Skin Disease Detection Using Support Vector Machine and Convolutional Neural Network

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Abstract - Dermatology deals with the diagnosis and treatment of skin diseases which is rapidly increasing for past few decades. Worldwide, skin diseases are fourth prominent non-fatal diseases. It becomes decisive to identify the disease at their early stage to restraint it from spreading which leads to diverse health complications or even death. Tests are carried out in wide. The system is designed to detect and prevent the skin disease at its early stage. The process in disease detection are Image Acquisition, Segmentation is images which is processed by Support Vector Machine (SVM) and K-Nearest Neighbor (KNN) algorithms. Feature extraction by using complex techniques and classification of images based on extracted features are trained using Convolutional Neural Network (CNN) with an accuracy of 93%. The proposed system is more accurate and efficient system for dermatological disease detection.

Key Words: Automatic detection, Convolutional Neural Network, Dermatology, Image processing, K-Nearest Neighbor, Skin disease, Support Vector Machine.

1.INTRODUCTION

Skin is the largest organ containing seven layers of ectodermal tissues, blood vessels, nerves, and muscles [6]. It plays a vital role in defending our organs from bacterial, fungal infections.

Increasing pollution, global warming and harmful UV rays are some factors which stimulates Skin infections. Skin diseases may be painful or painless with distinct symptoms. It and it is the fourth prominent non-poisonous diseases in world. Rural areas are affected largely because of skin infections. Infections may outset form childhood and some may due to gene. Some stops stepping in the society and collaborating with other people of their looks which differ from others. Such kind of mentality and attitude of person makes them depressed. Some diseases like scarlet fever, measles, eczema etc.. are quite familiar. Detection of skin infections at critical sage undergoes to numerous complications or even death.

Photosensitive skin diseases and infectious skin diseases are quite familiar in India. Countries like Bangladesh, vast people are deteriorated a lot due to skin diseases every year. It's unavoidable for patients and dermatologists to have automatic skin disease detection. Image processing is carried out in four stages likely image acquisition, segmentation, feature extraction, classification. Developed system extract some features from image pre-processing outputs and from inputs. This processing technique will be carried out on the various skin patterns and will be analyzed through which infections are identified. The user provides input of the disease image which then processed, feature extraction is done using SVM algorithm and CNN to train dataset. If disease is found, the system provides a positive outcome.

2.LITERATURE REVIEW

Multiple skin infections are classified using several image processing and machine learning techniques. The most commonly used techniques used for skin infection classifications are SVM (Support Vector Machine), artificial neural network, trees, ensemble classifiers, K-nearest neighbor and convolution neural network(CNN).

Zhang et al. used a combo of deep neural network and human intelligence to classify the seborrheic keratosis, melanocytic nevus, and psoriasis. Their accuracy rate is about 87.25% with 1067 images.

Kyamelia Roy elaborates the prototype using feed forward artificial neural networks. Hashim et al used several matlab tools for image processing

and Wahab et al conferred a texture classification.[7]

A multi-layered system was proposed and evaluated by Solomon A. Odunaike by using ANN to develop the single layered and multi-layered system.[1]

Due to these limitations and accuracy, there is a need for an intelligent system that can execute the multi-class classification of a wide range of skin infections. In this research identical approaches are used in order to recognize various types of skin diseases from image.

3.PROPOSED METHODOLOGY

The main objective of the proposed system is to detect and classify the skin disease with the broadly categorized following stages:

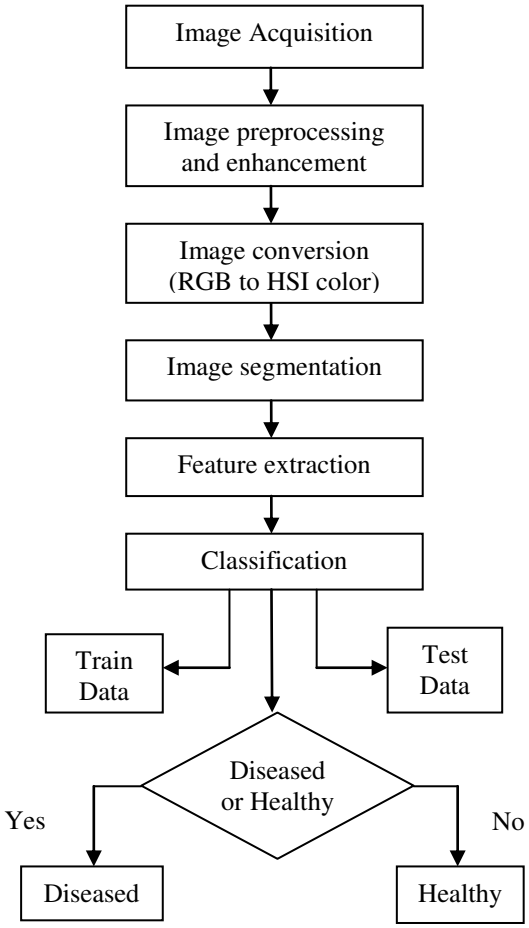

Fig1: Proposed system design

i. RGB image of all skin samples are picked

ii. Color transformation is created and converted into HSI color.

iii. Segmenting the images with the help of SVM and KNN algorithm.

iv. GLCM function is used to extract and calculate features from the images.

v. CNN is to classify the features, train the data and identify disease.

In the proposed system, first and the foremost step is data collection. Images of healthy, Eczema, Scarlet fever, measles and acne are collected from various sources, and dataset is created.

3.1 Image Acquisition

The dataset of the skin images are collected through either by live or stored dataset. The input image is clear and a high quality image is required. The skin diseases that are mostly found in scarlet fever, measles, eczema etc... Segmentation is done using some algorithms after acquiring the images. The images in the data are categorized into training and testing dataset.

	Training Images	Testing Images	Total
Healthy	211	124	335
Melanoma	154	109	263
Vascular lesions	177	117	294
Dermatofibroma	111	98	209
Melanocyticnevi	160	120	280
Total	**813**	**568**	**1381**

Tab 1: Training and Testing datasets

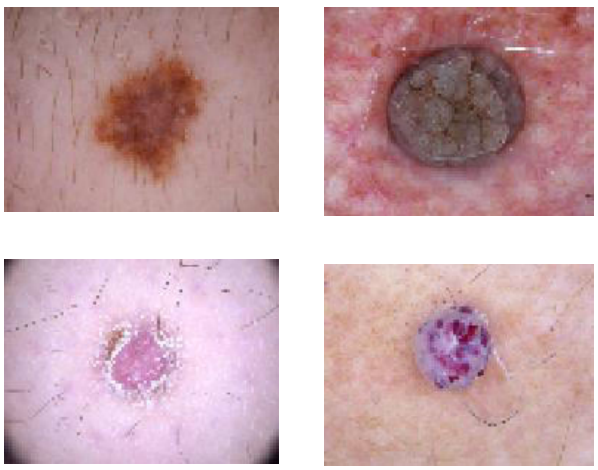

Fig 1: Sample images from dataset

3.2 Image Segmentation

Segmentation is the process of isolating the digital images into various segments to observe or remove the part of infected skin. The image is converted into pixels which is below or above the given threshold value. The segmentation stage includes steps: Image thresholding, image filling, image opening, converting extracted region to gray level [4]. Since this way of segmenting images does not give effective values and limits the classification, hence we use SVM and KNN algorithm. Segmentation by SVM and KNN algorithm using color, partitions the image in to consequential parts for enhancing the analysis and understand the images.

3.2.1 SVM Algorithm

SVM is one of the most common machines learning algorithm that can be used in data classification [5]. It is used for segmentation of images. The primary objective of SVM, is to detect the optimal separating hyper plane which enhance the edge of training data that binds all the training vectors into two collections detached by hyper plane of one training vector as (+1) and other training vectors as (-1) from datasets. Accused images are fed as input to SVM for extracting features. We can design a multiclass SVM model and train dataset or any image and classify our data of predetermined aspects from diseases infected skin and healthy skin. The designed algorithm is enforced on a database of 500 images of skin obtained from the plainly available dataset.

3.2.2 KNN Algorithm

KNN (K-Nearest Neighbor) is actually simple, highly capable and adequate algorithm for image processing. In KNN, classification of skin samples is based on the nearest neighbor of their class [2]. KNN is frequently used in many studies, especially when there are only few or no information about the data distribution.

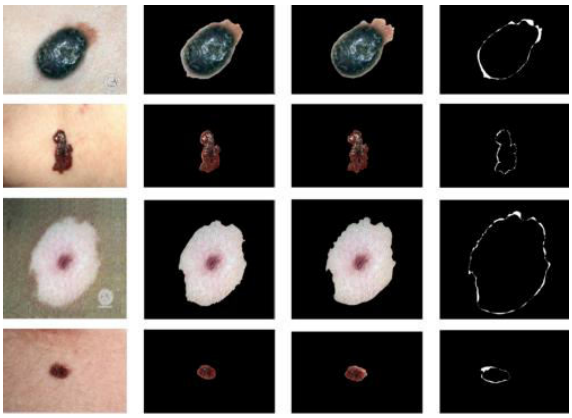

Fig 3: Segmented images

The skin color in texture is extracted and combined together to form a feature vector which is then compared with an existing database of diseased and normal skin. Generalization is not made by KNN which involves and maintains all training images or data.

The "K" neighboring objects is found for every row in the set of training data and test data is classified by bulk poll with ties are collapsed at random. Instances are admitted in the poll when there are ties for the vector which is K the nearest [4]. Distance between training vectors are calculated and particular procedure is used for calculating distance between all training vectors. In case of two input skin images, magnitude of difference is computed as the Euclidean distance between vectors of two input p and q [Equ 1] i.e. p - q where they have "m" dimensions i.e p = (p1, p2, p3, p4,.....,pm) and q = (q1, q2, q3, q4,.....qm).

$$d_{L2}(x,y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2} \rightarrow (1)$$

Equ 1: Euclidean distance

Then take the test instance "x" is taken and K-nearest neighbors is found from training data, "x" is assigned to the class appearing most among the K neighbors

	Healthy	Melanoma	Vascular lesions	Dermato fibroma	Melanocytic nevi
Healthy	901	1	2	0	0
Melanoma	0	244	27	2	1
Vascular lesions	0	19	263	7	1
Dermato fibroma	1	1	2	738	162
Melanocytic nevi	0	1	3	148	218

Tab 2: Confusion matrix of SVM classifier

3.3 Feature Extraction Of Segmented Images

Feature extraction is the main and foremost step in image processing. Features are extracted from the segmented images and taken for classification. Feature extraction on the segmented images are carried out in 4 stages, they are

Stage 1: Enter the number of the disease that affected skin part only.

Stage 2: If the images are in RGB, then convert it into gray scale images.

Stage 3: Create the Gray Level Co-occurrence Matrices (GLCM) for extracting the feature from images.

Stage 4: Derive features from GLCM matrix.

Various disease skin features based on texture are obtained using Gray Level Co-occurrence Matrix (GLCM) for diseases identification. This method is the extraction of statistical features for reviewing the spatial relationship of pixel level

3.4 CNN Techniques For Classification

Convolutional Neural Networks are known to be immensely in the field of identification and image classification.

CNNs have three layers like input layer, hidden layer and output layer. Convolutional layer performs convolution operation to the given skin images. Then pooling groups the clustered features into single part. Features which are extracted from skin images are classified and trained. This makes deep learning extremely accurate for computer vision tasks. Here each layer enhances the complexity of the features in images.

Some of the stages included in the CNN techniques are follows:

i. Get input of skin image and apply different filters to create a feature map.
ii. Apply a pooling layer which is the next layer of CNN to each of the feature map.
iii. Determine the long vector from the pooled images and input the same into fully connected neural network.
iv. Now it processes the features by the network and trains through forward and back propagation. This is repeated until well defined network with trained feature detectors.

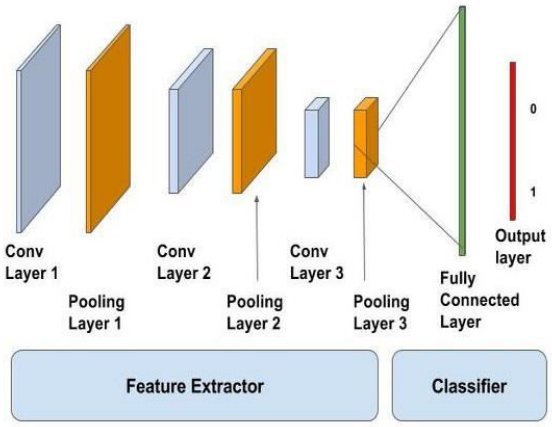

Fig 3: Convolutional Neural Networks

4 RESULTS & DISCUSSION

The proposed system has been conferred as an intelligent expert to execute multi-class classification of skin infection implemented in Tensorflow by using machine learning algorithms. Testing is done with 1380 skin images in total for 7 infections. The segmentation technique displays promising outcomes for four different categories of diseases. The designed system is a powerful tool for segmentation, extraction of features, and classification of skin infections using CNN and SVM. The overall accuracy attained by KNN and SVM classifier is 93%. We conclude that the combination of the three transforms afford the maximum and decisive detection of infection.

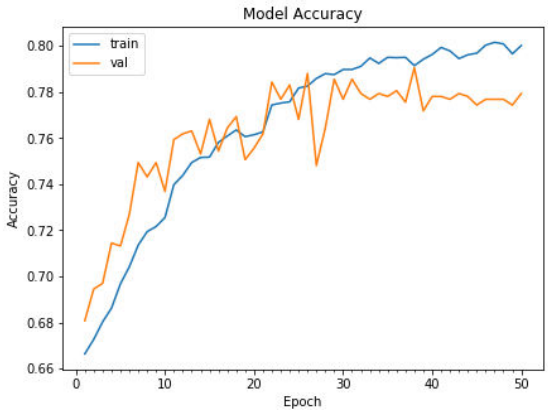

Fig 4: Proposed System Accuracy

Automated classification of skin lesions using images is a challenging task owing to the fine-grained variability in the appearance of skin lesions. Our project can assist in proper treatment methods for a patient diagnosed with skin diseases

Author's name	Algorithm	Accuracy
Kyamelia Roy	SVM	80%
Zhang et al	CNN	87.5%
Sultana et al.	SVM,CNN	90%
Our proposed system	SVM,KNN,CNN	93%

5 REFERENCE

[1] Damilola A. Okuboyejo, Oludayo O. Olugbara, and Solomon A. Odunaike, "Automating Skin Disease Diagnosis Using Image Classification," Proceedings of the World Congress on Engineering and Computer Science 2013 Vol II WCECS 2013 , 23-25 October, 2013, San Francisco.

[2] R. Yasir, M. Rahman, N. Ahmed, "Dermatological Disease Detection using Image Processing and Artificial Neural Network".

[3] R. Sumithra, S. Mahamad , D. Guru, "Segmentation and Classification of Skin Lesions for Disease Diagnosis," International Conference on Advanced Computing Technologies and Applications.

[4] L.Wei, Q. Gan, and T. Ji, "Skin Disease Recognition Method Based on Image Color and Texture Features," Computational and Mathematical Methods in Medicine Volume 2018.

[5] Nazia Hameed, Antesar M, M. A. Hossain Multi-Class Skin Diseases Classification Using Deep Convolutional Neural Network and Support Vector Machine

[6]. Jainesh Rathod, Vishal Waghmode, Aniruddh Sodha, Dr. Prasenjit Bhavathankar Diagnosis of skin diseases using Convolutional Neural Networks

[7] Kyamelia Roy Sheli Sinha Chaudhuri Sanjana Ghosh Skin Disease detection based on different Segmentation Techniques

[8] Nazneen N Sultana , Bappaditya Mandal, N. B. Puhan, Deep Residual Network with Regularized Fisher Framework for Detection of Melanoma (2018).