Siamese Convolutional Neural Network Model for Melanoma Skin Cancer Recognition

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ABSTRACT

In recent years, the application of deep learning has increased significantly. Many computer applications rely on deep learning, which provides great convenience for people's work and life. Especially in the medical field, in-depth learning can quickly and accurately identify different medical images, saving a lot of time for medical personnel. This article mainly aims at the recognition of skin cancer melanoma, and develops a skin cancer melanoma recognition system based on the Siamese network. The system uses a dataset of melanoma skin cancer images to train on a dual neural network consisting of the same subnetworks of two Vgg16 networks that remove the last three fully connected layers. Using the trained model to accurately identify skin cancer melanoma, a high recognition accuracy of 91.0% was achieved through modifying different parameters and training the model. The implementation process includes image preprocessing and feature extraction, design and training of dual neural networks, and GUI design. In the experiment, a dataset of 10000 skin cancer melanoma images downloaded from Kaggle was used. This project has good application prospects and can be widely used in clinical medicine, health management, and other fields to improve the early warning ability of skin cancer melanoma, and protect human health and life safety.

INTRODUCTION

In the medical field, cancer can be said to be one of the most difficult diseases to overcome, especially skin cancer. In skin cancer, melanoma is one of the most lethal. Melanoma can be divided into benign melanoma and malignant melanoma. The difference between the same type of melanoma is very small, but the difference between different types of skin lesions is very large. Therefore, even experienced clinical dermatologists cannot make good judgments, and the accuracy of general doctors who have not received a lot of professional training will be greatly reduced [1]. Therefore, this project is a skin cancer melanoma recognition system based on deep learning, with the aim of correctly identifying melanoma skin cancer, thereby distinguishing benign and malignant melanoma from skin cancer. To solve the current recognition problem of skin cancer melanoma.

METHODOLOGY

The model for this project mainly consists of the Siam network. The Siam network consists of two identical subnetworks. The subnet uses its own independently designed Mod-Vgg16 network. The difference between this network and Vgg16 network is that the full connection layer of the last three layers in the Vgg16 network structure is removed and used as a new neural network.

The training for this project used a dataset downloaded from Kaggle, which used 10000 images from a melanoma skin cancer dataset, including a mental and test set.

The GUI uses the PyQt5 framework, which can be used to compare the similarity between two images.

GUI

The GUI framework uses PyQt5. Some plug-in designs are used to implement functions such as image display, uploading images, and similarity scores. Conduct similarity analysis based on the trained model, and then display the prediction results in the form of scores.

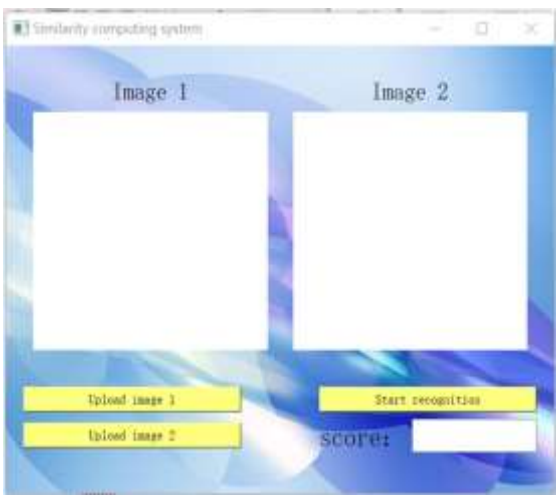

Figure 3: The GUI of the project

DATASET

The dataset uses an open source dataset on melanoma and skin cancer downloaded from Kaggle. This dataset has 500 benign and malignant images each, a total of 1000 test sets, and 5000 benign and 4605 malignant training sets, a total of 9605. The project uses 100 test images for project testing and all training sets for model training.

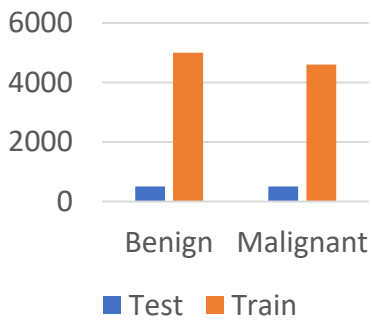

Figure 4: Image distribution of the dataset

ARCHITECTURE

1. Siamese Network

Siamese network has two inputs. The designed VGG network is used to map the input to a new space, forming the representation of the input in the new space. Evaluate the similarity of the two inputs through the calculation of Loss. The sigmoid function is used as its Loss function for the result of this neuron, so that its value is between 0-1, representing the similarity of the two input pictures.

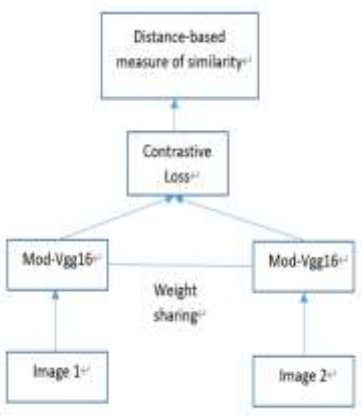

Figure 1: Siamese network's architecture

2. Mod-Vgg16 Network

The project designs Mod-Vgg16 network. Due to the need for one-dimensional images to calculate the loss function, the subnetwork refers to the structure of the Vgg16 network and deletes the entire connection layer of the last three layers.

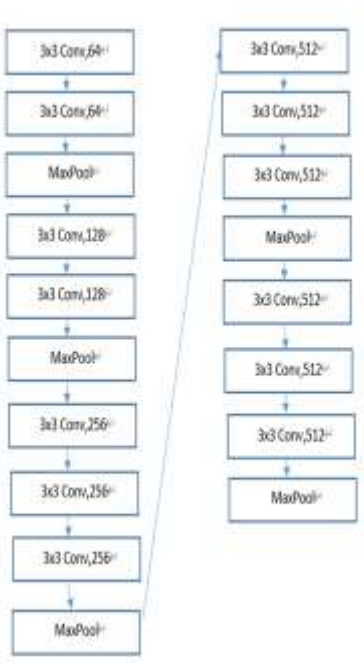

Figure 2: The Mod-Vgg16 architecture

RESULT

After several training results and parameter modifications, a model with training set accuracy of 91.0%, verification set accuracy of 86.3%, training set loss of 0.253, and verification set loss of 0.307 was finally obtained. In addition, corresponding smoothing curves are set for accuracy and loss to more intuitively reflect the parameters of the model.

Then use two cases to test all functions of the GUI, and the GUI functions can be implemented normally.

1. Select a benign melanoma skin cancer as the reference object, and select another benign melanoma skin cancer for similarity recognition. When the similarity score is greater than 0.6, the test passes.
2. Select a benign melanoma skin cancer as the reference object, and select another malignant melanoma skin cancer for similarity recognition. When the similarity score is less than 0.6, the test passes.

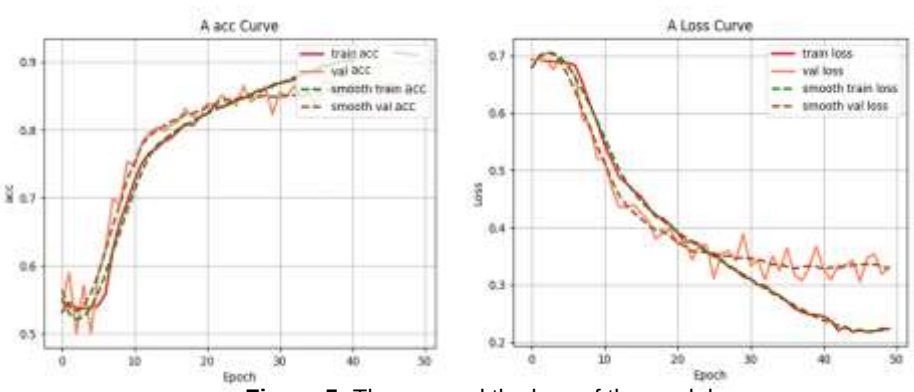

Figure 5: The acc and the loss of the model

Figure 6: The result of the case 1

Figure 7: The result of the case 2

DISCUSSION

The project developed a melanoma skin cancer image recognition system based on the Siamese network, with an accuracy rate of 91.0%. Using the GUI, the type of melanoma cancer can be accurately identified through similarity scores between two images.

FUTURE WORK

In the future, it is necessary to expand the dataset used to meet more training requirements, and add a detection function to the input image to ensure that the image is a melanoma skin cancer image. In addition, it is also necessary to add the proportion of malignant and benign images to make the recognition results more intuitive.

REFERENCES

[1] B. Zhao, J. S. Feng, W. Xiao, et al., "A survey on deep learning-based fine-grained object classification and semantic segmentation," International Journal of Automation and Computing., vol. 14, pp. 119-135, 2017, doi: 10.1007/s11633-017-1053-3.