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CNN Based Disease Identification using Human Nail Images

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Abstract: ***The main idea of the system is to identify the disease without harming humans. Various diseases can be detected by observing the nails of a person. But it can be very difficult for our eyes to find the variations in colour of nails. Our system can overcome the limitation since whole process happens through computer. The input to the system is images of nail. The system takes the nail image of the person and tries to identify if any features are present or not. The colour and patterns of the nails can be used for the identification of disease. Here, first the nail images are trained with various diseases through the CNN model This trained images of nails are used to compare with the input image to identify the disease. If trained nail images matches with the features of the input nail image, then the disease will be identified. To identify the features properly, the nail images undergo different processes. The images are analysed properly and are processed to extract the required features.***
Keywords: Image processing, Deep Learning, CNN, ANN, Nail Features

I. INTRODUCTION

The proposed system that is being developed is focused on image recognition based on colour and pattern analysis. In medical field human nail can be used for identifying various diseases. Many diseases can be diagnosed by using nail images of the hand. The proposed system only need the nail image of the person. The image is given as input to the model and the image is kept under different processes to identify the features in it. The image is filtered in order to remove distortions and the image is segmented into many parts. The algorithms like CNN and ANN are used to extract the features from the nail image. The colour and pattern features of the nail image are to be compared with the trained nail images. Through comparison, the system identifies the disease.

II. PROPOSED SYSTEM

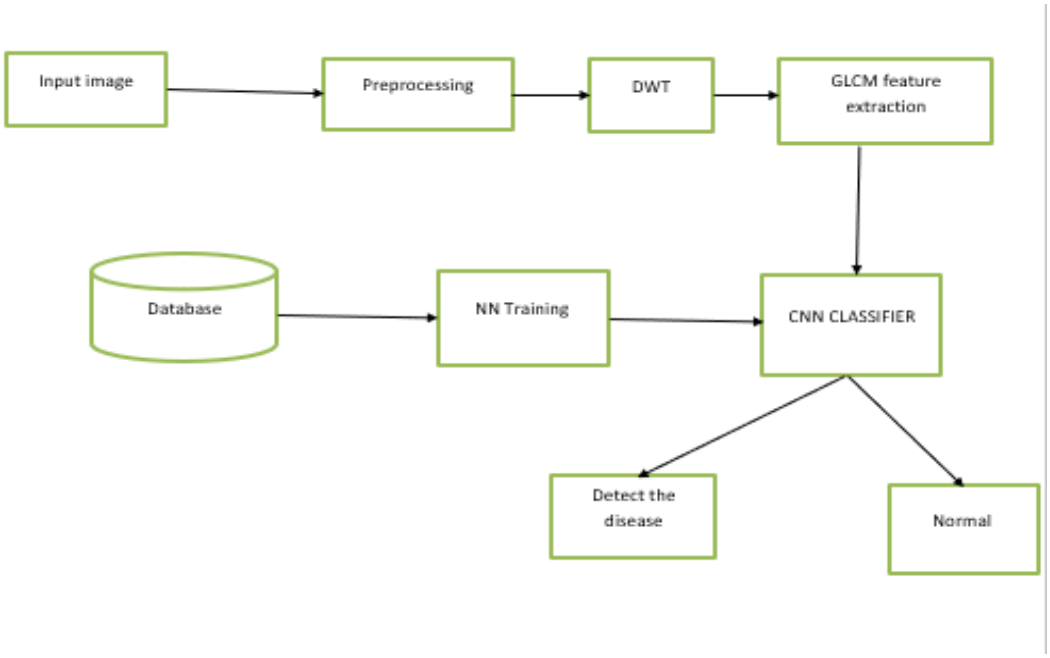


Fig. 1 Block Diagram

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A. Implementation

1) *Input Image:* The first step is to take the input image. The image can be given in jpg, png formats only.
2) *Pre-Processing:* Pre-processing means the features of the image observed and analysed. Analyses the features like colour, patterns of the nail. Resizing of image to 256x256. The colour image is converted to gray image. It is done for better extraction of features. Filtration of image is also done in pre-processing, where the unwanted distortions are removed. The distortions may be of different forms
    - Motion Blur
    - Noise
    - Camera misfocus

These distortions are removed in pre-processing and the output is the clean image. Segmentation is also done in pre processing which means it divides the given image into several multiple regions in order to extract the feature from the image.

B. DWT (Discrete Wavelet Transformation)

The Discrete Wavelet Transform is used for decomposition of the input image. We are using 4 levels of decomposition in the proposed system. Here, we do image compression from high level to low level. It makes the further process easy. And by compression of image we can reduce the storage usage. By this, decomposition accuracy can be increased.

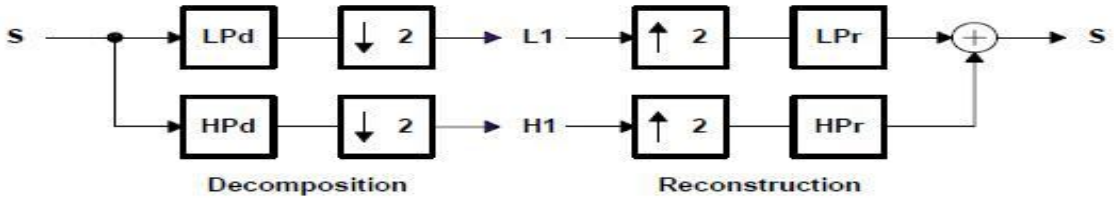


Fig. 2 Discrete Wavelet Transform

C. GLCM (Gray-Level Co-Occurrence Matrix)

Gray Level Co-Occurrence Matrix. GLCM can be created by Gray Co-matrix function. It is used to analyse the features of the images of the nail. It also analyses how the pixel values of the image occurs. Features are analysed based on the statistics like colour contrast, average value, entropy, homogeneity, and correlation. In the process of creating GLCM, first, we convert the RGB image into gray image. Comparison of every pixel and analysis of the pixel with the adjacent pixels is done, which results in the pixel values in pairs. These pixel values are to put as a square matrix.

D. ANN (Artificial Neural Network)

ANN has different layers where many neurons are interconnected. The input given will be processed through all the layers to give the output. ANN is used for classifying the images. It can also perform regression. It can accept the input in the form of images, text or any other format. The image to be processed is given as input to the input layer, the neurons in the input layer takes the input to process it further.

Layers of ANN:

1) *Input Layer:* It is the first layer of ANN, where input is given. The input may be in the form of text, image, voice or data. The output of input layer is as input to the hidden layer.
2) *Hidden Layer:* It is the intermediate layer of ANN. The main function of this layer is extracting the high level features from the input image.
3) *Output Layer:* This is the final layer of ANN. The function this layer is to produce the final output of the network i.e., the classification label or the numerical value or probability distribution.

E. CNN (Convolutional Neural Network)

CNN is a deep learning algorithm. It can be used for processing of data and for recognizing objects and images. It performs classification. It is more efficient than any other algorithm. CNN can identify any object and can perform image recognition. CNN can perform better classification of the images. CNN has large number of filters inside the layers. In CNN, there are many models which can perform image and object recognition. In the proposed system, we are using DenseNet121.

It has 3 layers

1) *Convolutional Layer:* All the computations mainly occurs in this layer. Kernel filter is used in this layer for further processing. The filter will be passed through out the image for the to check if the features are present or not.
2) *Pooling Layer:* It improves the efficiency of CNN. It reduces the complexity. Pooling layers are of two types.
    - Max Pooling: It takes the maximum value of elements. It only considers the relevant features and discards the irrelevant features.
    - Min Pooling: It takes the average value of the elements. It reduces the noise and gives smooth output.
3) *Fully connected Layer:* The main function of this layer is image classification. It is the final layer which is used as output layer.

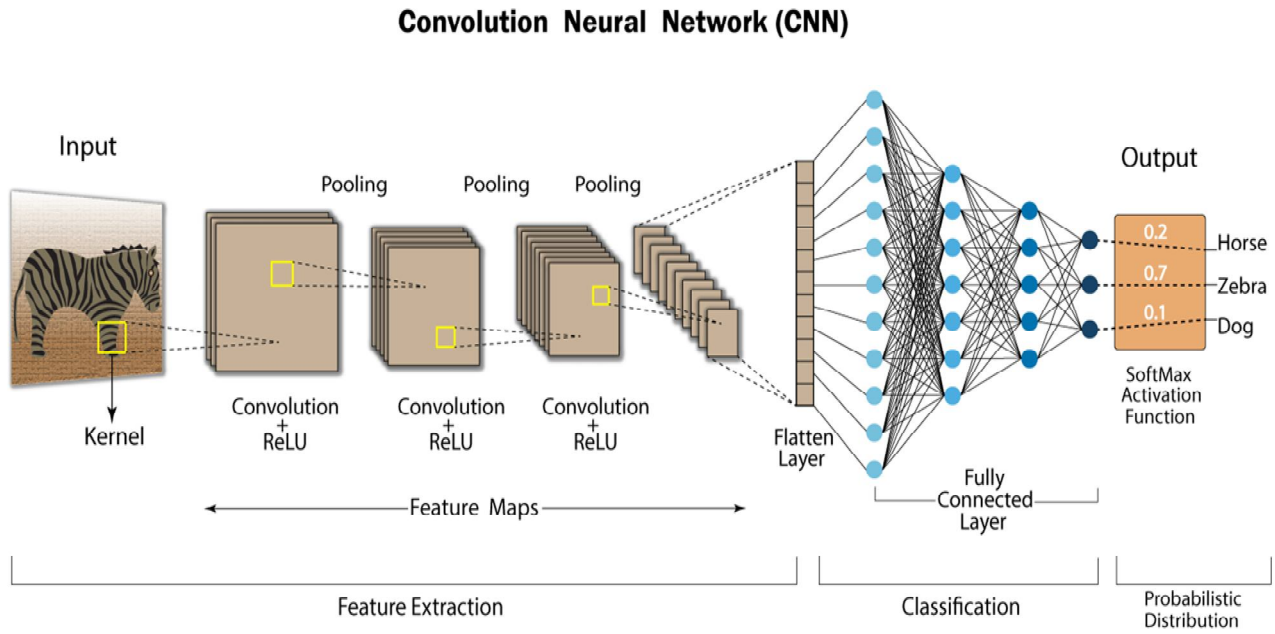


Fig. 3 Convolutional Neural Network

F. DenseNet121

DenseNet121 is a trained model of CNN. The processing of data happens through 121 layers. The neurons connectivity of DenseNet is more and it can cover more area of the given input image. It can be used for image classification, recognition and object recognition. It has layers same as CNN but has extra 4 dense blocks, which has convolutional layers. Each layer will have 64 filters of 7x7 size. The image is given as input to the input layer. And the image is processed through pooling layer and the output of it is connected to the dense blocks. Every dense block output is connected to the next block. Every dense block are separated by transition layers. It is more efficient. Efficiently classifies the images and gives the results with greater accuracy.

1) *Layers Of DenseNet121*

a) *Convolutional Layer:* Interconnection of more number of neurons.
b) *Pooling Layer:* Output of convolutional layer is given as input to the pooling layer. The main function of pooling layer is to remove distortions.
c) *Dense Blocks:* There are four dense blocks after the pooling layer. All dense blocks are separated by transition layer.
d) *Output Layer:* The classified label is given by the output layer.

2) *Advantages of DenseNet121*

- Low memory requirement
- Improved performance
- Feature reuse

A. Diseases based on Nail colour and Patterns

Based on Colour

Type of Nail	Nail Image	Disease	Causes
Black Nail		Skin Cancer	• Exposure to UV radiation • Exposure to chemicals
Yellow Nail/Greenish nail		Jaundice	• Infections • Genetic Disorders
Bluish Nail		Thyroid	Fungal Infection
White Nail/Pale Blue Nail		Liver Disease	• Obesity • Alcohol misuse

Fig. 4 Diseases Based on Colour

Based on Patterns on nails

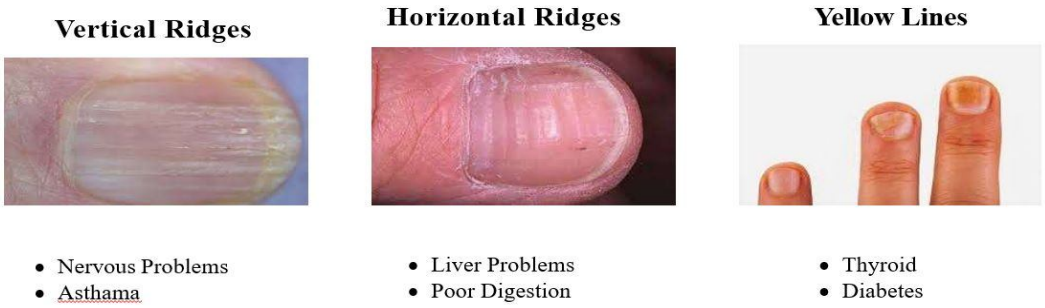


Fig. 5 Diseases Based on Patterns on nails

III.EXPERIMENTAL RESULTS

Two algorithms for classification namely Artificial Neural Network and Convolution neural network were used. The two algorithms are compared based on the following parameters:

1) Accuracy
2) Specificity
3) Sensitivity

The parameters used for analysis are

TP-True Positive, TN-True Negative, FP-False Positive, FN-False Negative.

All the three parameters are compared between the two algorithms. ANN is the older version which is less accurate. CNN is the latest model which can perform the classification better and it gives better results than ANN. CNN gives more accuracy and sensitivity than ANN. And the specificity is almost equal in both the algorithms.

TABLE I
METRIC VALUES FOR ANN AND DENSENET121

S.no	Metrics	ANN	DenseNet121
1	Accuracy	63.64	90
2	Specificity	66.66	60
3	Sensitivity	60	94.28

- Accuracy gives how correctly the system is identifying the diseases and normal .
- Specificity tells about how correctly the system detects the normal ones.
- Sensitivity gives how correctly the percentage of diseased ones are detected.

IV. CONCLUSION

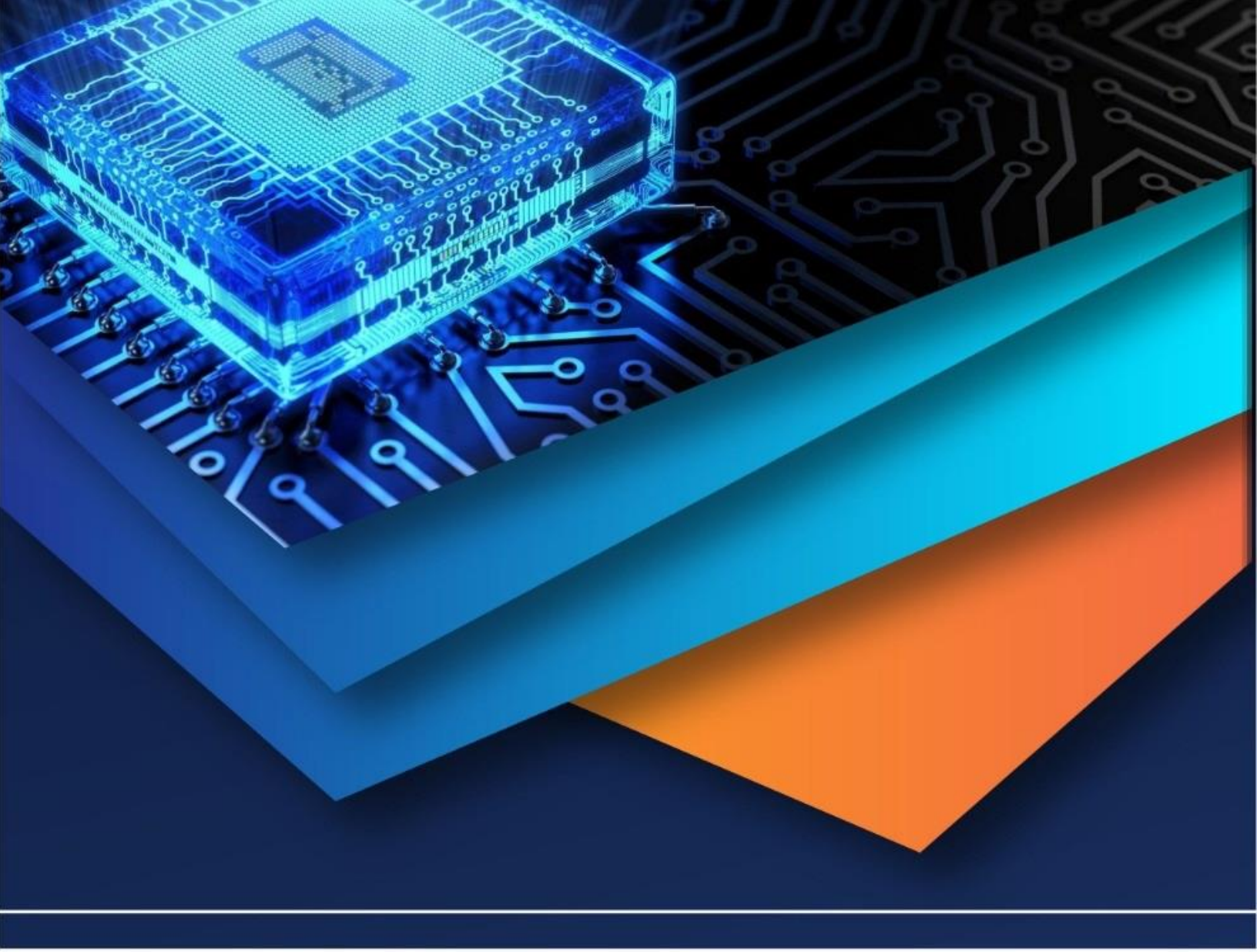
In the proposed technique we have trained a model that classifies the disease based on the colour and pattern of the nail. The system detects the diseases based on the features. It is able to identify the small patterns and colour variations also such that providing a system with higher success rate. We have used two algorithms ANN and CNN(DenseNet121) to get accurate results. The proposed model gives more accurate results than human vision, because it overcomes the limitations of human eye like to identify the variations in nail colour and patterns.

V. FUTURE SCOPE

In the proposed system we can identify the diseases based on both colour and patterns of the nail. In future this system can be improved by adding some other diagnostic features like symptoms and medical history of patient. We can also make this system to use in real-time by developing mobile app.

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