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Enhanced Data Augmentation for Monochromatic and Polychromatic Medical Images

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Introduction

Data augmentation is a technique commonly used in expanding image dataset by artificially creating new images based on real original images. However, studies on data augmentation effects on medical images are limited.[1,2,3] This work compared traditional augmentation techniques including rotating, shearing, flipping, and Gaussian addictive noise on monochromic and polychromic medical images.

Methodology

Two different types of medical image were acquired from open source. A total of 7048 skin diseases images with 4879 benign lesions and 2169 malignant lesions, labelled with diagnosis verified by histopathology and a set of 5856 pediatric chest radiographs acquired from a retrospective cohort were used. VGG16 Net was constructed for training.[4] Original dataset mixed with different types of augmentation techniques were used for training.[5] After training, each networks tested for their performance based on recall, precision and F_1 score.

Results

Experiments showed gray-scale chest radio-graph performed better than color-scale skin disease images in VGG16 Net with recall and precision more than 0.95 in identifying pneumonia. Rotation technique had best F_1score for skin images and performed equally well in chest. On the other hand, flipping had improved neural net performance for chest radiograph slightly more compared to other techniques. Meanwhile, training using augmented images alone had worst achievement than others.

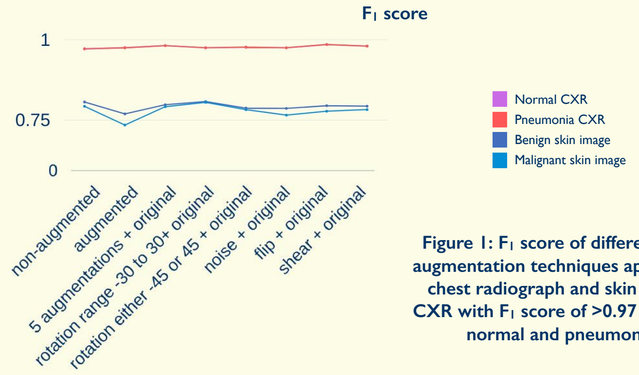

Figure 1: F_1 score of different data augmentation techniques applied on chest radiograph and skin image, CXR with F_1 score of >0.97 for both normal and pneumonia

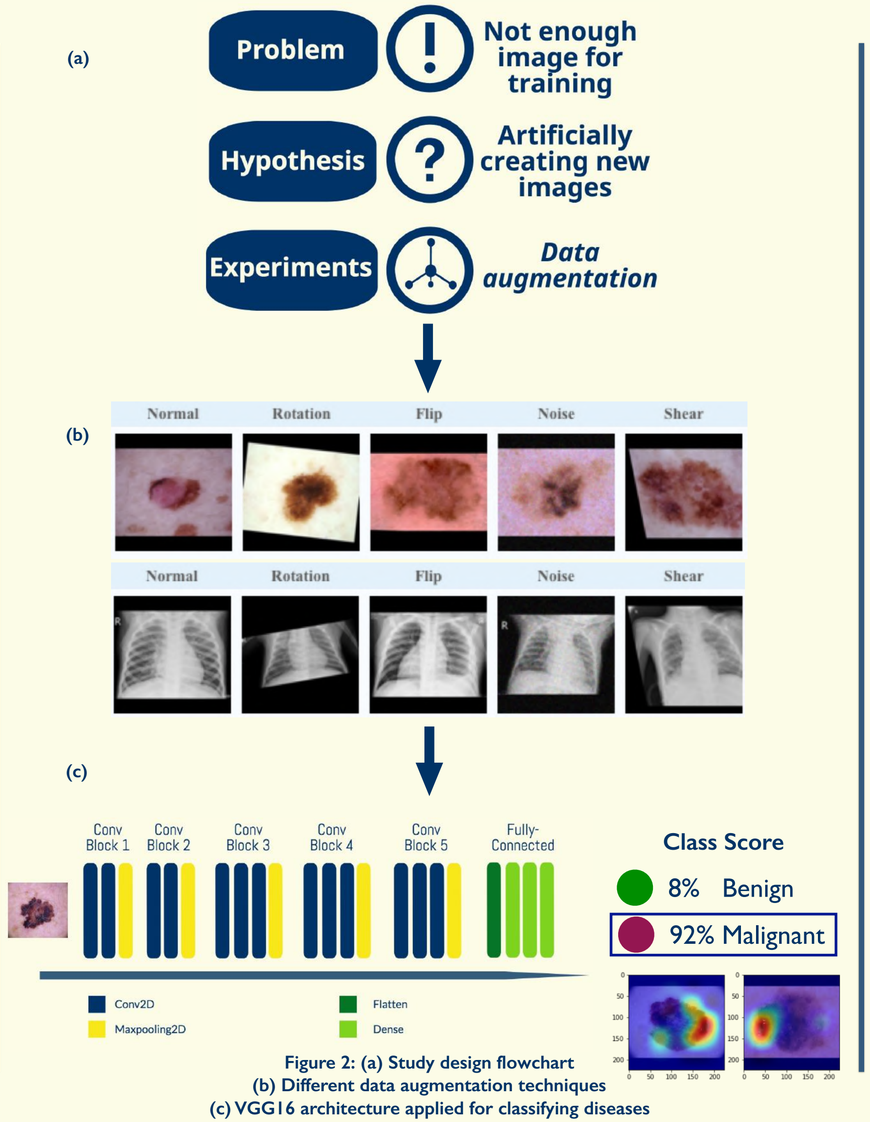

Figure 2: (a) Study design flowchart
(b) Different data augmentation techniques
(c) VGG16 architecture applied for classifying diseases

Figure 3: (a) Skin disease images visualized by t-SNE (b) CXR visualized by t-SNE
Clustering of abnormal CXR is more obvious than skin diseases
because differentiating abnormal CXR is easier for classifier

Discussion/Conclusion

- Data augmentation is applicable in both types of medical images when combining together with original datasets, giving merits for generalization.
- Both monochromic and polychromic medical images classifiers have various degree of boosted performance with all types of data augmentation techniques.
- Training of medical image classifier is not indifferent towards type of data augmentations, rotation can provide better recall which is favored in real world.
- It would be better to train together with original images than only augmented image, because latter alone has no benefits towards medical image training.

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