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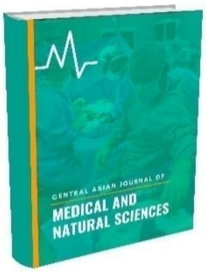

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Nail Disease Detection and Classification Using Deep Learning

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Abstract: Many disorders are identified in the early stages of diagnosis by analyzing the human hand's nails. The colour of a person's nails can aid in diagnosing certain medical conditions. The suggested approach, in this situation, leads to illness diagnosis decision-making. Human nail art is used to feed the system. The technology analyses nail photos and extracts disease-specific nail characteristics. The human nail has numerous characteristics, and the suggested system detects illness by changing the colour of the nail. The initial training set data is extracted from an image of a patient's nails with a certain condition and processed with the Weka tool. Nail To obtain the desired results, the image's feature results are compared to the training dataset. Deformation of the nail unit is referred to as nail disease. Nail units have their sickness class because of their distinct indications, symptoms, causes, and consequences that may or may not be related to other medical illnesses. Nail problems are still unknown and difficult to diagnose. This study proposes a fresh deep learning system for identifying and categorizing nail disorders from photos. CNN models (CNN) are combined in this framework to extract features. This research was also contrasted with certain other province algorithms (Support vector, ANN, K - nearest neighbors, and RF) evaluated on datasets and showed positive results.

Keywords: Human Nail, Deep Learning, CNN, Neural Networks, Preprocessing.

Introduction

The colour of human nails may be used to diagnose most nail-related illnesses in medicine. Doctors have discovered that the patient's nails can aid in diagnosing the condition. A healthy individual generally has pink nails. The naked eye is biased with colours, has limited resolution, and is a few pixels smaller than the nail, necessitating a nail analysis device for illness prediction. If the computer detects a minor nail colour change, false results might arise. The suggested system would extract colour characteristics from a nail picture for disease prediction. The computer is specialized in photo reputation based on human nail colour assessment. Many diseases may be detected by examining the nails. This equipment uses a camera and a computer to upload a nail picture. The captured snapshot is submitted to our system, and the hobby's proximity to the nail site is manually determined based on the provided photo. The chosen region is subsequently analyzed in the same way to extract nail functions, including colour. This nail colour characteristic is matched using an easy matcher set of principles for predicting illness. In this way, the gadget can help predict illnesses in their early stages. In our literature review, we discovered several diseases linked to colour changes in the nails. Deep neural networks are the most recent method for learning trends in various fields, from photo evaluation to natural language processing, and are widely used in academics and business.

These advancements have enormous promise in medical imaging technology, medical data analysis, medical diagnostics, and medical care in general, and this potential is increasingly apparent. A quick summary of current breakthroughs in machine learning as they pertain to medical imaging and image processing and some of the issues that come with it. Traditional machine learning techniques were widely utilized long before deep learning. Decision trees, SVMs, naive Bayes classifiers, and logistic regression are just a few examples. The feature extraction process represents the provided raw data, which can then be utilized to complete tasks using these standard machine learning techniques. Divide your data into various groups or classes, for example. Feature extraction is often quite difficult and needs an extensive understanding of the subject area. This pretreatment layer must be tweaked, tested, and polished across numerous rounds for the best results.

Deep Learning's synthetic neural networks are, on the other hand. The Feature Extraction phase is no longer required for them. The layers can assess an implicit depiction of the raw data quickly and independently. Over several layers of synthetic neural networks, and increasingly summarised and compressed depiction of the raw data is created. The finished result is then generated using this compressed data depiction. The outcome might be classifying the more tired data into distinct classes.

Literature Review

Because the human eye has subjective colours and resolution limitations, a tiny quantity of colour shift in a few pixels on a nail would never be emphasized to human vision, resulting in incorrect findings. In contrast, a computer recognizes small colour changes on nails. Matthew Burnette [1] worked to detect the nutrition elements in human nails using micro plasma-induced breakdown spectroscopy with a clustering algorithm using Image processing; it had poor detection. Peilun Du [2] worked with a category activation map and classifier refinement for poorly supervised object detection. It was done using a supervised algorithm using ML, but it has the drawback of high expensive. And Gaddi Blumrosen [3] did work on fingertip writing Technology Based on pressure Sensing using a colour detection algorithm in Image Processing. Still, the process was time-consuming. D. Nithya [4] worked on The blood flow alterations can easily be determined based on colour, not segmentation, in Nail Based Disease study at a preliminary phase with thresholding in Image Processing. Trupti S. Indi [5] wrote a paper on the human nail image analysis method for early disease diagnosis with a colour detection algorithm, but it had a slow detection. Dr M. Renuka Devi [6] studied the Image processing technologies used in the nail unit. The Navy Bias algorithm in ML had a low prediction rate. In this training, Mali Supriya [7] did Human Nail Image Recognition Disease Diagnosis System with Color analysis is not accurate. Ting wie-houe [8] made a method for segmenting fingernails using image processing in microscopy images by clustering in image processing, but it had a poor image quality [9-15].

Proposed System

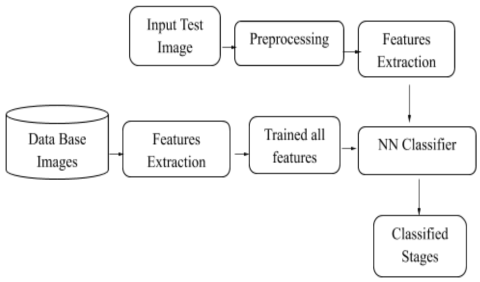

Figure 1: Architecture Diagram

The proposed process is the image of the affected nail by the available preprocessing techniques. The input image is preprocessed to reduce the noise and to enhance the input image for processing (figure 1) [16-25]. After the preprocessing stage, averaging RGB values is done to save space and reduce the size to make the processing easier [26-49]. Then, the input image is sent to the trained model, which is compared with predefined available features of the affected nail [50-71]. Based on the input image analysis over the trained model, the respective disease can be identified for that particular disease [72-89].

- INPUT IMAGE
- PREPROCESSING
- FEATURE EXTRACTION
- NEURAL NETWORK

Preprocessing

The purpose of preprocessing is to improve input image data by reducing unneeded distortion and enhancing image features used for future processing [90-101]. Image preprocessing is the general name for operation on images at low-level abstraction. Their input and output are images with intensity. Image recovery compares a corrupted / noisy image to the original, clean image. Corruption can manifest itself in several ways, including Motion blur, noise, and camera blur are all examples of B [102-115]. Picture enhancement is not the same as image restoration. Image augmentation seeks to improve the functioning of images and make them more appealing to viewers [116-121]. However, it does not always produce scientifically accurate. The Imaging Package picture enhancing techniques (such as contrast stretch and nearest neighbour blur) does not rely on an a priori description of the image creation process [122-145]. Enhancement noise can be effectively removed from photos at the cost of some resolution, but this is unacceptably low in many situations [146-151]. The resolution in the z-direction of a fluorescent microscope is already modest [152-168]. You'll need to utilize more powerful image processing techniques to restore items [169-175]. An example of an image reconstruction approach is deconvolution. You can boost the axial resolution to reduce noise and boost contrast [175-181].

Neural Network

A Convolutional Neural Network is a neural network which specializes in processing input data that have grid-like topology pictures [182-189]. The binary representation of visual data of a digital image [190-195]. It has a series of pixels that look like a grid and contains values of pixelsportray the colour and brightness of every pixel (figure 2).

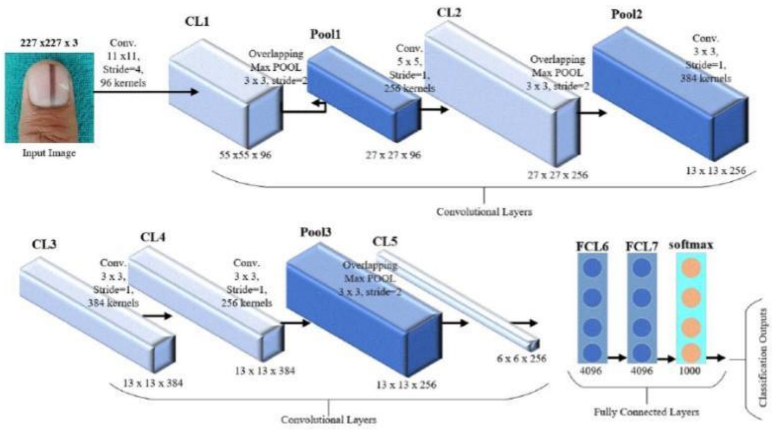

Figure 2: Architecture of CNN

The convolutional layer is a component of the CNN. It occupies most of the workloads on the network [196]. This layer is a two-matrices inner multiple. One of its matrices is the kernel, a collection of learnable parameters, while the other matrix represents a restricted field section. The kernel appears to be spatially smaller and more detailed than the image [197-199]. For example, if a picture has three (RGB) channels, the core width and height will be reduced in space, while the depth will extend throughout all channels. The nucleus slides over the image's height and width during the forward travel, creating a visual representation of its receiving region. An activation map is a two-dimensional representation of the image that results from this process. This is the reaction of the kernel at each spatial position in the image. The stride refers to the kernel's floating size. The size of the output volume can be calculated using an input of size W x W x T and a kernel Dout number of space size F with increment S and fill P:

$$W_{out} = \frac{W - F + 2P}{S} + 1$$

For the input image with a fingernail that goes under preprocessing, it is essential to noise remove the image and suppress unwanted distortions or enhance some image features important for further processing. Then the image goes under the feature extraction like colour, shape, and texture. On the other hand, database images go under the feature extraction and then go to the trained data sets and work in the NN classifier where the input images come and get the results of classified image status. These trained datasets run the NN classifier through the various layers mentioned above and get the results of the diseases.

Implementation and Result Analysis

The proposed system was implemented using a Jupyter notebook for python, with an i5 processor of 4.0 GHz,8 GB Ram, and 60 GB of hard disk storage. The TensorFlow package is used to train the neural network VGG16 used in the model. The Image Data Generator package is essential and used to augment the fingernail images so that the system can be more accurate and robust. The Sci-kit learn library, particularly the image sub-library, helps use various image manipulation techniques for the image data involved. The cv2 package incorporates OpenCV, which helps in accessing, loading, and manipulating the image data. The algorithm for the proposed system is portrayed in Algorithm 1.

Algorithm1: Algorithm for the Proposed system
Input:Finger Nailimageryclassifiedasdeformationset **Output:** validationiftheFinger Nailimagesmatchwiththesystem
Load datasetpathintothesystem
Forimagein the deformationsets**do**
Preprocessing using digital image processing
Applyfirstset offiltersforimageinaset
Performmorphologyusing operations forimageinaset
Get average RGB
End
Gettraintest splitandvalidationsplit basedonfeaturesextracted
for imageindataset**do**
Compare test data with training data
End
Forimagesinnewdataset**do**
Get the disease name which got match in comparison
End
Loaddatainto Alex net CNNandvalidateiftheFingerNailimagery is match.

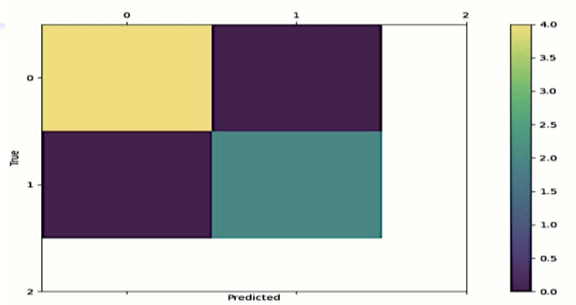

Figure 3: Output Prediction by the System

The Graph of prediction and true with a scale shows the difference with every output using a convolution neural network (figure 3). For every input, the prediction graph will appear.

From Fig 3b. and Fig 3c., It is evident that the validation accuracy rises for both sets due to the efficiency of the model. Also, the loss and validation loss decreases at the end of training. This is because of the feature extraction owing to the application of filters, morphology, canny edges and contour detection, interpolation and skewing of the images. The downsizing of images helps in choosing the best possible image data, and augmentation of the dataset before training by the neural network training increases the amount of use case. Further, the neural networks can produce output not exclusive to the input. The neural network architecture can edify its examples and properly use them when similar circumstances occur.

Result and Discussion

We considered every angle to achieve the best possible outcome. Present, in section, we looked at the results of the images we ran earlier. When compared to other recent models, we can find that our detection procedure is the best at 93.8 percent. We can observe how our CNN performed compared to a practising dermatologist and the most recent machine learning techniques with minimal preprocessing. Our findings were obtained after testing pre-trained models on various datasets. To all hidden layers, 5 max-pooling and 16-convolutional layer layers were added. After applying three correctly associated layers, RELU is projected concealed layer. After that, by seeing our output, changes in the accuracy of the synopses are significant. During our training period, the events were nearly equal, but in the case of preparing a CN2 Rule Induction, bringing the most likeable way for proposing the most favourable way (93.8 percent). We see that, by increasing the number of convolutional layers to a framework, accuracy improved due to more efficient feature extraction

(Table 1). Table 1: Comparison Table

Author	CNN model	No. of Images	Accuracy	Precision
Naveen et al. [28], 2020	Vgg16	150	76%	74.30%
Yani et al. [12], 2019	Tensor Flow Inception V3	165	94.39%	95%
Proposed Work	Alex net	185	95%	90%

Conclusion

In the technique, we have trained a system which classifies the disease on the pattern on the nail. This proposed system is to predict the disease for the pattern respective of the nail with high accuracy. It is to identify the small patterns to provide a system with a high success percentile. The proposed system excludes the drawbacks of the existing model. This way, the model is useful in predicting the diseases in their initial stages. As mentioned above, some diseases are linked to colour changes in the human nail. The model gives a greater accurate result than the naked human eye because it overcomes limitations like resolution power and subjectivity. To classify nail illnesses, we deployed an ensemble of CNNs and achieved a 95 percent classification accuracy. The task became considerably more complicated due to the lack of a pre-existing database with considerable photographs of nail illnesses. Still, shortly after that, there must be room for expansion. Early diagnosis of nail illness, which allows for prompt medical intervention, could be one of our work's applications. Dermatologists can expand on our work and utilize it to evaluate patient data and diagnose diseases with less human resources and human participation.

Future Enhancement

- In the future, even a small change in the nail can be observed, and early-stage diseases can be diagnosed.
- The diseases can be cured when it is in the early stage.
- Further, we can add the pattern of the nails for disease classification.
- Along with the feature, we can collect symptoms observed in patients as input to the disease prediction system.

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