

**AUTOMATIC EXUDATE DETECTION FROM NON DILATED DIABETIC RETINOPATHY  
RETINAL IMAGES USING FUZZY C-MEANS CLUSTERING**

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Diabetic retinopathy eye diseases are the main cause of vision loss and their prevalence is set to continue rising. The screening of diabetic patients for the development of diabetic retinopathy can potentially reduce the risk of blindness in these patients. Early detection enables laser therapy to be performed to prevent or delay visual loss and may be used to encourage improvement in diabetic control.

Current methods of detection and assessment of diabetic retinopathy are manual, expensive and require trained ophthalmologists. Automatic exudates detection would be helpful for diabetic retinopathy screening process. Exudates are the primary sign of Diabetic Retinopathy. Many techniques have been performed for exudate detection, but they have limitations like poor quality, intensive computer power for training and classification, dilation of pupil etc.,

Early detection can potentially reduce the risk of blindness. An automatic method to detect exudates from low contrast digital images of retinopathy patients with non-dilated pupils using a Fuzzy C-Means (FCM) clustering is proposed. Contrast enhancement pre-processing is applied before four features, namely intensity, standard deviation on intensity, hue and a number of edge pixels, are extracted to supply as input parameters to coarse segmentation using FCM clustering method. The first result is then fine-tuned with morphological techniques. The detection results are validated by comparing with expert ophthalmologists' hand-drawn ground-truths. Sensitivity, specificity, positive predictive value (PPV), positive likelihood ratio (PLR) and accuracy are used to evaluate overall performance. It is found that the proposed method detects exudates successfully with sensitivity, specificity, PPV, PLR and accuracy of 87.28%, 99.24%, 42.77%, 224.26 and 99.11%, respectively.