HEp-2 Specimen Classification Using Deep CNN

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INTRODUCTION

Indirect Immunofluorescence (IIF) on Human Epithelial-2 (HEp-2) cells is the most commonly used methodology to diagnose autoimmune diseases. The recognition of HEp-2 cell pattern in IIF images is one of the core challenges for antinuclear antibody (ANA) tests. Traditional approach requires experienced physicians to manually identify the cell patterns, which is extremely laborious and suffers from the inter-observer variability. Consequently, developing an automatic and reliable system for HEp-2 images processing tasks, e.g. cell and specimen image classification, becomes an attractive research topic. In this work a Deep Residual Network is used for classifying specimens into predefined classes. The effects of data augmentation via rotating specimen images was also investigated.

OBJECTIVE

In cell image classification first individual cells must be extracted from the specimen images, and then a system is trained on the extracted cell images to predict the class of the new cell images. But in specimen image classification, such cell extraction is unnecessary, instead, a system can be directly trained on the specimen images to predict any unknown specimen image into one of the predefined classes.

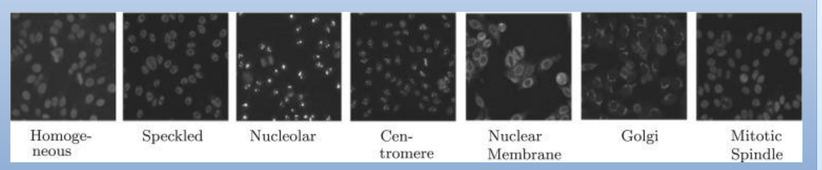
The goal of this work is to investigate a pre-trained CNN architecture for specimen classification and to evaluate the role of data augmentation for network training.

METHODOLOGY

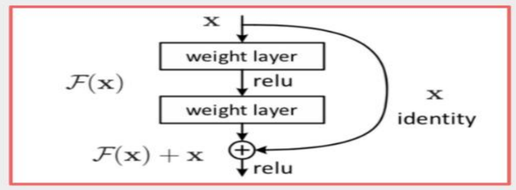
The ImageNet pre-trained Residual Network ResNet-50, was used. The last classification layer with 1000 nodes was replaced by a classification layer with 7 nodes.

DATASET

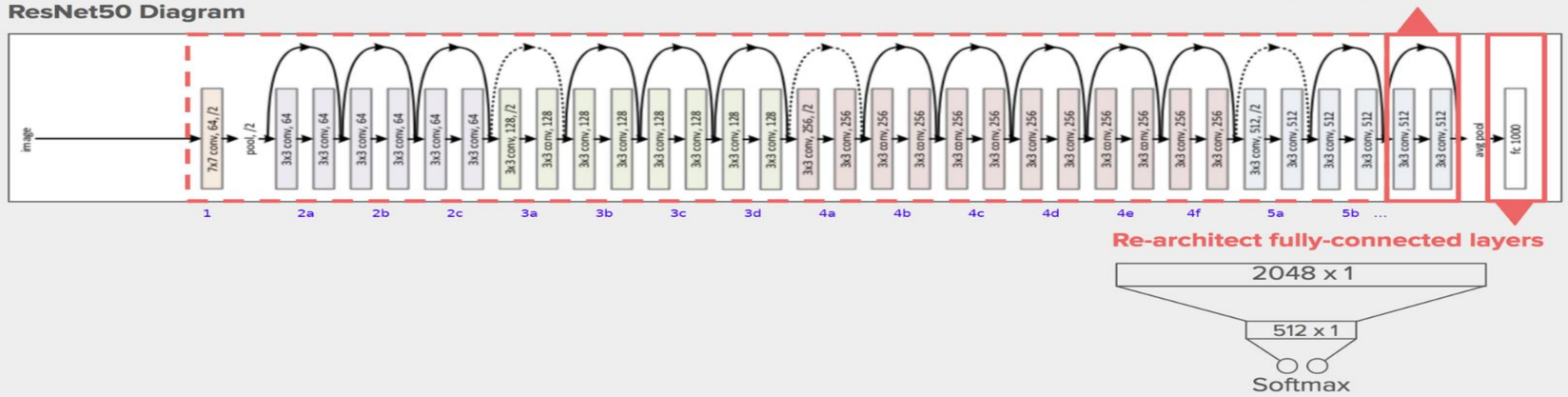
To evaluate, publicly available I3A-2014 dataset (1008 images) was used to train the model to classify HEp-2 specimen images into seven categories.



ResNet_50 Architecture



Residual Learning Block



EXPERIMENTAL SETUP

80 percentage images of the dataset was used for training and the rest was used for testing. The Mean Class Accuracy (MCA) was used as the evaluation measure.

The model is trained with batch size of 200 and 50 epoches, and the learning rate is set to 0.001.

RESULT AND DISCUSSION

- By using ResNet-50 architecture, the testing accuracy achieved 86.1% for HEp-2 specimen image classification.
- Comparison of data augmentation strategy:
  To evaluate the effect of data augmentation, the proposed model was trained with data augmentation via random rotation.

Augmentation scheme	Result accuracy
Without augmentation	86.1%
Random rotate by 90◦	87.4%

CONCLUSION

This study proposes an automatic classification model for HEp-2 specimen images by using ResNet architecture with transfer learning.

Experiments shows that data augmentation improves the classification accuracy.

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