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Detection of Conjunctivitis with Deep Learning Algorithm in Medical Image Processing

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Abstract:- Artificial Intelligence[AI] using deep learning (DL) plays the significant trend in the image processing. Also AI using natural language processing and speech recognition is a recent trend in the health care industry .There are various ongoing researches for incorporating deep learning in ophthalmic field which is more trending now. DL can be used for extracting the fundus photographs, optical coherence tomography which is accomplishing the performance in identifying the conjunctivitis .How ever there is lot of technical challenges in the identifying the right algorithm and implementing in both clinical and technical areas. This proposed work is focused on diagnosing and identifying the conjunctivitis using deep learning technique. Keywords: Eye disease, Conjunctivitis, medical imaging field Deep Learning.

1. Introduction

Conjunctivitis is frequently termed as pink eye disease caused by various reason, there are various types of conjunctivitis named as infectious conjunctivitis, Chemical conjunctivitis, Allergic conjunctivitis. Normally the disease will affected by one eye and drastically will affect the next eye. The disease should be treated in the primitive stage otherwise; there is a chance of developing a serious problem. The infection is due to the bacterial Growth. Based on the cause of the infection, There are various methods of treating the conjunctivitis which are as followed, For allergic conjunctivitis[14] we need to remove the irritant and do cool compresses and do simulate the artificial tears which will the relieve the discomfort and additionally we can use the non-steroidal anti-inflammatory medications .For bacterial conjuctivis it should be treated with the antibiotic eye drops, for viral conjunctivitis steroids can be used for treatment .In case of chemical conjunctivitis we can use saline water flushing in eyes is the standard treatment.[1].The conjunctivitis will have the following symptoms[1] and the patient should consult the doctors immediately.

1) If there is a redness in the white layer of the eye.
2) Lot of tears in the eye.
3) Frequent yellow pus discharging.
4) Sudden changes in vision, which results in, blurred.
5 Raised sensitivity when exposed to light.

The proposed work carried out based on computer-aided diagnosis CAD [17] where deep learning algorithm is applied for processing, image segmentation, and classification.

Fig 1 Deep Learning Architecture

2. Analysis of deep Learning Architecture

In the fig 1 above, the deep learning architecture [1], consist of six layers along with the weights. The first four layers are convolutional framework and the resting are two layers are fully connected. The output of the last layer is fully connected layer and it is fed to the softmax classifier for conjunctivitis prediction. In the proposed model, the response normalization layers and overlapping layers are implemented for better accuracy and results [2][3].

3. Image Segmentation –High level block diagram

The proposed technique for image segmentation is mentioned in the Figure 2. In the initial step, preprocessing is performed for the given picture using wiener channel [4-8] by filtering the images with mean and standard deviation. In the second stage, the picture phase is altered fluffy c implies calculation. In the

third stage, the conjunctive eye and ordinary eye pictures were assessed by utilizing profound learning calculation to identify the diseased eye and image processing happens in different stages as follows image models, image estimations, image discriminations[18-19] image preprocessing, image segmentation, image classifications.

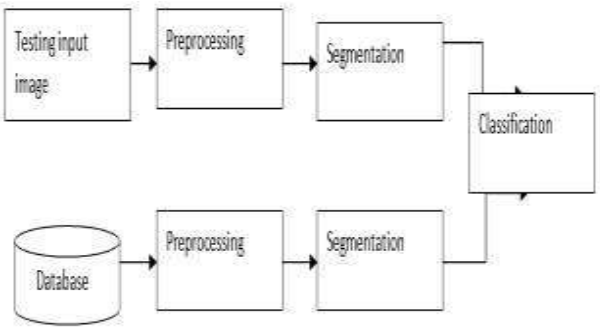

Fig 2 Block diagram of the proposed method

3.1 Image preprocessing and Image segmentation through fuzzy techniques

The first step in image processing is the preprocessing technique which is used for reducing the noise, sharpening and smoothening the image and then with the image segmentation. For this activity, several filters are used. However, in our proposed methods we selected median filter and wiener filter.

Median filter [11] is very effective if the image is having the impulse noise like pepper and salt noise and wiener filter is used if the image is having the random noise like Gaussian noise .Median filter also termed as order statistics filter Which is used for replacing the values of pixel by median gray level in acquaintance of that pixel.

Generally in the system-processed images, two filters and seven segmentation methods are used .By applying the filter in the image the noise will be reduced , In the proposed system we are using two filters, namely, Median and Wiener filters [12] .The medial filter is used if the image is having the noise that has corrupted the signal. Median filter is a nonlinear operation used to reduce "salt and pepper" noise.

The Wiener filter is more powerful in removing the additive noise and will reverse the blurring simultaneously, it will executes as a optimal tradeoff between noise smoothing and inverse filtering Normally Median filter [13-15] will be replace the values of a pixel by grey levels using the below function.

In turn median filter is also named as statistics filter or nonlinear filter, you can implement the median filter in the below equations

Median (P) =Med {Pi} (1)

Median (P) =Med {Pi} (2)

=Pi (K+1)/2, K is odd (3)

=1/2[Pi (K/2) +Pi (K/2) +1], K is (4)

In the above equation P1, P2, P3…..PK is the sequence, which indicates the neighbor pixel .The pixels should be arranged, should be either ascending or descending order. Usually the pixel sequence will be Pi1<=Pi2<=Pi3<=….PiK after applying filtering and performance sorting.

Wiener filter is used to remove the blur images due to linear motion of unfocussed optics, the blur image will happens if the shutter speed is too slow and camera is in motion if a given pixel will be an amalgram of intensities from points along the time of the camera motion , The two –dimensional analogy is

G(u,v)=F(u,v),H(u,v) (5)

Here F indicates the Fourier transform and H is the blurring function, which is termed a sinc function, If there is a three pixel in a line having the same info then the digital image will be pointed in the time domain with the three point box car and this can a reverse engineer or F estimate if H and G are known values and this technique is termed as inverse fitering.

There are two problems occurred in the real word when H value is not known then the engineer can assume the blurred function for that situation, But identifying the good blurring requires need to experiments lot of trial and error methods.in some of the case in inverse filtering the sinc function will goes to 0 for the values x and y in this case the real picture will be having lot noise which is amplified which will destroy the reconstruction of an Fest. For this the best method for solve the second problem is use the Wiener filtering which is mentioned below .The tools will solve the estimate of F accordingly below.

$$Fest(u,v) = |H(u,v)|^2.G(u,v)/(|H(u,v)|^2.H(u,v) + K(u,v)) \quad [6]$$

Where K is a constant, which is required to optimize the estimate.

In the image segmentation, we are using seven methods namely; Prewitt, Sobel, Roberts, LoG, Canny edge detection, basic global thresholding and Otsu's global thresholding methods and the results are compared by visual inspection.

We use fuzzy technique for the effective image segmentation. Different phases are involved for the effective segmentation such as SIFT, Fuzzy image segmentation [7], Detection algorithm, Training phase, Testing phase. In the SIFT phase four steps are involved such as scale space extrema detection, Key

point descriptor, Orientation Assignment, Key point localization

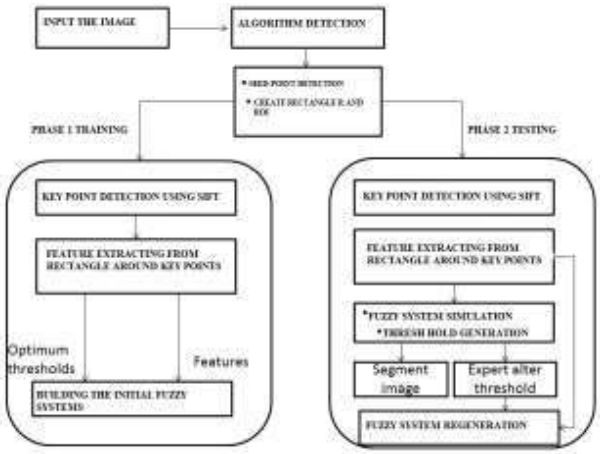

Fig 3 The effective Fuzzy Segmentation technique

3.3 Proposed algorithm using Deep learning technique

Data augmentation: We use data augmentation technique for solving the fitting problem, We train the DLCNN using the dataset by increasing the count from 600 to 1500 to 100 for both the negative and positive images, To maintain the accuracy we flipped the images by 90 degree and algorithm is applied for extraction and again flipped by 90 degree and applied the algorithm, We did this for 360 degree and observed that image extraction is similar in all the angles [8]

No of Data sets	Data Sets for Training	No of Positive Images for Extraction	No of Negative Images for Extraction	Total no of Images	for What Purpose
Data Set1	*600*	*300*	*300*	*600*	*for Training*
Data Set2	*1500*	*750*	*750*	*1500*	*for Training*
Data Set3	*100*	*50*	*50*	*100*	*for Training*

Table 1: Data sets for Conjunctivitis

Training the DLCNN Networks: The DLCNN is trained with three different datasets. It starts with the data set one contains 600 Images initially and increased the value for 1500 in data set two and then with data set three with 100 images [8]

Convolutional Layers: We used 4 x 4 filters for all the layers, the first three layers is having 25 feature maps and fourth and fifth layers is doubled featured maps i.e. 50 feature maps and the last layer is tested with 100 feature maps [8]

Pooling layers: Feature maps is used for extracting the feature and pooling layers are used for decreasing the resolution in the feature maps, we used three pooling layer using 2 x 2 windows pixel stride [8]

Fully connected layers: The image classification is done fully connected layers, we added 2 FCL having the channel of 2048 layers each and the output is given to softmax function.

4. Experiments and Results

We used python language for deep learning algorithm refereed in keraas website [9] for training the CNN model in the Windows 10, i7 processor.

Datasets

Datasets	Train accuracy %	Test Accuracy (%)
SET 1	*86.725*	*73*
SET 2	*94*	*91*
SET 3	*95*	*93*

Table 2: Results of Conjunctivitis classification

In the above data sets it clearly indicates that when the proposed model is trained with the data set 1 then we can observe the difference between the train accuracy and test accuracy is enormous with the huge value difference which results in over fitting problem, However when we applied data augmentation technique in the model for the data set2 we observed that the data fitting problem is reduced and having the value difference is very less and the same is observed in data set3 also.

5. Conclusion

The analysis of medical images in CT scan, MRI, X-ray's are not effective because of the less accuracy level in diagnosing the disease. The advantage of Deep learning technique due to its multilevel of classification results in a higher accuracy level [10]. By implementing the DLCNN technique in the Medical field, it results in an exceptionally good performance. We have discussed this technique in detection of the eye disease conjunctivitis and observed that the certainty level is increased. The future scope of this research work is carried in scope the 3D DL CNN [13] and deep reasoning technique.

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