DIABETIC RETINOPATHY DETECTION

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1. Introduction

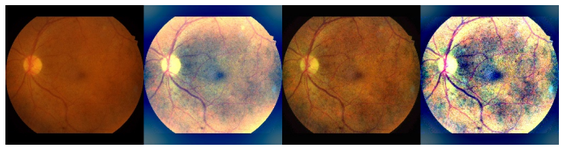
- Diabetic retinopathy is an eye disease, in which damage occurs to the retina due to diabetes.
- Diabetic Retinopathy Classification is to predict, based on fundus images, whether a patient has non-referable (NRDR) or referable diabetic retinopathy (RDR).

2. Input Pipeline

- Images are cropped to the size of fundus and resized to 256x256 pixels.
- The labels 0 to 2 are assigned to NRDR (label:0).
- The labels 3 and 4 are assigned to RDR (label:1).
- Resampling the minority class to prevent data imbalance.

3. Image Processing

- Different types of image processing methods were tested.
- This helped us to improve the accuracy and to produce consistent results.
- **Ben Graham's processing method** Subtract the local average color of the image .
- **CLAHE** : Clahe stands for Contrast Limited Adaptive Histogram Equalization.
- CLAHE improved the local contrast of the image but has a tendency to amplify the noise.



Models	Original Images	Ben's Images
CNN	11.24	2.42
CNN-SE	6.13	4.74
DenseNet	2.89	0.65

Tabelle 1: *Variance of Accuracies from 10 runs*

4. Models and Training

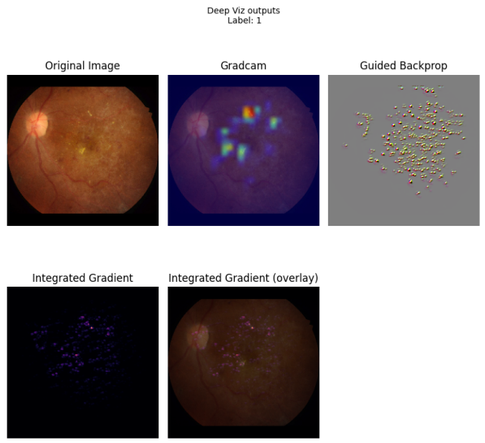
- 2 Custom models and 3 transfer learning models were trained.
- Custom CNN and CNN with Squeeze and Excitation Blocks are trained.
- The Custom models are compact but undergo extensive training iteration.
- Transfer learning models are larger but demand fewer training steps.
- Adam optimizer with L1 and L2 regularization.
- Grid search hyperparameter optimization.
- Ensemble learning using 5 architectures.
- Soft voting and hard voting ensemble methods were tested.

5. Results

Models	Balanced Accuracy	Unbalanced Accuracy
CNN	11.24	2.42
CNN-SE	6.13	4.74
DenseNet	2.89	0.65
InceptionV3	2.89	0.65
InceptionResnet	2.89	0.65

Tabelle 2: *Best Accuracies from 10 runs are shown in the table.*

6. Deep Visualization



- Different Deep Vizualization methods are implemented.
- **GradCAM** highlights the important regions in an image based on gradient information.
- **Integrated gradients** attributes importance to each pixel by integrating the gradients along entire input space.
- **Guided Backpropagation** emphasizes the contributions by backpropagating only the positive gradients.

7. Conclusions

Image Preprocessing

- Training with **Bens Processing** reduced the variance in accuracy significantly and thereby it was better in reproducibility.
- Training custom models with **original images** gave the highest accuracies around 90% .

Architecture

- **Custom models** provides higher accuracies but lower reproducibility.
- **Transfer learning models** provides consistent results but with lower accuracies compared to custom models.

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