Non-invasive Autonomous Anemia Screening Using Conjunctival Images

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Anemia is a common disease that affects 24% of the world population. The standard practice for diagnosis of anemia requires blood analysis, which is invasive and time-consuming. Physicians often use paleness of a patient's conjunctiva to pre-screen and to prescribe a blood test if necessary. However, a study showed that even trained physicians can only achieve 66% pre-screening accuracy. In this research, we develop an autonomous, non-invasive, and high-accuracy anemia pre-screening system using conjunctiva images and machine learning techniques. Specifically, five conjunctiva images from each of the left and the right eye of 55 adults, of which 26 have anemia, were taken. A total of 550 conjunctiva images were used for training and testing. We trained a TernausNet model to automatically detect the palpebral conjunctiva region from an input image. Experimental results showed that the trained detector achieved a 0.903 IoU accuracy. We also compared the k-nearest neighbor (k-NN) and the support vector machine (SVM) supervised learning models for the classification of the extracted palpebral conjunctiva region images. A 10-tuple vector computed from the HSV distribution of the palpebral image was used as a feature for classification. Experimental results showed that when using a 3-NN classifier, along with a multi-image decision criterion, anemia pre-screening accuracy of 0.891 with low false positive (0.138) and low false negative (0.077) rates is achieved. Similar high accuracy is achieved for both male and female groups. This research enabled an efficient conjunctiva-based anemia screening method, for which an anemia screening sensor can be developed.

Awards Won:

Association for the Advancement of Artificial Intelligence: Honorable Mention