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Examining palpebral conjunctiva for anemia assessment with image processing methods

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Abstract

Examining the hemoglobin level of blood is an important way to achieve the diagnosis of anemia, but it requires blood drawing and blood test. Examining the color distribution of palpebral conjunctiva is a standard procedure of anemia diagnosis, which requires no blood test. However, since color perception is not always consistent among different people, we attempt to imitate the way of physical examination of palpebral conjunctiva to detect anemia, so that computers can identify anemia patients automatically in a consolidated manner for a screening process. In this paper we propose two algorithms for anemia diagnosis. The first algorithm is intended to be simple and fast, while the second one to be more sophisticated and robust, providing an option for different applications. The first algorithm consists of a simple two-stage classifier. In the first stage, we use a thresholding decision technique based on a feature called high hue rate (HHR) (extracted from the HSI color space). In the second stage, a feature called pixel value in the middle (PVM) (extracted from the RGB color space) is proposed, followed by the use of a minimum distance classifier based on Mahalanobis distance. In the second algorithm, we consider 18 possible features, including a newly added entropy feature, some improved features from the first algorithm, and 13 features proposed in a previous work. We use correlation and simple statistics to select 3 relatively independent features (entropy, binarization of HHR, and PVM of G component) for classification using a support vector machine or an artificial neural network. Finally, we evaluate the classification performance of the proposed algorithms in terms of sensitivity, specificity, and Kappa value. The experimental results show relatively good performance and prove the feasibility of our attempt, which may encourage more follow-up study in the future.

Keywords: Anemia; Images of Palpebral Conjunctiva; Color and Texture Features; Support Vector Machine; Artificial Neural Network.

1. Introduction

Iron deficiency anemia is the most common type of anemia. The prevalence of anemia, defined by low hemoglobin (Hb), is commonly used to assess the severity of iron deficiency in a

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