

KLASIFIKASI *DIABETIC RETINOPATHY* BERBASIS CITRA FUNDUS MENGUNAKAN SVM BERDASARKAN *RED LESIONS*

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ABSTRAK

Diabetic Retinopathy (DR) merupakan komplikasi diabetes yang dapat menyebabkan gangguan penglihatan hingga kebutaan apabila tidak terdeteksi secara dini. Proses identifikasi manual citra fundus retina membutuhkan ketelitian tinggi sehingga diperlukan sistem klasifikasi otomatis. Penelitian ini bertujuan membangun sistem klasifikasi citra fundus retina menggunakan metode *Support Vector Machine* (SVM) berbasis ekstraksi fitur citra. Tahapan penelitian meliputi *preprocessing* citra, segmentasi pembuluh darah, *haemorrhage*, dan *microaneurysm*, kemudian dilanjutkan ekstraksi fitur menggunakan *Fractal Dimension*, fitur geometri, dan *Gray Level Co-occurrence Matrix* (GLCM). Fitur yang diperoleh digunakan sebagai input pada proses klasifikasi menggunakan SVM dengan variasi kernel linear, *Radial Basis Function* (RBF), dan *polynomial*. Pengujian dilakukan dengan beberapa variasi pembagian data training dan testing serta parameter C dan *degree* untuk memperoleh model terbaik. Hasil penelitian menunjukkan bahwa sistem mampu melakukan klasifikasi citra retina dengan baik. Berdasarkan evaluasi *confusion matrix* agregasi diperoleh nilai *accuracy* sebesar 76.6%, *precision* sebesar 79%, *recall* sebesar 83.33%, dan *F1-score* sebesar 81.05%. Sistem juga berhasil diimplementasikan dalam bentuk aplikasi berbasis web menggunakan Flask yang menampilkan hasil klasifikasi, nilai *confidence*, serta visualisasi hasil pengolahan citra. Hasil penelitian menunjukkan bahwa metode SVM dengan kombinasi ekstraksi fitur citra dapat digunakan untuk membantu proses klasifikasi citra fundus retina secara otomatis.

Kata kunci: *Diabetic Retinopathy*, Fundus Retina, *Support Vector Machine*, GLCM, *Fractal Dimension*.

DIABETIC RETINOPATHY CLASSIFICATION BASED ON FUNDUS IMAGES USING SVM BASED ON RED LESIONS

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ABSTRACT

Diabetic Retinopathy (DR) is a complication of diabetes that can lead to visual impairment and even blindness if not detected early. The manual identification process of retinal fundus images requires high precision, making an automatic classification system necessary. This study aims to develop a retinal fundus image classification system using the Support Vector Machine (SVM) method based on image feature extraction. The research stages include image preprocessing, segmentation of blood vessels, haemorrhages, and microaneurysms, followed by feature extraction using Fractal Dimension, geometric features, and Gray Level Co-occurrence Matrix (GLCM). The extracted features were used as input for the classification process using SVM with variations of linear, Radial Basis Function (RBF), and polynomial kernels. Testing was conducted with various training and testing data splits, as well as variations in the parameters C and degree, to obtain the best model. The results showed that the system is capable of classifying retinal images effectively. Based on the aggregated confusion matrix evaluation, the system achieved an accuracy of 76.6%, precision of 79%, recall of 83.33%, and an $F1$ -score of 81.05%. The system was also successfully implemented as a web-based application using Flask, displaying the classification results, confidence values, and visualization of the image processing outcomes. These findings indicate that the SVM method combined with image feature extraction can be utilized to assist the automatic classification of retinal fundus images.

Keywords: *Diabetic Retinopathy, Retinal Fundus, Support Vector Machine, GLCM, Fractal Dimension.*