Early Stage Malignant Melanoma Detection Using Morphological Features

Project Team

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Project Description

Although less common than other skin cancers, melanoma is the most deadly variety causing the majority of skin cancer related deaths globally [3]. Most cases are curable if detected early and several reliable and standardized screening techniques have been developed to improve the early detection rate [1], [2]. Such screening techniques have proven useful in clinical settings for screening individuals with a high risk for melanoma, but there is considerable debate on their utility among large populations due to the high workload on dermatologists [3]. This project will develop an application for mobile phones to provide a pre-screening of individuals in the general population to help assess their risk. No computer application can provide a concrete diagnosis, but it can help inform the individual and raise the general awareness of this dangerous disease.

Melanoma develops in the *melanocyte* skin cells responsible for producing the pigment *melanin* which gives the skin, hair, and eyes their colors. Early stages of the cancer present themselves as irregular skin blemishes. Detection algorithms for early stage melanoma use the morphological characteristics of those skin blemishes to classify risk levels. The most established method to date is the "ABCD" method initially introduced in 1994 [1]. Skin blemishes are ranked based on asymmetry, irregular borders, color variation, and diameter. Each of these morphological features has a standardized score and an overall risk score is calculated using a mathematical formula. The mobile phone application will take an image of an individual's skin and calculate and report the standardized ABCD test score.

The proposed algorithm for the mobile phone application will first identify and localize skin blemishes in a larger skin image using the Difference-of-Gaussians (DoG) and support-vector machine (SVM) detector in [4]. Once localized, the border of each skin blemish will be determined using a principle component analysis (PCM) in the CIE XYZ color space introduced in [5]. After border detection is performed asymmetry and border irregularity can be computed directly. Color variation will be performed on the Y (luminance) axis of the CIE XYZ color space using threshold sets. Diameter will be inferred based on a requested imaging distance or a calibration chess board placed in the image scene.

Mobile Platform

The ABCD score calculation algorithm will be implemented on an Android-based mobile platform. Likely candidates are the Samsung Galaxy Tab and the Motorola Xoom.

References

1. Stolz W, Riemann A, Cognetta AB. ABCD rule of dermatoscopy: a new practical method for early recognition of malignant melanoma. *Eur J Deratol* 1994; 4:521-7
2. G. Argenziano, C. Catricala, M. Ardigo, P. Buccini, P. De Simone, L. Eibenschutz, A. Ferrari, G. Mariani, V. Silipo, I. Sperduti, I. Zalaudek. Seven-point Checklist of Dermoscopy Revisited. *The British Journal of Dermatology* 2011; 164(4):785-790
3. Parkin D, Bray F, Ferlay J, Pisani P. Global cancer statistics, 2002. *CA Cancer J Clin* 2005; 55(2):74-108
4. T. Cho, W. Freeman, H. Tsao. A reliable skin mole localization scheme. IEEE 11th International Conference on Computer Vision, 2007. Oct. 2007.
5. Schmid-Saugeon P, Guillod J, Thiran JP. Towards a computer-aided diagnosis system for pigmented skin lesions. *Computerized Medical Imaging and Graphics* 2003. 27(1);65-78