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Inception Separable CNN for Retinal Disease Classification

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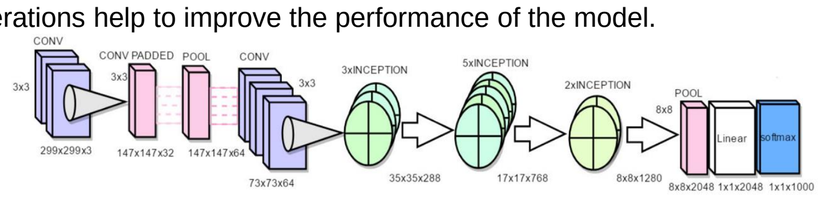
Abstract

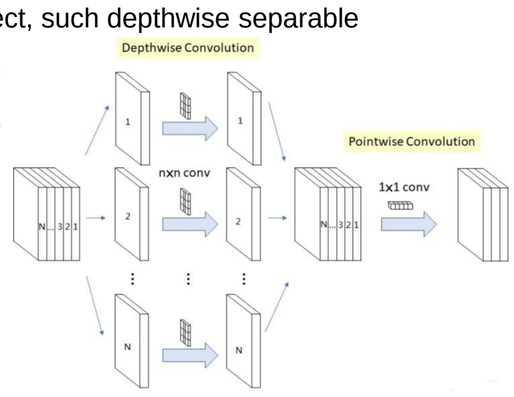
Retinal diseases have significant impact on vision health and need to be recognized in time for more effective treatment, artificial recognition of retinal disease is not efficient and accurate. Therefore, this project aims to develop a retinal disease classification model which combines the Inception model and separable convolutional neural network (CNN) architectures. In this project, cataract, diabetic retinopathy, glaucoma and normal retinal optical coherence tomography (OCT) images can be identified by the proposed model. Through iterative hyper-parameter tuning and model optimization, the proposed model accuracy is about 91.9%, and the validation loss is about 0.057. The average precision, recall rate and F1-score of the model reaches to 0.91. The project includes a graphical user interface (GUI) to improve user operability. Through these evaluation indicators, it shows that the proposed model can provide a better solution for the field of retinal disease classification.

Methodology

the proposed model also contains the relevant technology of Inception V3, which includes different scale Convolution kernels and pooling operations, and implements a similar operation of Depthwise Separable Convolution. These operations help to improve the performance of the model.

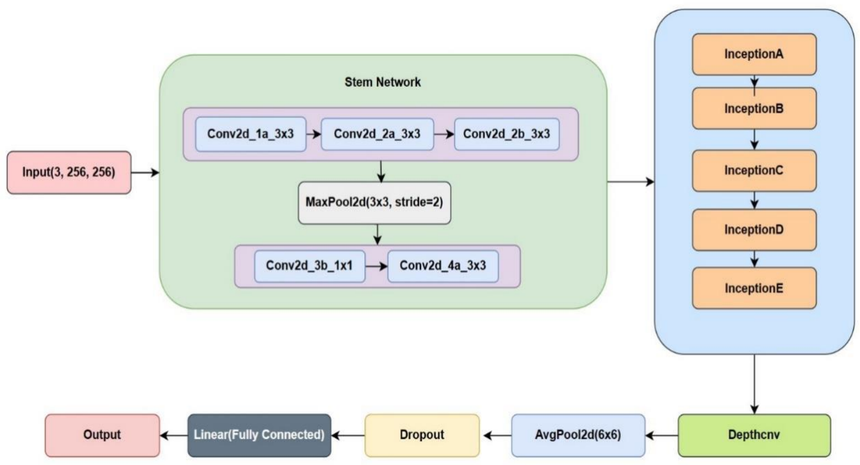


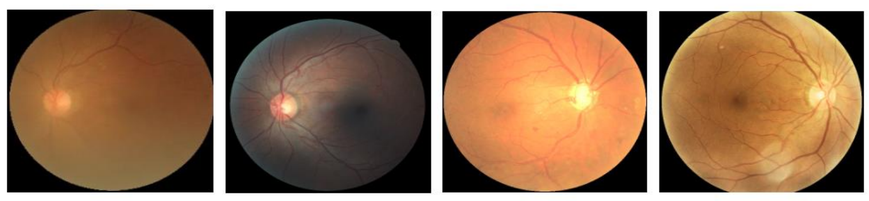
In the model proposed in this project, such depthwise separable convolutions are applied to certain branches in the Inception module, as well as in other convolutional layers. Firstly, the intermediate feature map is generated by the depth convolution, and then the information of each channel is fused by the pointwise convolution



Model Architecture

The overall structure of the model proposed in this project includes the Stem Network, multiple Inception modules, and the final fully connected layer. The Stem Network is responsible for the preliminary feature extraction and dimensionality reduction processing of the input image, including a series of convolutional layers and pooling operations. Inception module is the core part of the model, which is divided into five modules A, B, C, D and E. Each module extracts and combines features through different branch structures, and uses depthcnv class to realize depthwise separable convolutions to multi-scale extraction of features and parameter efficiency optimization.

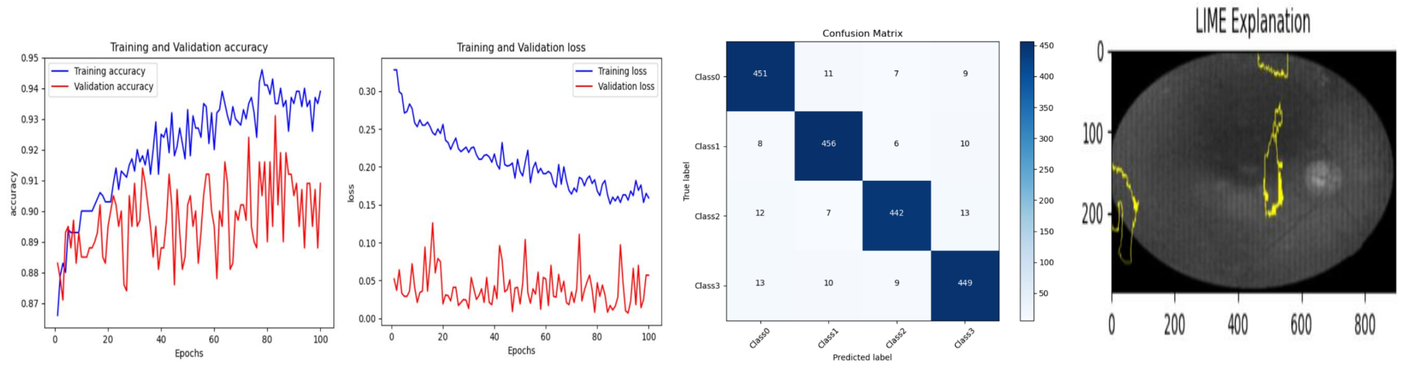




Cataract Diabetic retinopathy Glaucoma Nomal.

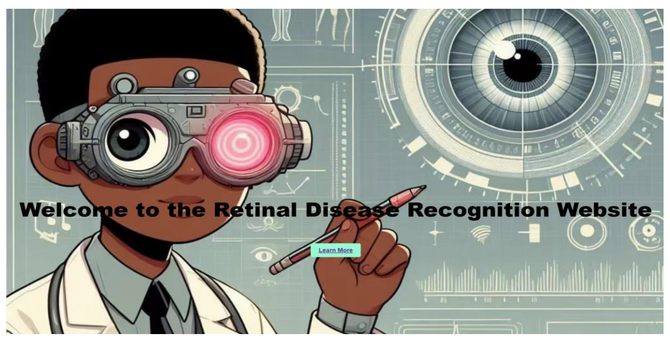
Results

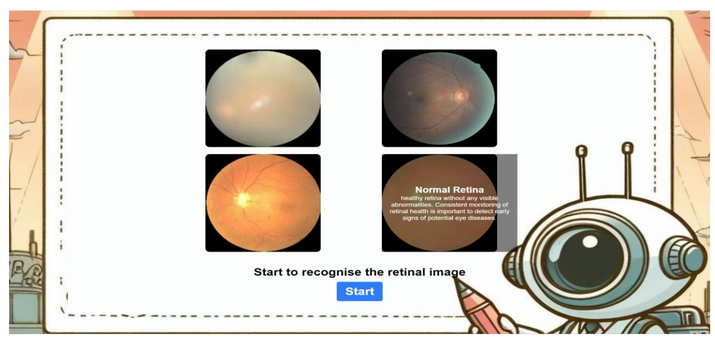
When batch size = 70 and epoch = 100, the obtained data show that the train accuracy gradually increases and finally reaches 94.6%, validation is around 91.9%. train loss eventually stabilized at around 0.16, F1-score, precision, recall score all stable at about 0.909. Confusion matrix shows the classification ability are average at each class. The LIME explanation diagram illustrates the interpretation of the original image classification findings, it can analyse how much each feature contributes to the final result.

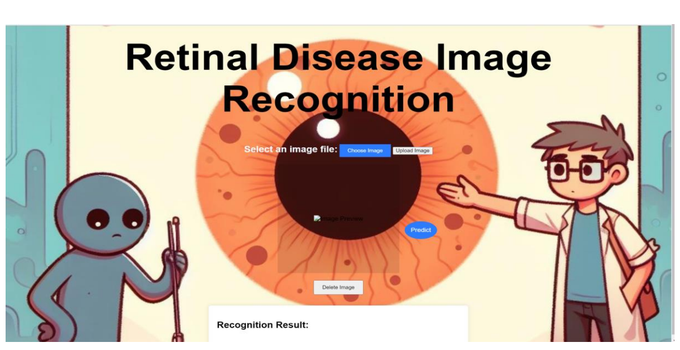


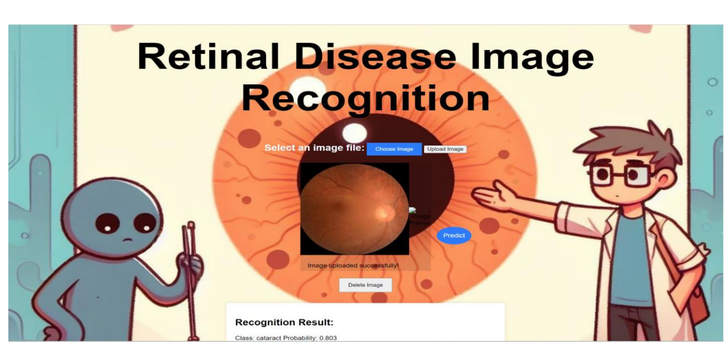
Web application

There are 3 pages in web application. Click the button in home page turn to second page to learn more knowledges about retinal disease. And the detect page allows to select the retinal OCT images for classification. Recognition result is output in the blank bar.









Conclusion and Future work

Conclusion

1) Model architecture: Combined Inception and separable CNN. 2) Automation of disease identification: Reduces manual reliance. 3)Model evaluation: Training accuracy 94.6%, validation accuracy 91.9%, validation loss 0.057.

Future work

1) Dataset improvement: Increase diversity, representativeness. 2) Technique enhancement: Integrate new ML techniques. 3) Parameter optimization: Further adjust for accuracy. 4) Healthcare system integration: Combine real-time data.