**Diabetic Retinopathy Detection Based on Deep Convolutional Neural Networks**

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**Introduction**

Diabetic retinopathy (DR) is an eye disease associated with long-standing diabetes. Early works on DR detection rely on the design of handcrafted features, which tends to be complicated [1]. Recently, CNN-based methods have significantly improved the DR detection accuracy [2][3].

**Proposed Framework**

**Image Enhancement**

The formulation of the classic linear unsharp masking (UM) is given by:

\[ g(n, m) = x(n, m) + \kappa I(n, m) \]  

(1)

We implement \( g(n, m) \) as:

\[ g(n, m) = 4[G(n, m, \sigma) \ast (x(n, m) - x(n, m))] \]  

(2)

where \( G(n, m, \sigma) \) is a Gaussian filter with \( \sigma \) equals to \( \sqrt{\frac{r}{2}} \), \( r \) is the radius of ROI of the fundus image, \( \ast \) denotes the convolution operator, and \( \lambda \) is set to 4.

**Post-prediction:**

Five probability values are extracted from the softmax layer and summed up according to the following formula:

\[ y_{pp}(i, j) = p_0(i, j) + p_1(i, j) + p_2(i, j) + p_3(i, j) + p_4(i, j) \]  

(3)

where \( y_{pp} \) is the post-prediction value, \( p_0, p_1, p_2, p_3, \) and \( p_4 \) are the probabilities of normal, mild, moderate, severe, and proliferative DR. Then, we can decide new thresholds according to our objective function, such as quadratic weighted kappa which is more flexible than fine-tuning.

**Experiment**

We evaluate the proposed framework on two public datasets: EyePACS and Messidor and utilize five metrics as listed in Table 2 to evaluate the performance of our proposed framework.

- Table 3 shows the results of six methods to further boost the recognition accuracy.
- Table 4 compares the results of our method with previous works on the Messidor dataset.
- Table 5 shows the comparison results of model complexity.

**Conclusion**

We present a framework based on DCNN for the DR detection. Along with six useful methods, the proposed framework achieves 0.959 and 0.965 AUC for DR and RDR cases on the Messidor dataset which outperform state of the art (0.921 and 0.957) [3]. Furthermore, we are able to achieve this performance with a lightweight model. Compared with CKML Net [2], VNNK [2], and Zoom-in-Net [3], SI2DRNet-v1 is more memory efficient with at least 5.26x fewer in total parameters and requires lower computation cost with at least 1.24x fewer in total FLOPs.

**References (Partial)**


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