

Detection of Varicose Superficial Venous Thrombophlebitis in Vein using MSNN Algorithm

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Abstract— A doctor uses the diagnosis of medical images to predict whether the person suffers from damaged tissues or organ. Therefore, object detection and image classification of medical images has received some concentration in medical field. This paper has put forward a varicose vein detection algorithm based on varicose superficial venous thrombophlebitis images and multi-level neural network algorithm (MSNN). The varicose vein diagnosis system has better accuracy and performance due to the uniqueness of the leg vein images. The proposed system used multi-scale technology by pre-processing the images and extracting features by feature extraction to create a detection system of varicose disease with high performance.

Index Terms— Vascular endothelial cells, inflammation, Multi-scale neural network, Sclerotherapy, Endovascular Laser Therapy.

I. INTRODUCTION

Biometrics is an automated recognition system that is used to recognize individuals by means of physical appearances. Veins are blood-carrying vessels that carry blood to every part of the body. Varicose veins appear as dark blue or purple veins which are swollen and enlarged. Digital medicine is a category in the medical field, which is a combination of prescription medication and ingestible sensor component.

The deep learning algorithm proposed by Lau et al. [1] the algorithm is used to achieve a good recognition system by training with several skin-damaged images of the patient. Mohammed et al. [2] used a 3-dimensional convolutional network to classify and recognize the patients with Alzheimer's disease. Kawahara et al. [3] used a CNN structure for obtaining structural connectivity maps from DTI by MRI scans. Yuan [4] used a multi-dimensional CNN algorithm to classify the skin tissue damages, working with each CNN model with a different image resolution. Al-Antari et al. [5] used a modified neural network combined with support vector machine to detect breast tumors, suggesting that the given model has an improved performance of the breast image classification.

Varicose veins present in the lower limbs of the body are the most common disease of our vessels. Around 23% of the people present in the world suffer from varicose veins in their legs and knees and at present, the number of people having varicose veins has exceeded 25 million in the world. In China, the ubiquity of the varicose veins has exceeded 8%. In addition to affecting esthetics, varicose veins can also cause complications, such as bleeding in the lower limbs, superficial vein swelling, inability to walk for long distance and reduced work capacity.

Varicose veins are generally valves that are enlarged and swollen that generally appear on the legs and feet of the patient's body. This condition happens due to the flow of blood against gravity and occurs after prolonged standing. Varicose veins cause aching pain in the legs and feet that cause discomfort in loss of joint function, which can lead to a circulatory problem.

The main problem facing doctors today is the difficult access to veins for intravenous drug administration.

Several problems occur when veins are incorrectly detected, such as injuries, lesions, thrombus, etc. Hence a non-surgical varicose diagnosis system based on MRI imaging using MSNN algorithm has been successfully developed which classifies the varicose veins from the given dataset.

Thrombophlebitis is a blood clot in leg and feet vein that causes an inflammation of superficial veins and is affected at the surface of the exterior skin. If a blood clot grows inside a swollen part of the vein, the vein appears puffed up and intensified.

Deep vein thrombophlebitis (DVT) appears due to the blood clot formed in the deep veins of the human body usually in the lower limbs. Varicose veins constitute and act as a primary reason for many diseases, especially of the lower limbs.

II. RELATED WORKS

Varicose veins are broadened veins in the hypodermis tissues of the lower legs or legs and varicose veins are quite easily visible to the naked eyes. In today's world, the improvement of society and changes in the life style of the people, varicose veins have become a universal disease in the world. Most people with varicose veins usually don't detect any changes in the superficial layer of the skin. Due to this people don't give enough attention to the changes in the lower limbs of their body due to varicose veins. Prolonged obstruction of the superficial valve of the lower limbs can cause severity in the varicose disease. Spider veins are a mild type of varicose veins which are smaller in size and appear in red or blue in colour and frequently appear in lower legs. Varicose veins can be prevented by regularly exercising, maintaining a healthy weight, wearing loose clothes which are not that tight to the body. Fig.1 shows the comparison of normal and varicose veins.

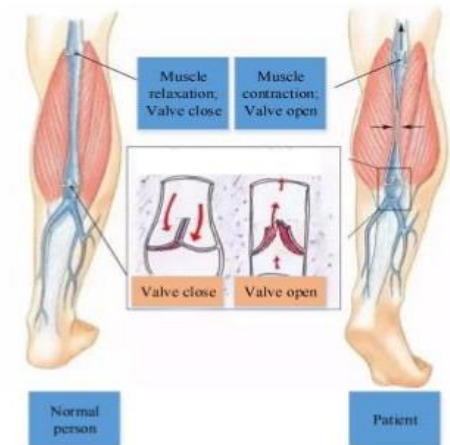


Figure 1. Comparison of varicose veins and normal veins

Figure 1

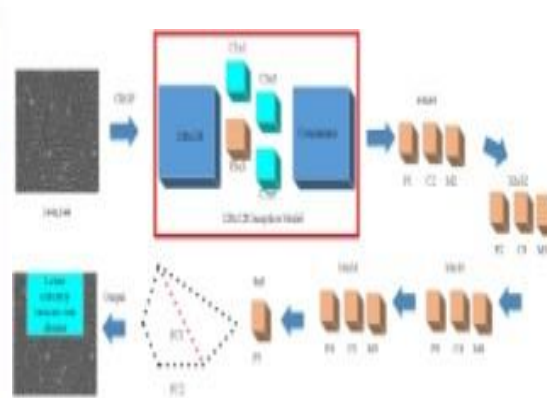


Figure 2. Lightweight deep convolutional neural network with enhanced feature extraction

Figure 2

The first work is done by Lau et al.[6] in which a network algorithm has successfully achieved a good detection system using 100 MRI images of the skin damages. By Kawahara et al.[7] applied a MSNN structure that connects the structural connectivity map that is obtained by DTI and MRI images. The main advantage of the MSNN algorithm is that it makes use of the spatial coherence that is it gives equal importance to all the edges of the network and it is independent of the geometrical transformations. The treatments that are used for varicose vein disease are injection treatment (sclerotherapy), laser treatment and vein surgery. Surgery is considered as one of the painful methods as it involves interceding by tubal ligation and also pulling out of the veins, these causes the patient massive pain and also the patient takes a long period of time to recover from the surgery. Sclerotherapy is a methodology that done by injecting medicine through the blood vessels or lymph vessels and this makes the swelling to shrink. This causes enormous pain in the swollen area as it is difficult to exactly find the affected vein. Sclerotherapy is commonly used in the treatment of spider veins which is a mild version of the varicose veins and this procedure is a non-surgical treatment as it only requires injection for treatment of the varicose vein disease. Complications of the varicose veins includes draining of blood, skin changes of the patient, rash, ulcers, infection, bleeding, blood clots. Endovascular varicose laser surgery is a method that is used to treat varicose veins by penetrating laser into the body and produces heat which shrinks the varicose veins. A model is designed to examine the bandwidth of the ultrasound devices and various values of the return

speed. The conclusion of the simulation is that the bandwidth in which necrosis in the valves of the blood vessels can be determined.

A. Multi-level Neural Network

Specialists and various exploration results that have extraordinarily advanced the advancement of clinical picture research favor the use of profound convolutional brain networks in clinical pictures. In any case, because of the absence of open huge scope data sets, most examination utilizing profound convolutional brain networks is completed on restrictive little data sets, and the heartiness of the organization isn't excellent. Fig.2 represents the multi-level neural network.

Furthermore, profound convolutional brain networks utilize managed preparing strategies. To further develop the organization speculation execution, it is important to extend the organization progressive system or look for a more sensible organization structure. As the level of the organization develops, more marked preparing information is required for variation. This paper joins the elements of Google-Net organization structure, VGG, and the writing to build a lightweight profound convolutional brain network with further developed highlight extraction. The letter "C" demonstrates the pack base layer. "M" indicates the MFM enactment layer. "P" demonstrates most extreme pooling and "Fc" shows a completely associated layer.

B. Inception Layer

Google Net is a kind of neural network that uses inception model for training and evaluating the given dataset. Google Net is a model that utilizes multiple size of the filter sizes present in the inception layer and rarely max pooling, two filter sizes for making the resolution of the images halved. There are some changes present in the Google Net from the other similar architectures of the neural network, that is Google Net uses 1x1 convolution layer and also global mean pooling. Fig.3 shows the inception model structure.

C. Activation Function

An activation function is a module that is used to provide compact outputs for compact inputs whereas it provides huge values if the input surpasses a threshold limit. There are few examples for activation function such as Relu, Sigmoid, Step function, Leaky Relu. The mathematical representation of the activation function is given as in the Figure.4

D. Relu

Relu is a rectified function in which the function tends to zero if the input values are less than zero and the function tends to the input value if the input values are greater than or equal to zero. Fig.5 shows the equation and Fig.6 shows the graph of relu function.

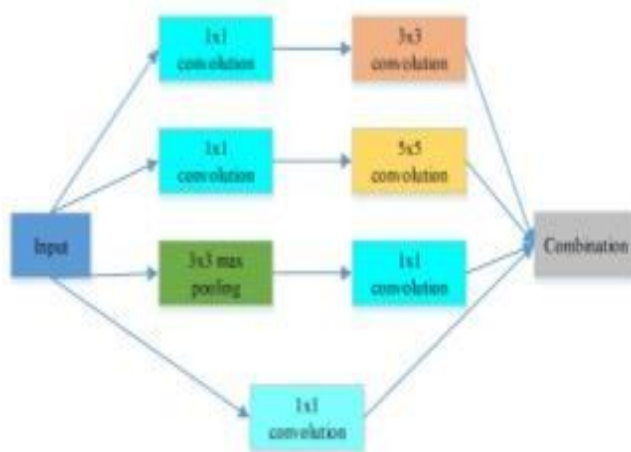


Figure 9. Inception Model unit structure

Figure 3

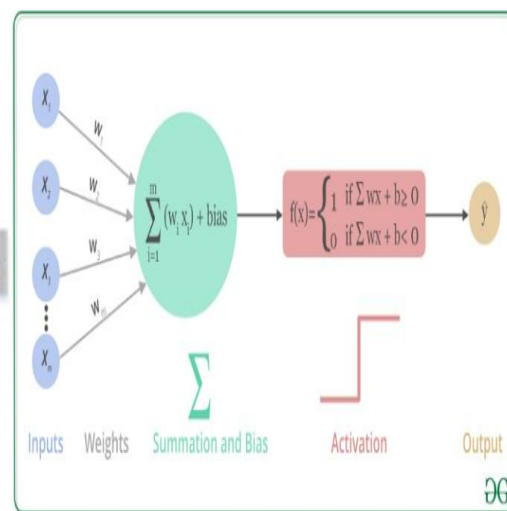


Figure 4

$$\sigma(x) = \begin{cases} \max(0, x) & , x \geq 0 \\ 0 & , x < 0 \end{cases}$$

Range: [0 to infinity)

Figure 5

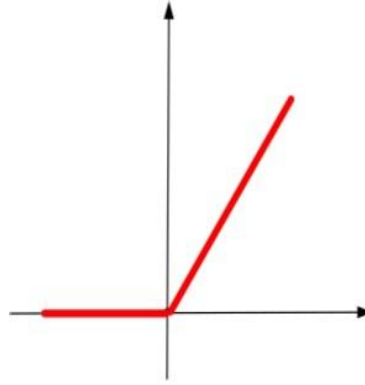


Figure 5.ReLU activation function

Figure 6

III. PROPOSED WORK

Varicose is classified into many types based on the severity of the disease in the patient's body. In this paper, each part of the image segmentation is developed to detect the varicose by image pre-processing, feature extraction and at the end segment the images over the original images. By using the algorithm, the classification results determine the efficiency of the infected veins. Fig.7 and 8 shows the block diagram of training set and testing set of the network.

IV. WORKING

A. Image Preprocessing and Feature Extraction

The images present in the dataset are pre-processed and the features are extracted by using mean pixel value method. These images are then separated into training set and testing set.

B. Neural Network Training

After pre-processing and feature extraction of the images present in the dataset, the MSNN algorithm is trained using the training set of the dataset. After training the neural network using training set, it is then evaluated and validated by the testing dataset. It is done by matching the testing set with the original images and the accuracy of the MSNN algorithm is measured. The accuracy of the testing set tends to increase by increasing the number of neural network iterations. The efficiency and error test curves of the MSNN model in maximum aggregate sampling mode are shown.

C. Network Performance Comparison

The amount of training parameters of the MSNN model network is related to the depth of the network and the number of network filters in each layer. A deeper network layer and a wider network width can capture more network features and improve the network's ability to represent features. The network parameters of NIN and Google-Net are smaller than VGG. Network training time is shorter, resource overhead is less, and network execution efficiency is higher. At the same time, the MSNN model constructed in this article introduces a deeply separable convolutional layer, the calculation size of the model parameters is the smallest, and the network runs

the fastest not only in the network. A desktop computer with a graphics card can run fast and can run quickly on a portable mobile device. Combined with image multi-scale technology, it can still achieve high classification accuracy while reducing the parameters of the deep convolutional neural network model.

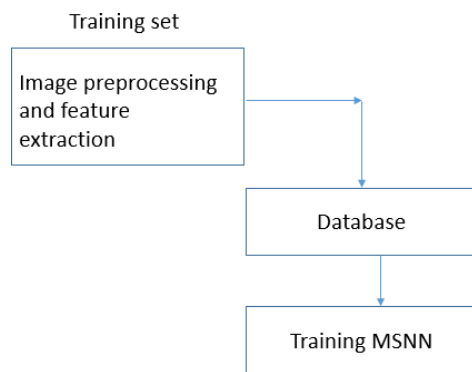


Figure 7

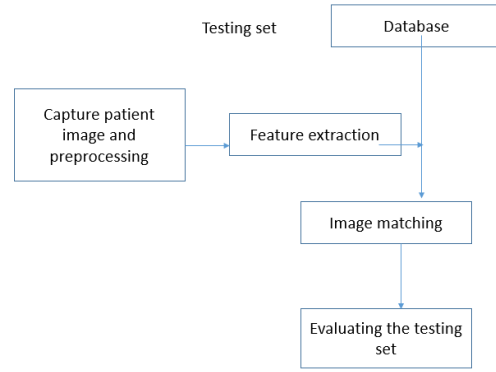


Figure 8

V. RESULTS

The proposed system accuracy for 30 epochs or 150 iterations of MSNN model is shown in Fig.9

Also the model is used to predict test samples of the dataset and the confusion matrix of the predicted values is displayed in the Fig.10

150/150 [=====] - 1s 7ms/step
Test accuracy: 91.33%

Figure 9

	Predicted NORMAL	Predicted VARICOSE
Actual NORMAL	20	7
Actual VARICOSE	6	17

Figure 10

VI. CONCLUSION

There is a positive correlation between vascular endothelial cell inflammation and varicose veins of the lower extremities. Therefore, this paper uses vascular endothelial cells as a research object to construct a deep convolutional neural network for lower limb varicose veins to improve classification and recognition accuracy. The accuracy of the presented work with MSNN comes close to meeting the acceptable error levels that would be required for a system with some classification of a patient's leg image. Compared with the existing deep convolutional neural network model, the network can improve the feature extraction ability of the network, has the characteristics of fast running.

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