



Supervisor's statement of a final thesis

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Thesis title: Virtual piano using image processing
Branch / specialization: Knowledge Engineering
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Evaluation criteria

1. Fulfillment of the assignment

- ▶ [1] assignment fulfilled
- [2] assignment fulfilled with minor objections
- [3] assignment fulfilled with major objections
- [4] assignment not fulfilled

The student fulfilled all the points of the assignment. He analysed interaction with the virtual environment with the user's bare hands, analysed necessary computer vision techniques and, according to the analysis, proposed and implemented several approaches for creating virtual piano. He then compared the selected approaches' accuracy and created an application that anyone can use to create MIDI sound files with piano tunes.

2. Main written part

87 /100 (B)

The thesis covers all necessary topics, although some devices described in the analysis bring limited value to the overall subject. The student chose several approaches for creating virtual piano, and even though some approaches, like using the Leap Motion sensors, were unsuccessful, the student correctly stated all reasons why the approach did not work. He compared the results of his work and provided his ideas for further improvement of the virtual piano.

However, some wording or text structure could be clearer. For example, some pieces of information are divided into separate sentences, even though they should be together in one sentence to make sense. Sometimes, there are words missing or redundant in the sentences, and the text contains few typographic errors and numerous missing comas.

3. Non-written part, attachments

82 /100 (B)

Several Python scripts are the main result of this work, one for each presented approach to the virtual piano. The best approach using MediaPipes is described in the

documentation and can be run by anyone who wishes to try the virtual piano. The attachment themselves could use a better structure, and the code is not very well documented. If the student had more time, an improved version of his neural networks approach would be in order.

4. Evaluation of results, publication outputs and awards

86 /100 (B)

The presented virtual piano works pretty well when the difficulty of the task is taken into account. Unfortunately, the student did not have enough time to improve the deep learning approach, so it plays only one note at a time. However, the MediaPipe solution shows promise. The future work regarding the usage of the Z-axis of the MediaPipe solution and UI of the whole system (for example, automatic selection of the piano keyboard from the image) could and should be implemented if the result is to be used by the general public. The student's own neural networks were abandoned too soon because of a shortage of time, but I think the solution could be extended, too. On the other hand, I need to express my satisfaction with the usage of a printed piano keyboard because it makes the virtual piano more user-friendly and intuitive than previously presented solutions.

The idea and approaches stated in this thesis can be used in other scenarios than virtual piano, which is a big plus.

5. Activity of the student

- [1] excellent activity
- [2] very good activity
- ▶ [3] **average activity**
- [4] weaker, but still sufficient activity
- [5] insufficient activity

The student had his problems overcoming writing of the analysis and design parts of the thesis. Still, when he finally got to the implementation, it was clear that he has many good ideas and is willing to spend a lot of time and effort to make them work.

6. Self-reliance of the student

- [1] excellent self-reliance
- ▶ [2] **very good self-reliance**
- [3] average self-reliance
- [4] weaker, but still sufficient self-reliance
- [5] insufficient self-reliance

The student reported on his progress regularly and presented a lot of his own ideas to improve the project's current state. He sometimes needed a little push, but then again, who doesn't.

The overall evaluation

85 /100 (B)

The presented virtual piano works pretty nicely, considering the difficulty of the topic, but some limitations could have been removed if life was not so short. Even though the student did not have enough time to implement all of his ideas, the potential for further

improving the virtual piano is there, and it is a goal of the student to work on it even after the thesis.

Instructions

Fulfillment of the assignment

Assess whether the submitted FT defines the objectives sufficiently and in line with the assignment; whether the objectives are formulated correctly and fulfilled sufficiently. In the comment, specify the points of the assignment that have not been met, assess the severity, impact, and, if appropriate, also the cause of the deficiencies. If the assignment differs substantially from the standards for the FT or if the student has developed the FT beyond the assignment, describe the way it got reflected on the quality of the assignment's fulfilment and the way it affected your final evaluation.

Main written part

Evaluate whether the extent of the FT is adequate to its content and scope: are all the parts of the FT contentful and necessary? Next, consider whether the submitted FT is actually correct – are there factual errors or inaccuracies?

Evaluate the logical structure of the FT, the thematic flow between chapters and whether the text is comprehensible to the reader. Assess whether the formal notations in the FT are used correctly. Assess the typographic and language aspects of the FT, follow the Dean's Directive No. 26/2017, Art. 3.

Evaluate whether the relevant sources are properly used, quoted and cited. Verify that all quotes are properly distinguished from the results achieved in the FT, thus, that the citation ethics has not been violated and that the citations are complete and in accordance with citation practices and standards. Finally, evaluate whether the software and other copyrighted works have been used in accordance with their license terms.

Non-written part, attachments

Depending on the nature of the FT, comment on the non-written part of the thesis. For example: SW work – the overall quality of the program. Is the technology used (from the development to deployment) suitable and adequate? HW – functional sample. Evaluate the technology and tools used. Research and experimental work – repeatability of the experiment.

Evaluation of results, publication outputs and awards

Depending on the nature of the thesis, estimate whether the thesis results could be deployed in practice; alternatively, evaluate whether the results of the FT extend the already published/known results or whether they bring in completely new findings.

Activity of the student

From your experience with the course of the work on the thesis and its outcome, review the student's activity while working on the thesis, his/her punctuality when meeting the deadlines and whether he/she consulted you as he/she went along and also, whether he/she was well prepared for these consultations.

Self-reliance of the student

From your experience with the course of the work on the thesis and its outcome, assess the student's ability to develop independent creative work.

The overall evaluation

Summarize which of the aspects of the FT affected your grading process the most. The overall grade does not need to be an arithmetic mean (or other value) calculated from the evaluation in the previous criteria. Generally, a well-fulfilled assignment is assessed by grade A.