

Review of a Doctoral Thesis at FIT BUT

Doctoral thesis (hereinafter referred to as "thesis"): RESEARCH IN THE FIELD OF BIOMETRIC DETECTION AND RECOGNITION OF INDIVIDUALS USING FACIAL IMAGE DATA

Name of the doctoral student (hereinafter referred to as "student"): TOMÁŠ GOLDMANN

Name and institution of the reviewer:

Prof. Sang Min Yoon

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Please state your opinion on the following aspects of (I) the student's thesis and (II) the student's overall achievements, and (III) state your conclusion (a minimum of approx. 300 characters for each item below is recommended):

I. Thesis

Appropriateness and relevance

Is the area addressed by the thesis appropriate to the particular scientific discipline of the thesis and does the thesis address relevant problems within the chosen area?

A summary of the contributions of the thesis

Biometric recognition has become a widespread concern across various fields such as forensics, anthropometry, biometrics, and computer science. This thesis specifically delves into the generation of datasets to assess face recognition algorithms, with a focus on preserving facial features. The primary objective of this thesis is to conduct comprehensive research in face recognition. It aims to establish a theoretical framework by identifying and summarizing state-of-the-art approaches in the field. The central focus is on developing reliable face datasets for evaluating biometric systems, emphasizing the simulation of real conditions and preservation of facial features. The main contribution is to overcome limitations imposed by the typically small sample sizes of existing datasets, offering new opportunities for evaluating face recognition algorithms and contemporary neural network techniques, resulting in the development of algorithms for face detection and recognition on embedded devices, utilizing the EfficientNet feature extractor.

Main contributions:

- The thesis successfully generates a dataset that simulates real-world conditions, incorporating various head poses and rotations.
- The study verifies the credibility of the generated dataset by comparing it with established face recognition datasets (LFW and CFP). Despite the challenge of limited labelled datasets for faces

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at different angles, the thesis demonstrates that detection and recognition algorithms perform comparably on generated images.

- The research explores algorithms for face detection and recognition on embedded devices, specifically in the context of edge devices. It focuses on the EfficientNet, considering factors like accuracy, parameter count, and acceleration possibilities.
- Efforts are made to optimize the overall performance by reducing inference time using neural network accelerators. The study addresses the challenges posed by post-processing tasks, and identifies the bottlenecks in accelerating face detection approaches for embedded devices.
- The pre-processing step is introduced to address image quality issues caused by varying lighting conditions, particularly in surveillance cameras. A lightweight algorithm using HSV and Gaussian techniques is designed to improve image quality without compromising performance on embedded devices.

Novelty and significance:

Please assess the level of novelty of the results and their significance for the given scientific area, for its further development, and if applicable for possible applications in practice.

Novelty lies in real-world variation, ensuring that facial features are preserved, setting it apart from AI-generated datasets. The dataset provides a platform for evaluating face recognition algorithms. The thesis successfully achieves its goal by contributing valuable insights and solutions to various facets of face recognition. It not only generates a reliable dataset for algorithm evaluation but also explores the challenges and optimizations necessary for implementing face recognition algorithms on embedded devices. The research has practical implications for surveillance systems, emphasizing the potential role of edge devices in addressing privacy concerns through on-site recognition. Future collaboration with law enforcement and anthropometry experts is anticipated for further research and application deployment.

Evaluation of the formal aspects of the thesis:

Please evaluate formal qualities of thesis and its language level.

The thesis demonstrates a clear and well-organized structure, with each paragraph addressing a specific aspect of the research. The language is highly technical and specific to the field of face recognition and embedded devices. The content flows logically, connecting one research aspect to the next. The language and terminology remain consistent throughout the thesis, maintaining a cohesive and unified voice.

Overall, the thesis exhibits strong formal qualities and a high level of language proficiency, catering to an audience well-versed in the subject matter. The precision, coherence, and technical depth contributed to its scholarly appeal.

Quality of publications

Has the core of the thesis been published at an appropriate level? Please judge the quantity and quality of the publications. When judging the quality, please take into account internationally recognized

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standards (WoS/Scopus quartiles, CORE ranks, specific knowledge of flagship publication channels of agiven community, etc.) in a way appropriate for the given area of the thesis.

The publications cover a range of topics, including dataset generation, simulation tools, 3D face scanning, and forensic recognition. While some publications are conference papers, others include a book, a survey, and utility models. The quality of publications appears to align with internationally recognized standards for conference proceedings and journals in the field. The contributions reflect a balance between theoretical understanding and practical applications, showcasing a diverse and valuable set of research outputs. However, the qualitative assessment of the thesis suggests a relatively limited presence in top-tier academic conferences and journals within the fields of computer vision, pattern recognition, and forensics.

II. Student's overall achievements

Overall R&D activities evaluation:

Does the student's thesis, the results included into it, and possible other scientific achievements listed in the list of scientific activities indicate that he/she is a person with scientific erudition and creative abilities?

The student's thesis, encompassing its results and additional scientific achievements outlined in the scientific activities list, robustly demonstrates a profound grasp of the subject matter, and exemplifies the student as a highly competent expert in the field. The depth of scientific knowledge evident in the thesis, coupled with innovative approaches and problem-solving skills showcased throughout, unequivocally affirms the student's exceptional scientific erudition and creative prowess. The comprehensive and meticulous nature of the research findings further underscores the student's capability as a distinguished authority in their domain.

Assessment of other characteristics (optional):

More characteristics of the student may be added here (e.g., awards, grant participation, international collaboration, etc.).

III. Conclusion

The conclusion should contain an explicit statement saying whether, in your opinion, the thesis and the student's achievements until now meet the generally accepted requirements for the award of an academic degree (in accordance with Section 47 of Act No. 111/1998 Coll., on higher education institution).*

* Short overview of both the Act and corresponding internal BUT regulations is enclosed.

In my opinion, the student's thesis, focused on facial recognition and forensics, is thoroughly adequate for the award of a doctoral degree in the respective field. The research exhibits a comprehensive understanding of facial recognition algorithms, dataset generation, and applications in forensics. The

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methodologies employed reflect a high level of technical expertise, showcasing the student's proficiency in the subject matter. Furthermore, the innovative approaches and problem-solving skills demonstrated throughout the thesis affirm the student's readiness for a doctoral degree. Overall, the research meets the generally accepted requirements, aligning with the rigorous standards expected for the attainment of an academic degree in facial recognition and forensics.

Seoul, SOUTH KOREA 08.02.2024

Signature of the reviewer:
