# Diabetic Retinopathy Detection through Image Analysis Using Deep Convolutional Neural Networks

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## Introduction

Diabetic Retinopathy (DR) is a leading disabling chronic disease and one of the main causes of blindness and visual impairment in developed countries for diabetic patients. Ninety percent of the cases can be prevented through early detection and treatment. Eye screening through retinal images is used by physicians to detect the lesions related with this disease.

## Data

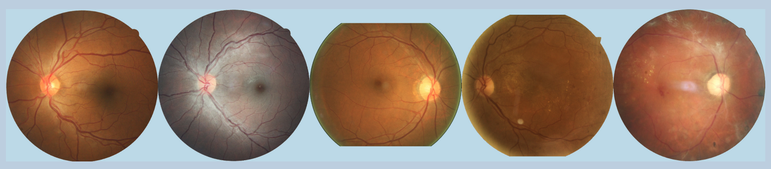

**Figure 1:** Five classes to predict. Class 0 (no apparent retinopathy), Class 1 (Mild), Class 2 (Moderate),Class 3 (Severe), Class 4 (Proliferative).

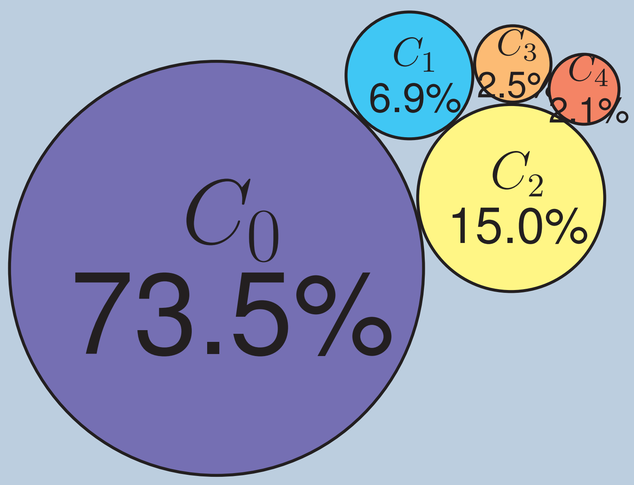


**Figure 2:** Class distribution of the dataset

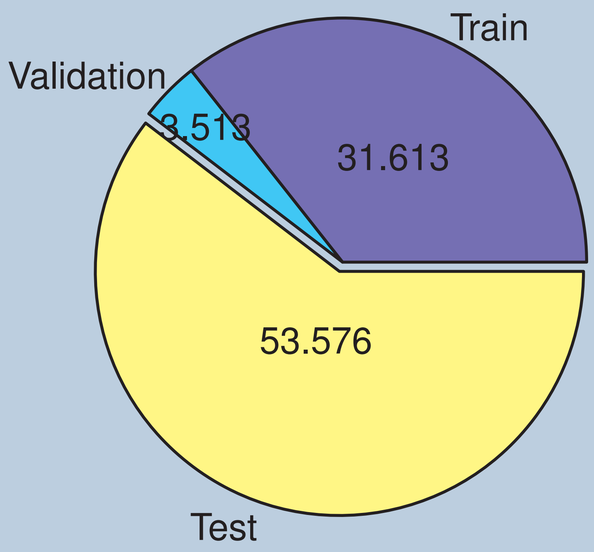


**Figure 3:** Training, Validation and Testing sets

## Conclusions

In this paper we show that deep learning techniques are a promising technique for solving medical imaging problems like the diabetic retinopathy detection. Having enough data this method is able to perform near human level expertise achieving $\kappa$ values of 0.752 not far from the $\kappa$ achieved by human experts, around 0.800.

## Forthcomming research

Future work will be centered on testing higher resolution input images, newer schemes, alternative cost functions and more elaborated methods for combining the information coming from both eyes.

## Train

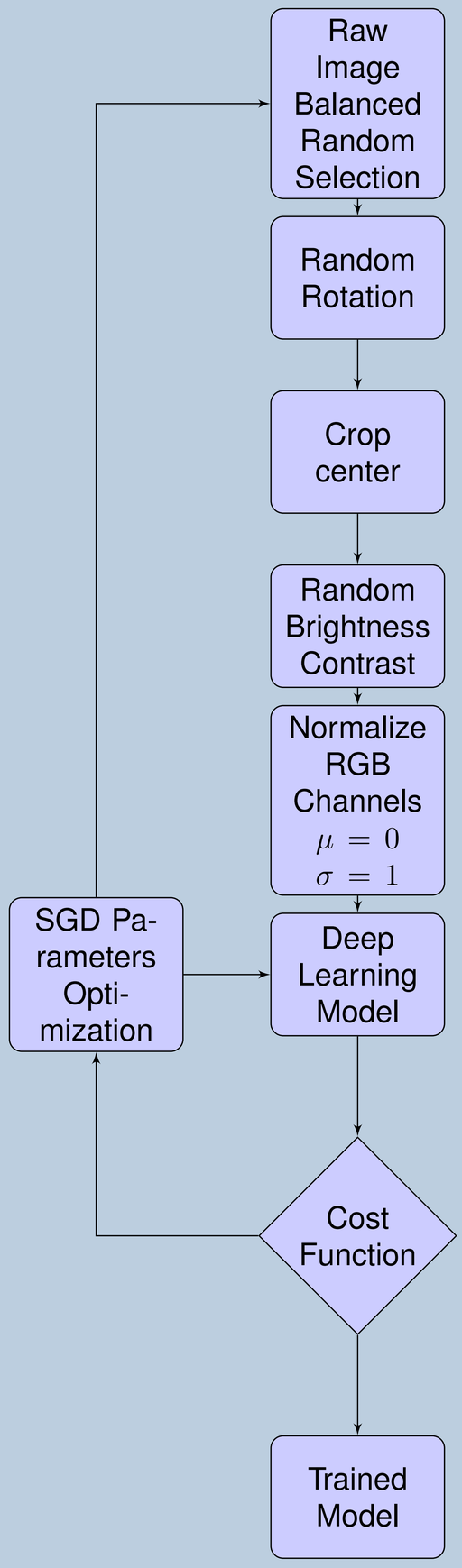


**Figure 4:** Training procedure: online data augmentation plus model optimization

## Best Model

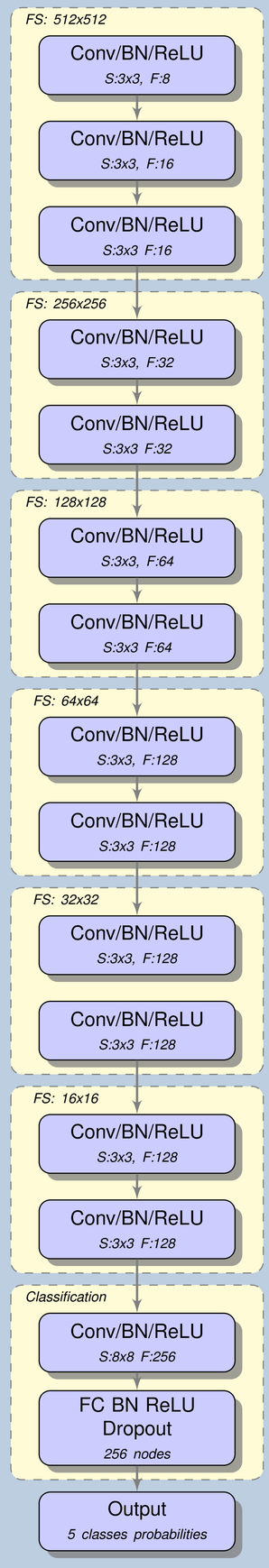


**Figure 5:** Architecture of the model with best performance

## Test

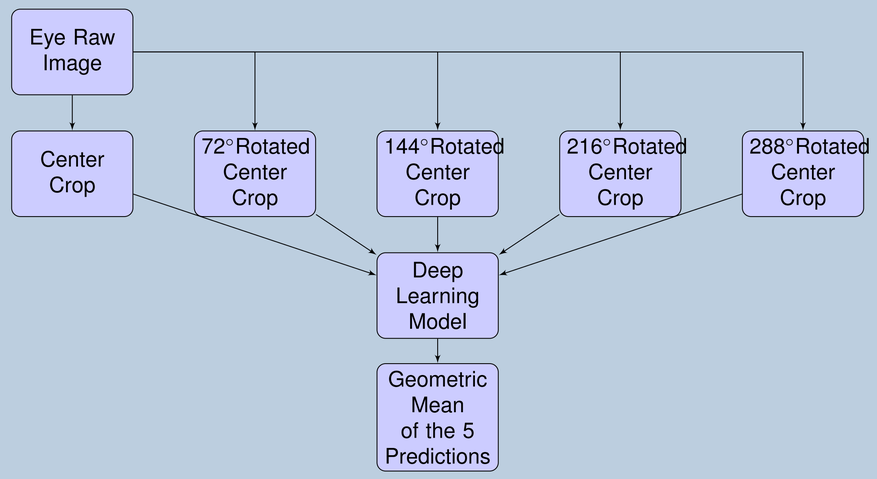


**Figure 6:** Geometric mean of five evaluations of the same rotated image

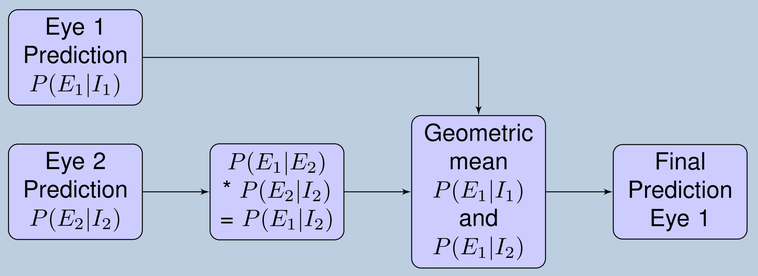


**Figure 7:** Method for combining the information coming from both eyes to improve the classification