A Discussion of Anemia Evaluation Method Using Eyelid Conjunctival Images

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***Abstract*—This paper discusses eyelid conjunctival regions that are useful for estimating anemia and a method for automatically extracting them from eyelid conjunctival images.**

Keywords—anemia evaluation, eyelid conjunctival images, hemoglobin concentration, region detection, machine learning

I. Introduction

In this study, we focus on the fact that physicians diagnose anemia using color observations of the eyelid conjunctiva. This paper discusses an evaluation method for estimating anemia status using machine learning and a reliable extraction method of eyelid conjunctiva regions for this purpose.

II. Eyelid Conjunctiva Extraction Experiment

A. Experimental Data Set

In the experiment, facial images and blood test data from 90 subjects at Fujita Health University were used in the study. The standard value of hemoglobin concentration was set at 11.6~14.8 g/dl.

B. Extraction Method

The face image shown in Fig 1(a) was used as input, and the eye region image shown in Fig 1(b) was output using Open-CV's cascade classifier for eye region detection. The eye area was detected using the detectMultiScale function with scaleFactor=1.02 and minNeighbors=8. Next, HSV thresholds were set for the eye area at the top, center, and outer corner of the eye, and the eyelid conjunctiva area shown in Fig. 1(c) was extracted.

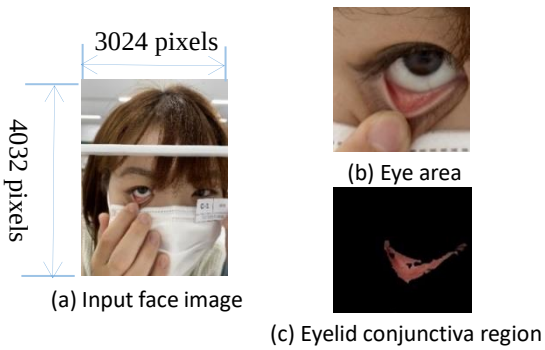

Fig 1 Eyelid Conjunctiva Extraction Flow

III. Anemia Evaluation Experiment

A. Experimental Data Set

In the machine learning process, the eyelid conjunctiva region shown in Fig 1(c) and the eyelid conjunctiva divided into three regions (the inner, middle, and outer corner of the eye) were set as the analysis regions. The data set was created by labeling the images of the eyelid conjunctiva region and the hemoglobin concentration values shown in Fig 1(c). Similarly, these three regions and hemoglobin concentration values were labeled to create a dataset. Machine learning was performed using 80% of the data as training data and 20% of the data as evaluation data.

B. Evaluation Method

Given a face image, the system outputs the predicted hemoglobin concentration values using a trained model. Based on the reference value, the output values are classified as being in the excess, standard, or anemic range. Similarly, the true hemoglobin concentration values for a given face image are classified. Both classifications were compared to determine the accuracy of the estimation of anemia status. If the analyzed region was the eyelid conjunctiva region, the percentage of correct answers for each hemoglobin concentration classification was output as a result.

IV. Discussions and Conclusion

The results of an experiment in which the eyelid conjunctiva region was divided into three separate regions showed a difference in the percentage of correct responses in each region. This indicates that some areas are more sensitive to the hemoglobin level than others. Therefore, finding appropriate regions is expected to improve the accuracy rate of anemia status estimation.

In the future, it is necessary to collect anemic data, for which the number of data is extremely small. In addition, we plan to improve the extraction method of eye regions, and to improve the threshold setting of HSV value so that it can be set according to the image.

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