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Detection of Diabetic Foot Ulcers Using SVM Based Classification

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Title:
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Abstract:
Diabetic foot ulcers represent a significant health issue, for both patients' quality of life and healthcare system costs. Currently, wound care is mainly based on visual assessment of wound size, which suffers from lack of accuracy and consistency. Hence, a more quantitative and computer-based method is needed. Supervised machine learning based object recognition is an attractive option, using training sample images with boundaries labeled by experienced clinicians.

We use forty sample images collected from the UMASS Wound Clinic by tracking 8 subjects over 6 months with a smartphone camera. To maintain a consistent imaging environment and facilitate the capture process for patients with limited mobility, an image capture box was designed with two right angled front surface mirrors and LED lighting.

We developed a novel foot ulcer recognition system using these sample images as our test data. Instead of operating at the pixel level, we use super-pixels, resulting from the quick shift algorithm, as the basic processing units. Then a support vector machine (SVM) based classifier is trained on the Bag-of-Words histogram representation of local Scale-Invariant Feature Transform (SIFT) features found in each super-pixel. As this classifier is very specific and the resulting histogram is very sparse, we merge the histograms from super-pixels in a size-specified neighborhood into one instance. Finally, to recover more precise boundaries of the foot ulcers, we apply conditional random field techniques to introduce new constraints that allow us to reduce misclassifications that occur near the edges of objects.

Experimental results show that our method provides promising recognition results, outperforming the regular SVM-based classification as well as the sliding window based object recognition method when evaluated using the Matthew correlation coefficient (MCC). We are integrating these algorithms into the wound assessment module of our Android phone-based diabetic self-management app.