Doctoral thesis (hereinafter referred to as "thesis"), title of the thesis: *Connection of algorithms for removal of influence of skin diseases on the process for fingerprint recognition*

Name of the doctoral student (hereinafter referred to as "student"), name and surname: Mona Heidari

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Name and institution of the reviewer (full name of the reviewer, full name and country of the institution):

Marta Gomez-Barrero, Universität der Bundeswehr München, Germany

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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 foreach <u>item</u> below is recommended):

I. Thesis

<u>Appropriateness and relevance</u>

Biometric recognition systems are being deployed in more and more areas of both everyday use and involving higher security standards. One example is fingerprint recognition. However, there are still some issues needing further research efforts in order to provide universal access to these applications. One of those is the focus of the present Thesis: the non-discrimination of subjects who cannot be properly recognised due to skin diseases. Thus, the topic of the Thesis is of high relevance.

<u>A summary of the contributions of the thesis</u>

The candidate has developed an automatic system, which for a given fingerprint sample, is able to:

- detect skin diseases.
- provide an exact damage area.
- determine which kind of damage is present in the sample.

Traditional machine learning algorithms based on texture analysis were used to achieve these goals.

<u>Novelty and significance:</u>

Whereas there is plenty of research dealing with healthy fingerprints, limited efforts have been directed so far to the analysis and processing of damaged fingerprints. Thus, this is a novel work with a promising potential to be further developed and cited in the community. Given the shortage in the amount of data available for this task, there is still need for further research into this topic before it can be transferred to industrial applications. However, the candidate addresses this point in the future work with an item referring to the generation of synthetic data in order to develop further approaches.

Evaluation of the formal aspects of the thesis:

The Thesis is well written, with a good introduction and review of the state of the art in fingerprint recognition. This serves as motivation for the work carried out during the PhD. The proposed algorithms are clearly differentiated from the current state of the art, and the candidate provides clear descriptions and reasoning of the choices made. The experimental evaluation is also solid, with the only drawback of dealing with a database of a reduced size. But again, these data being personal data and also related to diseases, there is no larger dataset available that the candidate could have been used.

I would only have one editorial comment: please use ISO standardized terminology throughout the manuscript (e.g. fingerprint matching has been deprecated in favour of fingerprint comparison, in order to avoid ambiguities).

Quality of publications

The Thesis has led to the publication of two journal articles in Q2 and a journal article in Q4. Furthermore, two other contributions have been submitted to top journals (IEEE TPAMI and IEEE TBIOM) in the area. This meets good quality standards in the community.

II. Student's overall achievements

Overall R&D activities evaluation:

The student's thesis and the results included into it indicate that she is a person with scientific erudition and creative abilities.

III. Conclusion

The present Thesis meets the generally accepted requirements for the award of an academic degree. The candidate has defined the research questions in a clear manner, carried out a thorough review of the state of the art, and presented her new methods in this context. The experimental protocol and evaluation follow academic standards, and the results are correctly discussed.

Munich, 20.11.2023

Prof. Dr. Marta Gomez-Barrero