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Diagnostic image analysis for risk assessment of skin cancer based on machine learning algorithms

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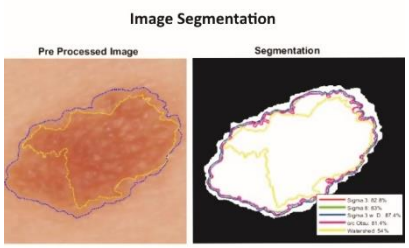
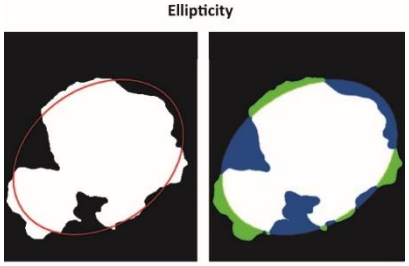
Dangerous skin diseases have seen a significant increase and are frequently fatal when left undetected. Early detection greatly increases the chance of survival. Machine learning and high performance mobile devices have made possible the development of systems for automatic risk assessment of suspicious skin alterations. At present, these systems are primarily expensive, professional ones used in specialised medical practices and hospitals. There is still huge potential for smartphone-based preliminary self-screening at home. The main goals of this thesis are: (1) a review of the current state of research, (2) creation of a database, (3) implementation of a software framework for automated classification of skin alterations (lesions), and finally (4) conception of a mobile application and development of a prototype.
One of the main challenges was the automatic segmentation of the images into lesion versus surrounding skin. Then, after segmentation, the most relevant features had to be extracted from the lesion images to train the classification algorithms. These features include aspects of symmetry, color and geometry. A comprehensive, expandable data and software base for automatic skin cancer detection was developed for the classification. Of the 4858 clinically classified images of skin changes, 3185 were automatically segmented. These images were then used as training data for three different machine learning approaches to distinguish between dangerous and harmless lesions. Of the three approaches, the artificial neural network showed the best results for melanomas (86.2% accuracy, 85.3% sensitivity, and 86.6% specificity for photographic images) and other types of skin cancer. Based on the developed software framework a prototype for a mobile application was developed.
With further improvements in image segmentation methods, as well as image preprocessing (e.g., digital removal of hair), a larger part of the data could be used. Coupled with optimisations of feature extraction, the accuracy of classification with machine learning could be further improved.



Implemented segmentation methods compared to a professionally pre-segmented image (white area in the right image).



For every image over 40 features are calculated, one of which is the ellipticity of the lesion.