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Expert System for Diagnosing Skin Disease

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Abstract*— The most unpredictable and difficult terrain in the field of medical diagnosis is dermatology. Dermatological diseases are the most prevalent diseases that one out of three men suffer skin disorder. Regardless of being prevalent , diagnosis of these diseases require more experience in domain. About 90 percent of skin disorders can be cured by primary care. This conveys that the early care for the disease is necessary . This early stage detection can be made easier by computer aided diagnosis system. Diagnostic expert-based computer systems that simulate the diagnostic ability of human body and disease. So we propose Expert system which classify skin diseases based on their appearance and its characteristics. Rather than training every diseases in single image classifier model . We categorize skin disease based on their characteristic and train model separately for each category. This system will filter and cleans data and categorize based on their characteristics. Feature extraction and classification using complex methods such as the convolutional neural network(CNN) and softmax classifier. This system will provide more accuracy , fast and efficient result than traditional method.

***Keywords*— Dermatology, Computer Aided Diagnosis, Expert System, Convolutional Neural Network ;**

I. INTRODUCTION

Skin diseases are common to all and a variety of allergies are common in the Human Environment . Some of these diseases can be very dangerous, especially if not treated at an early stage with efficient care. More than 125 different type of skin disease affects people all around the world. Treatment techniques and it's time period for each disease varies accordingly. Moreover, skin diseases need to be identified and treated in the early stage to avoid inflation. Doctors find it difficult to predict the disease in their initial stages. Hence, they treat the patients by following the trial and error policy. The latest study demonstrated that when only one medical provider is involved in the decision-making process, the diagnostic accuracy is only 60%.

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This can be avoided by using a expert system which will classify the diseases based on their appearance and characteristics.

II. LITERATURE SURVEY

There are many system developed for diagnosing of dermatological diseases previous. I mentioned them below. These systems are taken as inspiration and we have tried to overcome its cons. The author in [1] proposed his implementation of image processing with the help of Convolutional Neural Networks with OpevCv as Python Library. The process of diagnosis is divided into Image processing unit and Classification of disease. The layers of Convnets helps to process the given image for categorization of disease.

The AI system for Diagnosis of the Skin disease will act as human expert for the treatment of disease. The Expert Systems asks for the Symptoms and the Knowledge base of the AI will generates the result with the probabilistic inference and deep learning with neural networks by training data model[2].

The diagnosis of disease by Expert System is done by the Fuzzy Logic reasoning. The MATLAB and MIN-MAX is used by the fuzzy logic controller to generate the result with symptoms. The author specifies that their accuracy of expert system is 90.27%[8]. The author uses Forward Chaining method for the diagnosis of several skin disease. The inference method for forward chaining and decision tree helps the expert system to predict the disease with efficiency[9].

III. METHODOLOGY

Our proposed expert system mainly consist of two important component

1. Symptoms Analysis And Disease Categorization unit

In Symptoms Analysis And Disease Categorization phase of the expert, user have to provide required detail to web based expert system. In other words , system would ask user for symptoms and other disease related characteristic for branching the user to appropriate classification model. This phase plays an important role because it significantly reduce training period for classifier and increase accuracy for each model.

The main idea behind is disease in particular category will have similar properties or characteristic. Which makes the classifier more focused on minute detail rather than recognizing general patterns. The categorization of the diseases are based on their characteristics some of them are red spots , itching , dry skin, swallowing etc. but these characteristic are not mandatory to be symptoms .

2. Image processing unit

Image processing is a major part of the design process in our Expert System. Dermoscopic images or digital images taken from a simple camera usually include sounds like hair, air bubbles. These noises can lead to an inaccurate way of classification, and the system may result in incorrect estimation. Initially it is necessary to identify the area of the infected skin and undertake the image processing portion of the procedure. With the help of an average filter and a Gaussian smoothing procedure, the image of the skin disease is captured and saved to eliminate the noise in the form of eyelashes, bubbles, etc. Algorithms are used in the image segmentation process to remove the image's background. This means we separate the area of the disease. Then we finish with the image separation of the image.

IV. ARCHITECTURE

Architecture of our proposed expert system basically consist of two sub system, One for gathering data and training and updating system and another for user interaction and disease prediction. The proposed system is classified into several phases some of which are:

1. Data Acquisition

We are collecting both image data and symptoms data of diseases and store in seperate database. The image dataset is collected from both camera and online image repositories.

2. Image Pre-processing

Feeding an unprocessed image to a classifier will reduce quality and accuracy of the model. It is necessary to filter out incompatible data before feeding it into classifier model. Especially for image classifier pre-processing is important step where process like noise removal and image enhancement and segmentation takes place. Gray scale and gaussian filter are pretty standard process technique carried out before performing classification. Which are helpful in identifying salient features.

3. Category Classification

Category classification is most important phase in system. Where the image dataset is classified into several categories based on their similarities. This type of separating dataset will help in improving accuracy of disease prediction model.

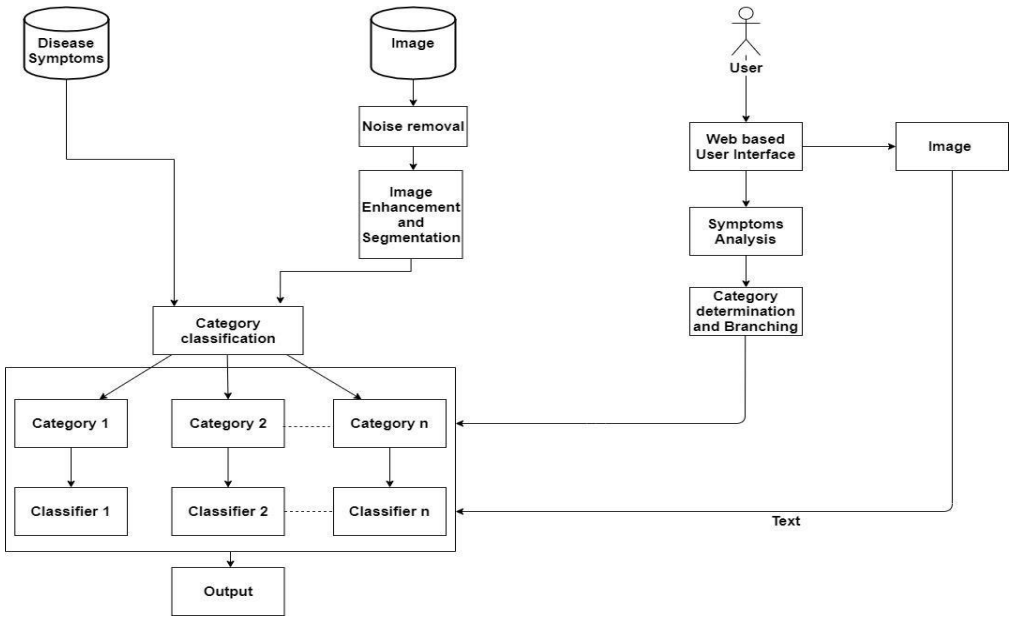

Fig 4.1 System Design

4. Training the classifier

Rather than training every dataset in a single prediction model. Each category has its own classifier. Each classifier are trained separately using its owns dataset. Thereby increasing the efficiency. Main idea behind this kind of model is that " In place of training single model for predicting multiple outcome in less efficiency, system uses separate individual model to predict outcome which has some similarities".

5. User interface

Web based user interface will intercept users query in a human friendly manner. Web based user interface is used to extract valid information form user.

Web based front end frameworks like react, angular js is used to develop.

6. Symptoms Analysis

In symptoms analysis phase, System gathers require information through a yes or no Q&A session. These are information which are not recognized visual.

These will be helpful in further diagnose of disease. These information are not certainly symptom, it may include information related to posture of the uploading photo.

7. Category Determination

Categorization or Category Determination is another important phase in system. In this phase, system navigates the user to appropriate classifier for classification using information gathered form symptoms analysis phase. So that image feeding by user will be predicted by appropriate category classifier.

V. IMPLEMENTATION

As our proposed system does not follow traditional expert system technique like knowledge base and inference engine. Those system require frequent update and maintenance to sustain reliability of the service. So our proposed system is solely based on data driven deep learning model.

1. Convolutional Neural Network

The breakthrough in Computer Vision with Deep Learning is built and perfect over time, mainly by a specific algorithm called the convolutional neural network. The convolutional neural network (CNN) is a deep learning algorithm that can take an input picture, determine the importance of different elements / objects in the image (learnable weight and bias) and distinguish one another. The Pre-processing is required very low compared to other ones on ConvNet Classification algorithms. Filters in primitive methods are hand-engineered and with the appropriate training, ConNets is capable of learning these filters / features. [3]

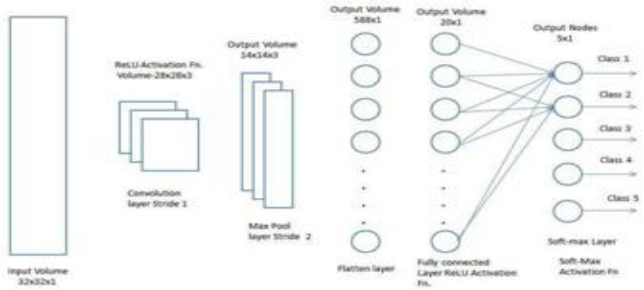

Fig 5.1 CNN Network Diagram

Through the application of relevant filters Convolutional neural Network will be able to successfully grasp the Spatial and Temporal dependencies in an image. The architecture is best fit for the image dataset like this because the reduction in the number of parameters involved and resuse weights. In other words, the network can be trained to better understand the sophistication within the image.[3] Convolutoional Neural Network basically consist of three layer.

A) Convolutional layer

A convolutional layer consists of a set of filters whose parameters must be learned. The height and weight of the filters are smaller than the input volume. Each filter is combined with the input volume to calculate the activation map made with neurons. In other words, the filter will slip in the width and height of the input, and the dot products between the input and the filter will be calculated at each spatial location. The stacking of activation maps of all filters along with the depth dimension gives the output volume of the convolutional layer. [4]

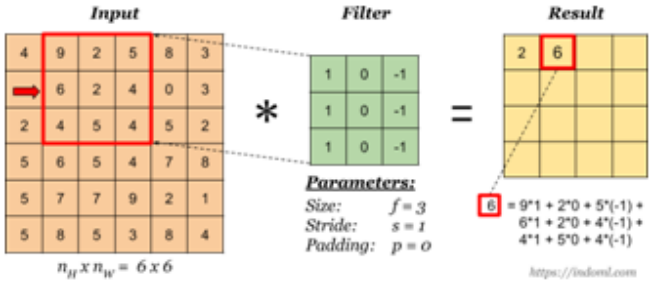

Fig 5.2 Convolution Layer

B) ReLu Activation Layer

ReLU or Rectified Linear Unit is a non-linear operation. ReLU acts on an elementary level. In other words, it is an operation which is applied per pixel and supersedes all the non-positive values of each pixel in the feature map by zero. It is basically a smooth approximation

C) Max Pool Layer

This layer is periodically inserted in the ConvNets and its main function is to reduce the size of volume which reduces the computation speed of memory and prevents overfitting. Max pooling and Average pooling are two most common types of pooling layers . If we use a max pool with 2 x 2 filters and stride 2, the resultant volume are of dimension 16x16x12.[5]

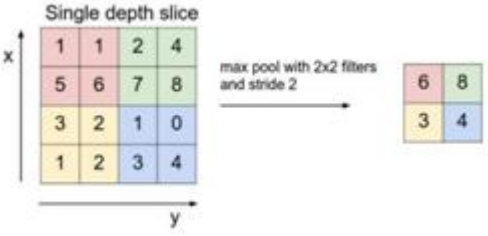

Fig 5.3 Maxpool Layer

D) Softmax layer

Softmax layer or fully connected layer is regular neural network layer which takes previous layer's input and calculates the class scores and outputs the 1-D array of size equal to the number of classes

2. Keras Backend

Keras is a model-level library that provides high-level building blocks for developing deep learning models. It does not handle low-level operations such as tensor products, convolutions and so on itself. Instead, it relies on a specialized, well-optimized tensor manipulation library that serves as Keras' "backend engine". Instead of selecting a single tensor library and linking Keros to that library, Keros handles the problem in a modular fashion and many different backend engines can be plugged into Keros smoothly.

VI. RESULT

Practical implementation of the system gives a promising results.

In first phase of implementation we use popular web framework django and basic html & css for gathering user information.

Fig 6.1 User Interface

In second phase of implementation we use pre-trained model with 90 percent accuracy. Training is done seperately and attached with application afterwards. We use Resnet34 pre- trained model for performing transfer learning.

Fig 6.2 Predictive Result

VII. CONCLUSION & FURTHER WORK

Skin diseases spreads very rapidly now-a-days and the diagnosis method using current technology helps the experts to conclude the treatment. Thus our proposed expert system model will aid and act as a support system for doctor to make decision. Since our system is based on data driven deep learning technology. The efficiency and accuracy of the system will improve subsequently with vast datasets. Unlike other expert system time and effort needed to collect training data is comparatively less. Since we are limited by available symptoms datasets, the categorization and branching operation are not efficient. In future if we get an better datasets for symptoms the efficiency and accuracy of the disease can be improvised.

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