Melanoma Detection as a Problem of Visual Recognition

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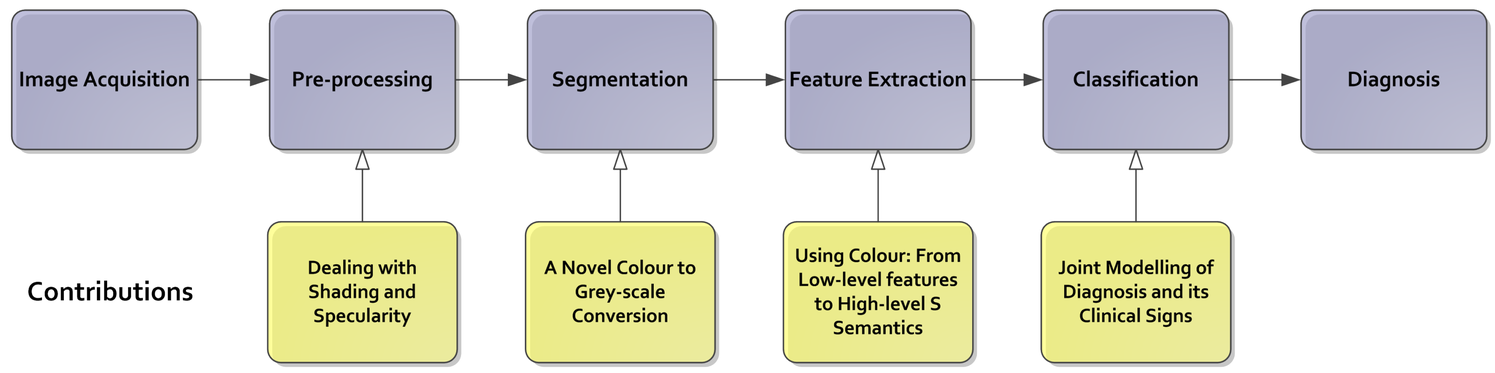
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Abstract

- As the incidence of skin cancer rises worldwide, the demand for computer-aided diagnosis of skin disease increases.
- Advances in imaging technology and image processing, have expanded the repertoire of diagnosis via image analysis; a task similar to visual recognition from static images in computer vision.
- The latter has significantly improved lately. We take inspiration from this progress and aim to transfer domain experience for further improving computerized image analysis of skin lesions.

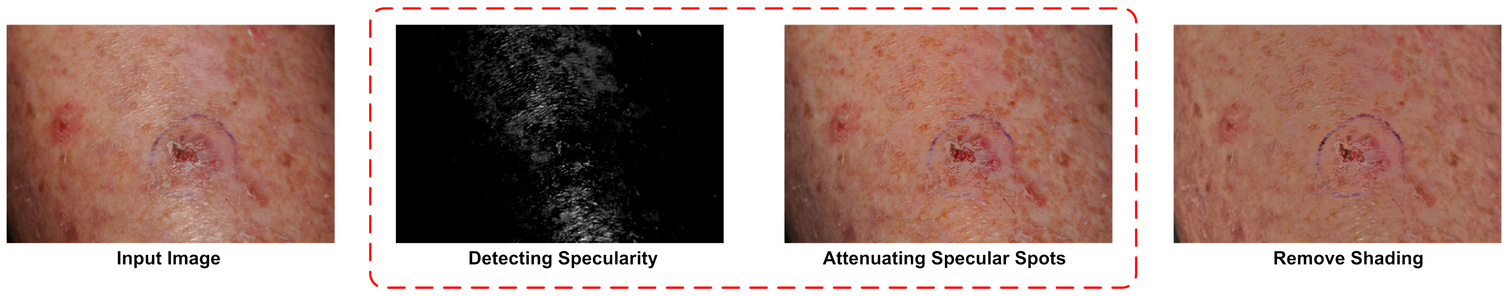
Early Detection of Melanoma

- Early detection of malignant melanoma is crucial as it would drastically change the patient's prognosis for greater survival. Unfortunately, clinical diagnosis is difficult, even for experienced dermatologists (mainly due to subjectivity of visual interpretation, and especially for clinically equivocal pigmented lesions).



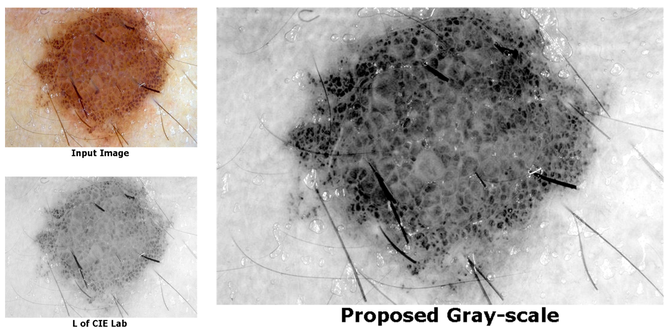
Pre-processing

- Dealing with shading and specularity in dermatological images.



Segmentation

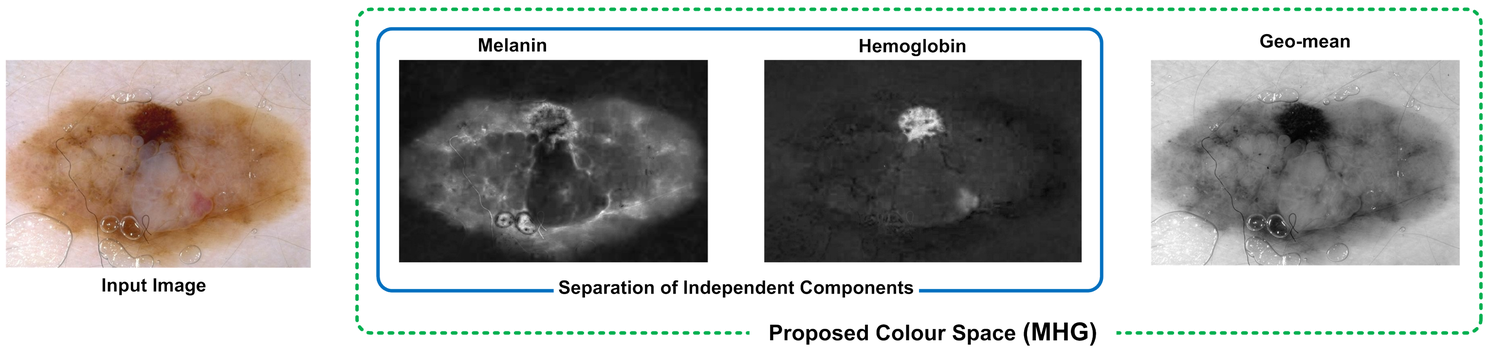
- A novel greyscale conversion.



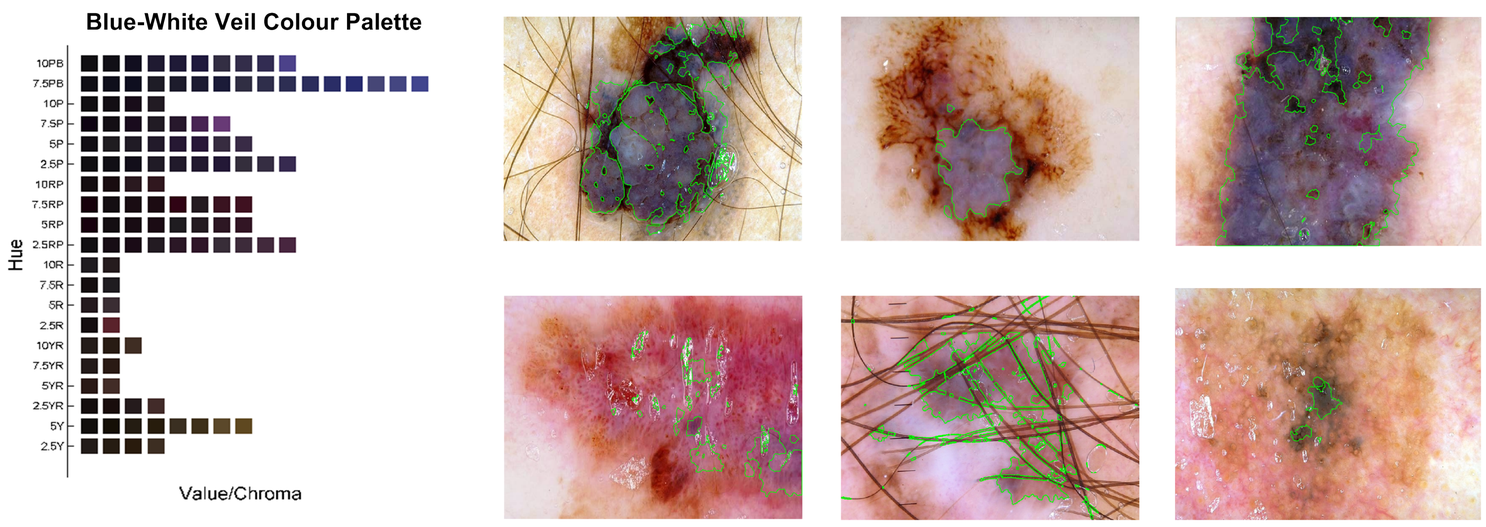
Feature Extraction

- Low-level – A bio-inspired colour representation for dermoscopy images

1: $R_k(x,y) = \omega(x,y) \int E(x,y,\lambda_k) S(x,y,\lambda_k) Q_k(\lambda) d\lambda$ where k indexes R,G,B channels.
2: $c_k(x,y) = R_k(x,y)/\mu(x,y)$ where $\mu(x,y) = (\prod_{k=1}^{3} R_k)^{\frac{1}{3}}$.
3: $\psi_k(x,y) \equiv \log c_k(x,y) = -\rho_m(x,y)(m_k - m_p) - \rho_h(x,y)(h_k - h_p) + w_k - (e_k - e_p)(1/T)$.
4: $\boldsymbol{\phi} = \mathbf{U}^T \boldsymbol{\psi}$ where $\mathbf{U}$ is any 3×2 transformation matrix onto 2-D plane $\perp (1,1,1)$.
5: Run ICA on the 2-D plane $(\boldsymbol{\phi} - \bar{\boldsymbol{\phi}})$ to find independent components.

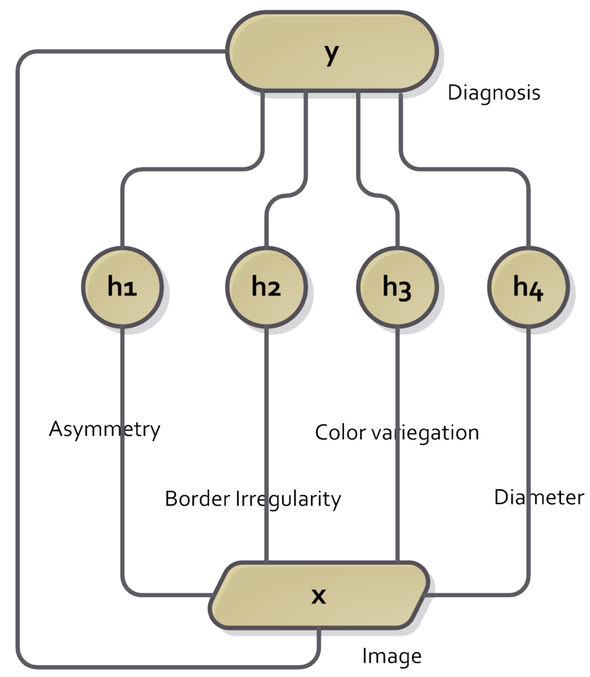


- High-level Semantics – Detection of Blue-white Veil pattern



Classification

- Joint Modelling of Diagnosis and its Clinical Signs (Latent SVM)



$$f_{\mathbf{w}}(\mathbf{x}, y) = \max_{\mathbf{h}} \mathbf{w}^T \phi(\mathbf{x}, \mathbf{h}, y)$$
$$y^* = \arg\max_y f_w(\mathbf{x}, y)$$
$$\mathbf{w}^T \phi(\mathbf{x}, \mathbf{h}, y) =$$
$$\mathbf{w}_y^T \varphi(\mathbf{x}) + \sum_j \mathbf{w}_{h_j}^T \theta_j(\mathbf{x}) + \sum_j v_{y,h_j}$$

- Global model: $\mathbf{w}_y^T \varphi(\mathbf{x})$
- Attribute model: $\mathbf{w}_{h_j}^T \theta_j(\mathbf{x})$
- Prior: v_{y,h_j}