

Title: Bayesian Optimized Machine Learning Model for Automated Eye Disease Classification from Fundus Images

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Abstract: Eye diseases are defined as disorders or diseases that damage the tissue and related parts of the eyes. They appear in various types and can be either minor, meaning that they do not last long, or permanent blindness. Cataracts, glaucoma, and diabetic retinopathy are all eye illnesses that can cause vision loss if not discovered and treated early on. Automated classification of these diseases from fundus images can empower quicker diagnoses and interventions. Our research aims to create a robust model, BayeSVM500, for eye disease classification to enhance medical technology and improve patient outcomes. In this study, we develop models to classify images accurately. We start by preprocessing fundus images using contrast enhancement, normalization, and resizing. We then leverage several state-of-the-art deep convolutional neural network pre-trained models, including VGG16, VGG19, ResNet50, EfficientNet, and DenseNet, to extract deep features. To reduce feature dimensionality, we employ techniques such as principal component analysis, feature agglomeration, correlation analysis, variance thresholding, and feature importance rankings. Using these refined features, we train various traditional machine learning models as well as ensemble methods. Our best model, named BayeSVM500, is a Support Vector Machine classifier trained on EfficientNet features reduced to 500 dimensions via PCA, achieving $93.65 \pm 1.05\%$ accuracy. Bayesian hyperparameter optimization further improved performance to $95.33 \pm 0.60\%$. Through comprehensive feature engineering and model optimization, we demonstrate highly accurate eye disease classification from fundus images, comparable to or superior to previous benchmarks.

Keywords: eye disease; machine learning; principal component analysis; Bayesian optimization

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