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Self-supervised Skin Lesion Screening in Dermatology Consultation

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Purpose

Early detection is essential for optimal survival of patients diagnosed with melanoma. To counteract the bottleneck of shortage of specialists and to enable at-risk patients to receive a faster consultation, an AI decision support tool is proposed. This will enable more efficient consultation, patients'risk assessment, and overall better treatment outcomes for patients.

Materials and Methods

During skin lesion screening, the dermatologists identify suspicious lesions or "ugly duckling"(UD) by direct comparison with all lesions on the same patient. This can be modeled as an outlier detection problem. Our dataset is composed by 90 high-resolution total-body images (TBI) acquired using Fotofinder© devices. For single lesion detection, a YOLOR architecture is trained on labeled patients in a supervised manner to automatically detect and extract all the lesions. The extracted lesions are then clustered in a self-supervised manner using DINO architecture. These embeddings are then used to find the outliers and potential UDs. The UD score for embedded lesion of a patient is calculated using the normalized cosine distance value from the average of his embedded lesions. The detection algorithm was trained in 15 labeled patients and tested on the dorsal region of 4 unseen patient images. For each of the 4 patients, the ten highest scoring lesions are presented. For validation these are compared against the top 4 UD by a pigmented lesion expert.

Results

Lesion detector achieved an average recall of 91% and precision of 88% with an IoU threshold of 0.5. The outlier selection and a 2D-tsne-representation of the embedded lesions show promising results and agreed with visual validation by a pigmented lesion expert.

Conclusion

An end-to-end DL pipeline for automatic lesion detection and self-supervised identification of "ugly ducklings"has been implemented and successfully tested on 4 unseen patients. Further clinical validation against expert's prediction is foreseen as well as implementation in routine consultation workflow.

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