressing the assigned tasks, with some aspects only partially fulfilled and others remaining unfulfilled or inadequately explained.

Methodology **partially applicable**

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

The approach and solution methods used in the thesis are correct. The student followed the assignment by conducting research on the requested topics and then proceeding to the practical part. However, in the design and implementation sections, there is a lack of explanation regarding the choice of specific tools, methods, or algorithms. It appears that these choices may have been predetermined, regardless of the research findings, potentially overlooking some viable alternatives (e.g. Keras, Udacity, Flask and Socket.io)

The documentation of the entire integration and deployment process is notably lacking, which makes it nearly impossible to validate and replicate the chosen approach effectively.

In the testing section, the student claims that the results were validated through simulation. However, there is no concrete evidence presented to substantiate these results, neither within the text nor in any attached materials.

Technical level **C - 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 thesis demonstrates a good level of technical soundness, with the student effectively applying expertise from their field of study. However, there is a notable gap in the practical part of the thesis where specific achievements and methodologies are insufficiently described. The provided description is vague, lacking proper technical documentation, and even the attached materials do not adequately address this gap.

Formal and language level, scope of 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 text is well-written, and the English is of good quality. The language used throughout the thesis is clear and easily understandable. The notations and formalisms are used correctly, contributing to the overall clarity. At first glance, the thesis is well-presented.
However, it's worth noting that the research section appears to be overly extensive compared to the relatively concise and hurried practical part. Additionally, the thesis structure lacks a clear distinction between the research and practical components, which could be further refined.

Selection of sources, citation correctness **F - failed.**

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?

The thesis initially appears to be well-referenced, drawing from a diverse range of sources and acknowledging earlier work on similar topics. The citations meet the required standards. However, there is room for improvement in the citation structure. In some instances, it is challenging to distinguish which specific claims within a paragraph are cited from respective sources, as the citation marks are placed at the end of the paragraph. It would be more beneficial to assign citation marks to individual claims, enhancing clarity for the reader.

Regrettably, it becomes evident that certain parts of the thesis, particularly the implementation section, contain instances of plagiarism. Figures 8.5, 9.2, and 9.3 present code that neither originates from the author nor is properly cited from another source. Furthermore, a substantial portion of the source code included in the attachments appear to be obfuscated copies from different source, indicating a significant issue with plagiarism.

The potential origin of the original work can be traced to the following source:

https://www.youtube.com/watch?v=oLi6mWDXRGM&list=PLMoSUbG1Q_r9JtujskOZkorWKCszT0w2S&index=1

The provided link directs to a YouTube playlist that serves as a practical guide for the thesis's implementation section. While there are minor differences in the implementation, it is undeniable that there exists a substantial similarity between the two. The exact matches with the referenced figures (code snippets) from above, which have appeared in the thesis, are presented in the appendix of this report for further examination.

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 source code provided in the attachments is incomplete. It lacks essential components, such as a dependency list for setup, sample data for testing and validation, and a comprehensive readme file to facilitate the reproduction of the steps to run the project.

The thesis consists of a total of 39 pages (from introduction to conclusion), with the introduction spanning 1 page, the conclusion encompassing 1 page, the theoretical section extending to 26 pages, and the practical part comprising 11 pages.

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.

The thesis is lacking in quality, with a theoretical section that is barely sufficient and a practical section that falls significantly below the expected standard. For a master's thesis, there are expectations of a substantial effort in its creation. Unfortunately, the student appears to have taken shortcuts by plagiarizing code from external sources and presenting it as their own work. While such actions might be somewhat tolerable for less critical or minor components, it is wholly unacceptable for the entire design and implementation, which was one of the primary objectives of the thesis.

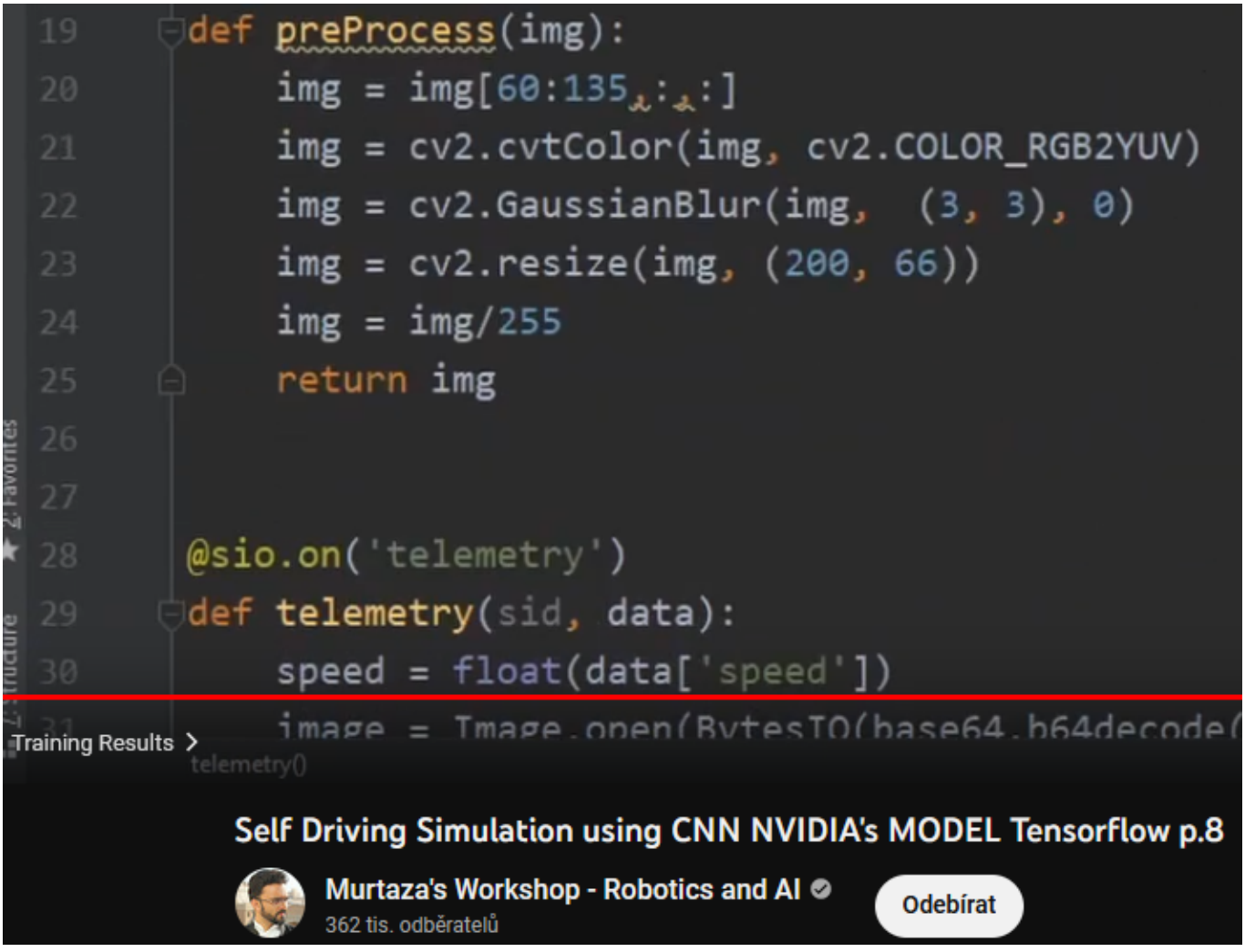
The grade that I award for the thesis is **F - failed.**

Date: **29.8.2023** Signature:

APENDIX: Examples of plagiarism matches

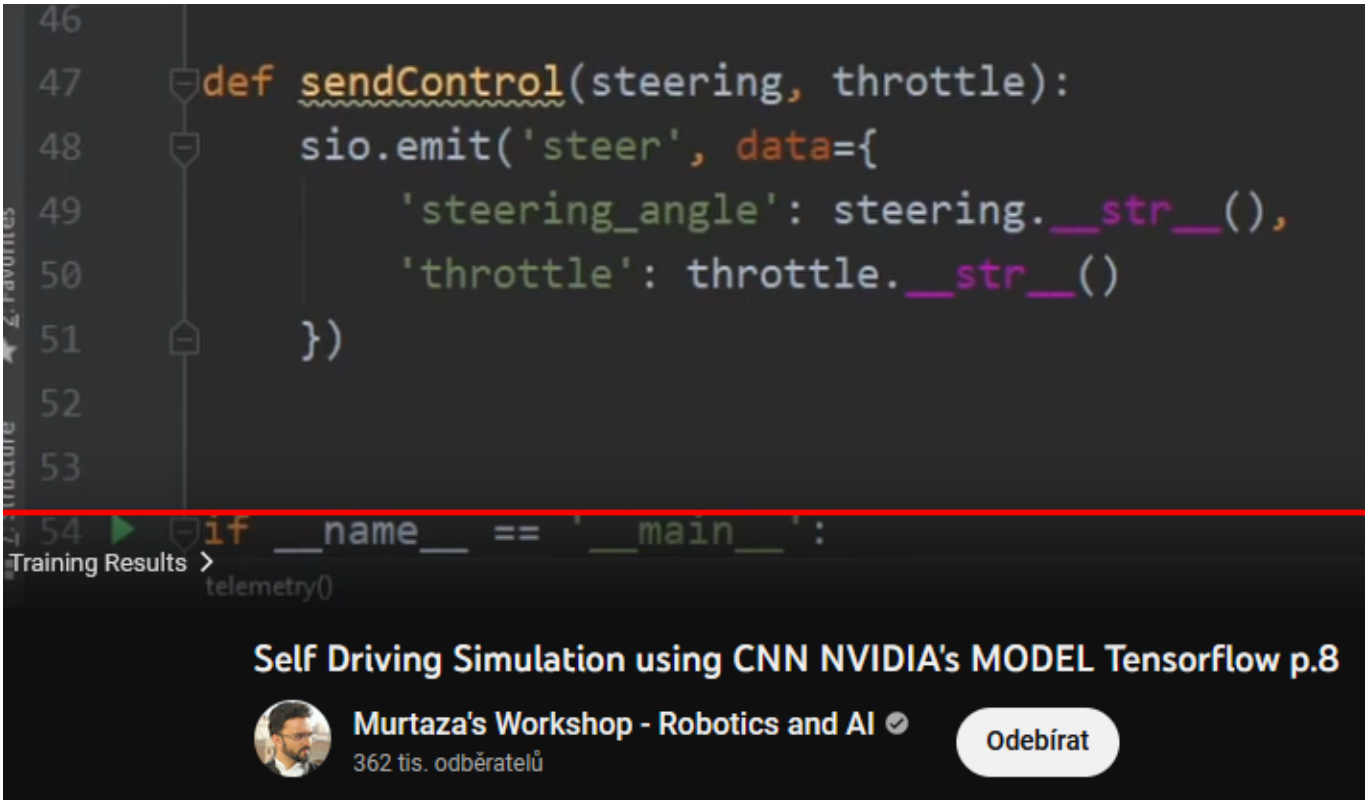
```
def img_preprocess(img):
  img = mpimg.imread(img)
  img = img[60:135,:,:]
  img = cv2.cvtColor(img, cv2.COLOR_RGB2YUV)
  img = cv2.GaussianBlur(img, (3,3), 0)
  img = cv2.resize(img, (200, 66))
  img = img/255
  return img

X_train = np.array(list(map(img_preprocess, X_train,)))
X_valid = np.array(list(map(img_preprocess, X_valid,)))
```

Figure 8.5: Code for preprocessing the image.



```
def send_control(steering_angle, throttle):
    sio.emit('steer', data = {
        'steering_angle': steering_angle.__str__(),
        'throttle': throttle.__str__()
    })
```

Figure 9.3: Function to send control commands to the simulator (client)



```
@sio.on('telemetry')
def telemetry(sid, data):
    speed = float(data['speed'])
    image =
    ↪  Image.open(BytesIO(base64.b64decode(data['image'])))
    image = np.asarray(image)
    image = img_preprocess(image)
    image = np.array([image])
    steering_angle = float(model.predict(image))
    throttle = 1.0 - speed/speed_limit
    print('{} {} {}'.format(steering_angle, throttle, speed))
    send_control(steering_angle, throttle)
```

Figure 9.2: Here, the server listens for a 'telemetry' event and responds by processing the data and sending back control commands.