

Diagnosis of Peripheral Artery Disease using Cnn Classifier



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Abstract : *Peripheral Arterial Disease is common to all elderly peoples, which reduces the blood flow to the limbs. Due to PAD, the affected person unable to walk and gives pain while they try to walk. This PAD does not have any specific symptoms to affected persons in the earlier stage. This paper presents a solution to find the disease in which stage the person was affected. The Peripheral arterial disease is evaluated using convolution neural network classifier to identify in early stage to take treatments. The affected persons image (particular part of the body. Eg. Leg) is compared with the dataset. The dataset contains the collection of images that contains both normal and Peripheral arterial disease affected images. The CNN classifier compares with the dataset and shows that the given input image is in normal stage or it is affected by the Peripheral Artery disease. The accuracy level is high. This methodology helps to find the disease in earlier stage.*

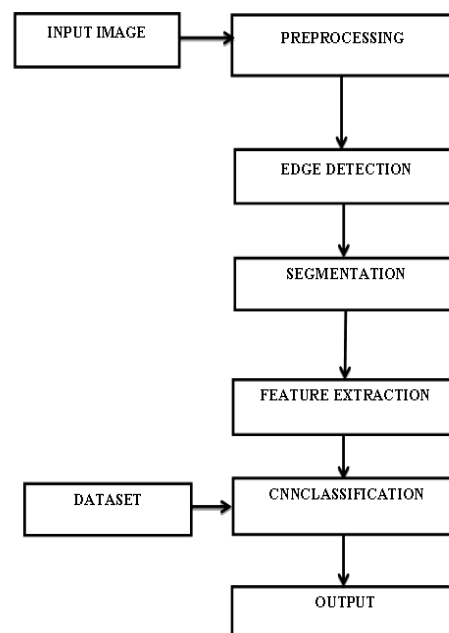
Keywords: *Peripheral Arterial Disease, CNN Classifier, Dataset, Accuracy.*

I. INTRODUCTION

Most of the elderly peoples, Diabetes patient, chain smokers were affected by Peripheral artery disease. Artery is the nerve which transfers the oxygenated blood from heart to all parts of the body. People who are affected by PAD[1]', there is no proper blood transfer to the leg. Due to this affected people are struggle to walk. In early stage of this disease there is no symptoms. Patient can check or scan their body due to their illness. We propose one new process to identify this disease in early stage. We can use the scanned image to identify whether they are affected by PAD or not by our developed technology. With the help of image processing technology, we can easily identify the image which is affected by PAD. It is also used to identify the stages of the disease, whether it is in normal stage or initial stage of PAD or critical condition of PAD. MRI scanned and CI scanned images are used for the dataset.

The input image is compared with the dataset to determine whether the given image is affected or not. Convolutional Neural Network classifier is used for comparing the given input images with the dataset. This project involves the process of preprocessing, edge detection, segmentation, Feature Extraction, Classification. The result of every module is used in next module. The input image should be a MRI scanned image or CT scanned image. The output will be in dialog box format. It popup the message like the pad is affected or not.

II. SYSTEM ARCHITECTURE



2.1 Pre-Processing

Preprocessing is the initial step used in our project. Preprocessing is used to convert the input image into some other form for future purposes. Preprocessing is used for image enhancement purpose i.e., improve the quality of the image[2]. Here we use Median Filter in preprocessing stage. Median Filter improve the quality of the image by converting the given image into fixed window size (window size should be low). If the window size is large the image will get blurred.

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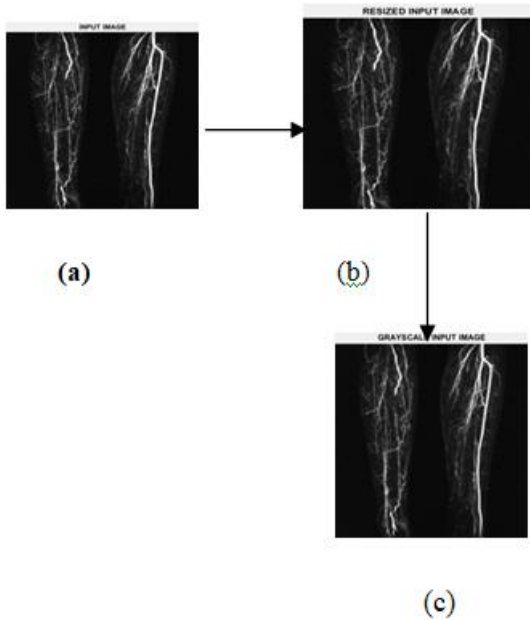


Figure 1. Pre-Processing input samples

First we convert the input image into resized input image using median filter and then convert the resized image to grey scale image. The grey scale image is used in future purpose.

2.2 Edge Detection

Edge detection is a technique used to identify the edges and region boundaries. This method is particularly useful when the disconnected edge is part of an illusory contour. In Edge detection phase we use Grey scale image as input. This grey scale image will convert into binary image i.e, Black and White image. The white color represent the value as 1 and black color represent the value as 0[4].

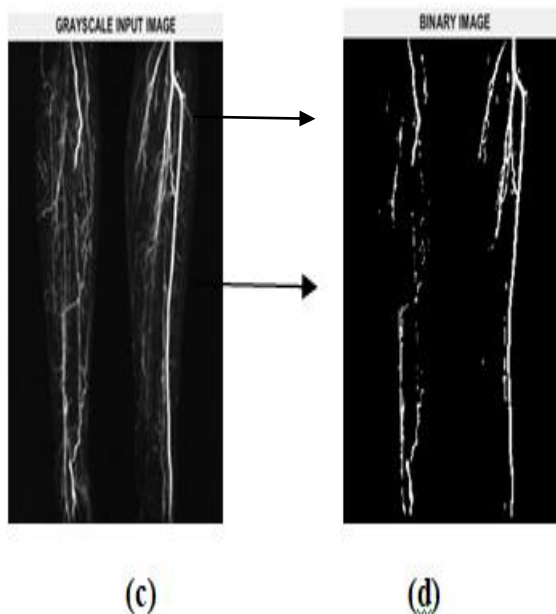


Figure 2:Edge Detection samples

2.3 Segmentation

Segmentation is a technique used to identify the object or thing what user exactly want in the image we use overlaid

image concept for segmentation process. First we convert the binary image into the complement image. i.e., The complement image is just opposite to the binary image. ie., White colored pixels are converted to Black pixels and Black colored pixels are converted to White pixels.

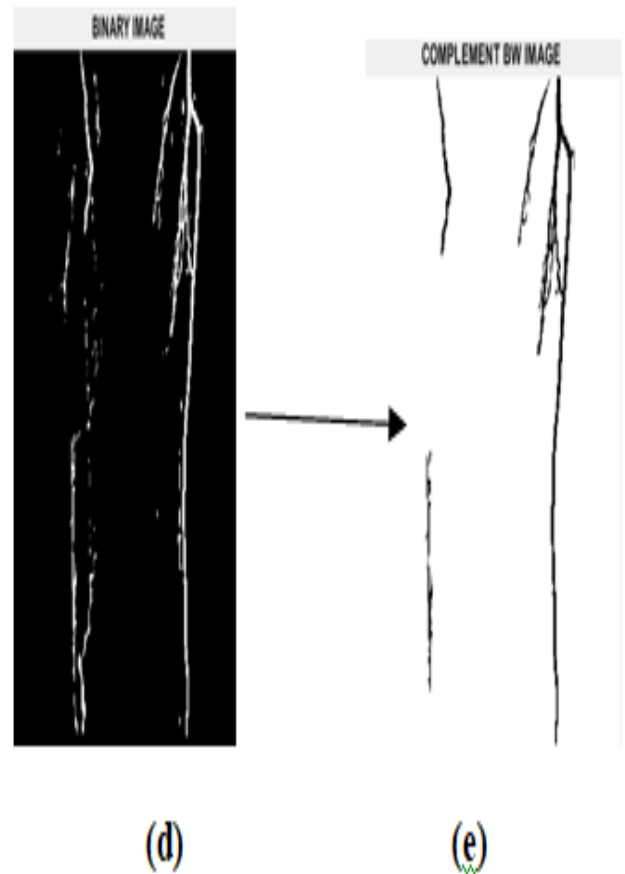


Figure 3: conversion of binary image to complement image

Now we introduce the overlaying concept i.e., overlaying the binary image with the complement image so that we can easily find the segmented object. In our project the artery can be segmented by this overlaying method.

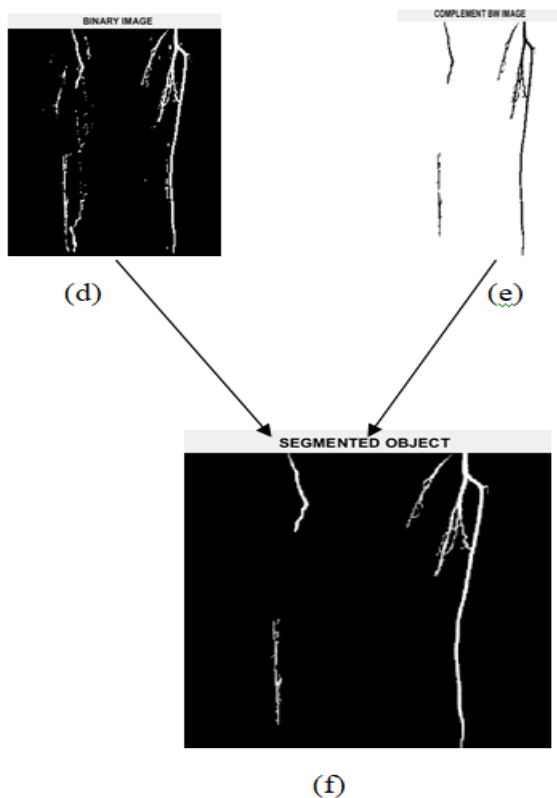


Figure 4: Segmented image

2.4. Feature Extraction

Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. For extracting the feature from the segmented image. We use GLCM (Grey Level Co-occurrence Matrix) algorithm. This GLCM is used to process each and every pixels in the image. GLCM process the pixel by minimum value, maximum value, energy, contrast, correlation.
 $a = a + \text{Norm_GLCM}(k) * \log_2(\text{Norm_GLCM}(k))$
 where a is initially assumed as 0. k will increase for every iteration. The maximum value of k will be $(\text{GLCM})^2$ [3][6].

2.5. Classification

After the feature extraction, the image will be classified by comparing the image with the dataset. The dataset should be trained and stored previously. The dataset is the collection of data. In our project we use CNN (Convolutional Neural Network) classifier [5].

2.6. CNN Classifier

Convolutional Neural Network is a powerful machine learning technique from the field of deeplearning. CNN classifier is used for visual imagery. In our project this classifier is used to classify

the input image. It helps to classify the input image whether it is affected by PAD or not. If PAD is affected it will show In which stage the PAD is affected. The datasets are previously trained in the database. After extracting the feature from the input image CNN classify the image based

on pixel values. It compare the pixel value. If the pixel value is normal PAD is not affected. If the pixel value is high PAD in stage level 1. If the pixel value is more high then PAD in stage level 2.

III. MATERIALS AND METHODOLOGY

The Dataset DIGST is a built up standard manually written digit arrangement dataset that is generally utilized for benchmarking profound learning models. It is a 10-class grouping issue having 60,000 preparing models, and 10,000 experiments – all in grayscale. Be that as it may, it is contended that the DIGST T dataset is "excessively simple" and "abused", and "it can not speak to present day CV [Computer Vision] tasks". Consequently, proposed the Fashion- DIGST dataset. The said dataset comprises of Zalando's article pictures having a similar dissemination, a similar number of classes, and a similar shading profile as MNIST.

Table 1: Dataset distribution for both DIGST and Fashion DIGST.

Dataset	DIGST	Fashion- DIGST
Training	60,000	10,000
Testing	60,000	10,000

3.1. Support Vector Machine (SVM)

The help vector machine (SVM) was created by Vapnik [5] for double characterization. Its goal is to locate the ideal hyperplane $f(w, x) = w \cdot x + b$ to isolate two classes in a given dataset, ith

$$\min \frac{1}{2} w^T w + C \sum_{i=1}^P \max(0, 1 - y_i (w^T x_i + b))$$

where $w^T w$ is the Manhattan standard otherwise called L1 standard), C is the punishment parameter (might be a subjective worth or chose esteem utilizing hyper-parameter tuning), y is the real mark, and $w^T x + b$ is the indicator work. Eq. 1 is known as L1-SVM, with the standard pivot misfortune. Its differentiable partner, L2-SVM (Eq. 2), gives progressively stable results [11]

$$\min \frac{1}{2} (w^T)^2 + C \sum_{i=1}^P \max(0, 1 - y_i (w^T x_i + b))^2$$

3.2. Convolutional Neural Network (CNN)

Convolutional Neural Network (CNN) is a class of profound feed-forward counterfeit neural systems which is regularly utilized in PC vision issues, for example, picture arrangement. The qualification of CNN from a "plain" multilayer perceptron (MLP) arrange is its use of convolutional layers, pooling, and non-linearities, for example, tanh, sigmoid, and ReLU. The convolutional layer (indicated by CONV) comprises of a channel, for example, . Instinctively, the CONV layer is utilized to "slide" through the width and tallness of an info picture, also, figure the speck result of the info's district and the weight learning parameters. This thus will deliver a 2-dimensional enactment map that comprises of reactions of the channel at given areas. Thus, the pooling layer (meant by POOL) lessens the size of information pictures according to the consequences of a CONV channel.

Subsequently, the quantity of parameters inside the model is additionally diminished – called down-examining.

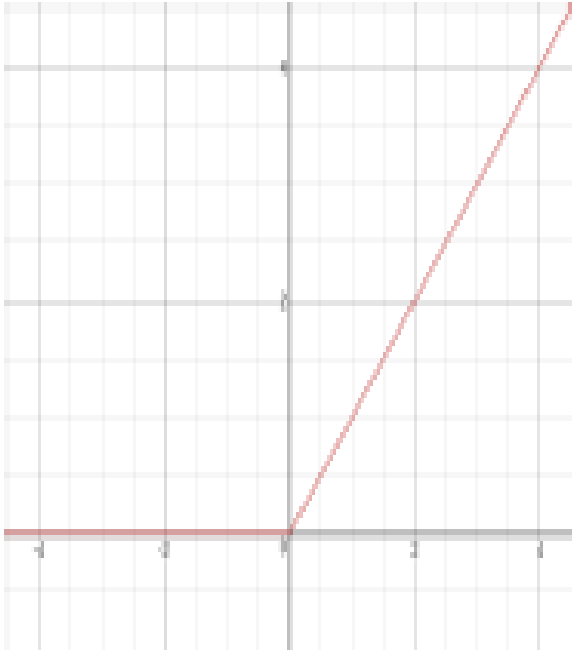


Figure 1: The Rectified Linear Unit (ReLU) activation function produces 0 as an output when $x < 0$, and then produces a linear with slope of 1 when $x > 0$.

IV. RESULT

We use CNN classifier so it compare the actual input image with the large number of dataset. This classifier is better than SVM classifier because SVM has limited number of dataset but CNN has large number of dataset. So the accuracy is higher than SVM classifier.

Hyper-parameters	CNN-Softmax	CNN-SVM
Batch Size	128	128
Dropout Rate	0.5	0.5
Learning Rate	$1e-3$	$1e-3$
Steps	10000	10000
SVM C	N/A	1

U. Table 2: Hyper-parameters used for CNN-Softmax and Cnnsvm mode.

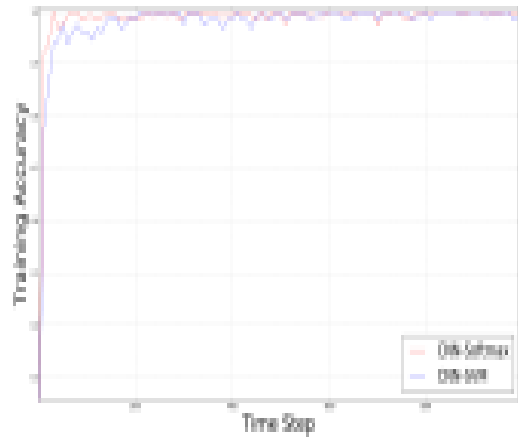


Figure 2: Plotted using matplotlib[7]. Training accuracy of CNN-Softmax and CNN-SVM on image classification using DIGST

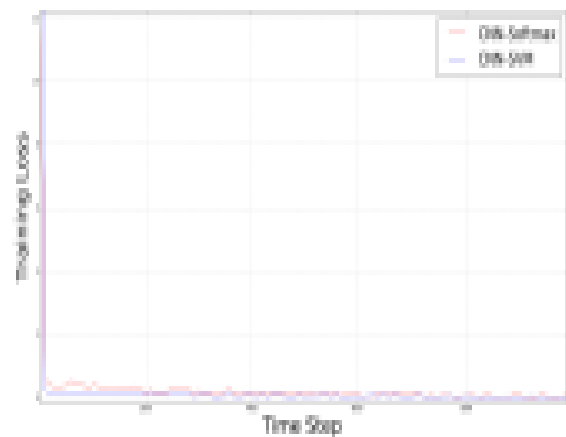


Figure 2: Plotted using matplotlib[7]. Training accuracy of CNN-Softmax and CNN-SVM on image classification using DIGST].

FUTURE ENHANCEMENT

In future we use thermal images as input. This work proposes a set of algorithms to automate temperature extraction from local regions of interest. It can be extended to any application which requires temperature data from the same regions.

V. CONCLUSION

The purpose of this paper is to identify the Peripheral Artery Disease with the help of image processing technique. The CNN classifier is used to classify the stages of the disease. This software project can used to medical field. Accuracy of classifier is high and clear when compare the CNN classifier with the SVM classifier. This project compare the input image with large amount of dataset. So the result will be accurate and efficient.

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