# Survey on Features and Techniques used for Skin Disease Classification

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***Abstract:*** *Dermatology is one of the most unpredictable and difficult field to diagnose due its complexity. In the field of dermatology, many a times more tests need to be carried out so as to decide the skin condition the patient may be facing. The time may vary from practitioner to practitioner. This is also based on the experience of that person too. So, there is a need of a system which can detect the skin diseases without any of these constraints. Machine learning and image classifier can be used to efficiently detect the skin diseases. This paper is a study on the various techniques we can employ for the classification of skin diseases. This paper likewise briefs about the openly accessible skin dataset for testing and investigation.*

***Keywords: Convolutional neural networks, Skin Disease, Tensorflow, machine learning***

## I. INTRODUCTION

Skin diseases are a major health problem in both high and low income countries and are the fourth leading cause of non-fatal skin disease burden. Skin diseases occur due to several factors like exposure to UV radiation, tanning, history of the family, environmental factors, alcohol etc. These factors affect the skin and have a devastating impact on its well-being. Skin diseases cause several problems like isolation, physical impairment, self-harm, body changes, difficulty in a relationship, unemployment, alcoholism and even death in case of malignant melanoma. Sometimes patients suffering from skin diseases attempts suicide.

Classifying skin diseases require domain expertise, specialized equipment and expert knowledge and there is a gross mismatch between the burden of the skin patients and resources required to manage them. Especially people living in low-income countries do not have access to these resources. Therefore, to decrease the problems caused by skin diseases, there is a need for intelligent expert systems that can perform multi-class skin disease classification to help the people for early diagnosis.

Image processing and machine learning based studies are being used in several areas such as face recognition, fingerprint recognition, tumor detection and segmentation. Different Machine Learning algorithms are used for the classification tasks in these areas. The commonly used ML algorithms are LDA, SVM, Artificial Neural Networks (ANN), Naive Bayes Classifier, K-Nearest Neighbor (KNN), and Deep learning algorithms. The selection of input feature is very important in any classification task, using ML algorithms.

### A. Skin Diseases

Skin diseases vary in severity and symptoms. Some diseases can be permanent or temporary, and may be painful or painless. Some may be genetic, while other may have situational causes.. Some skin conditions are minor and others can be major.

There are many different types of skin diseases, some are given below

**Acne**

These are commonly located on the face, neck, shoulders, chest, and upper back. Breakouts on the skin composed of blackheads, whiteheads, pimples, or deep, painful cysts and nodules and may leave scars or darken the skin if untreated.

**Psoriasis**

These are scaly, silvery, sharply defined skin patches and commonly located on the scalp, elbows, knees, and lower back. It may be itchy or asymptomatic.

**Melanoma**

These are the most serious form of skin cancer, more common in fair-skinned people. Symptoms of melanoma include mole anywhere on the body that has irregularly shaped edges, asymmetrical shape, and multiple colors. It has changed color or gotten bigger over time and usually larger than a pencil eraser.

**Measles**

Measles **s**ymptoms include fever, sore throat, red, watery eyes, loss of appetite, cough, and runny nose,

Also red rash spreads from the face down the body three to five days after first symptoms appear. Small red spots with blue white centers appear in the mouth.

**Hives**

Hives **s**ymptoms include Itchy, raised welts that occur after exposure to an allergen. These are red, warm, and mildly painful to the touch and can be small, round, and ring-shaped or large and randomly shaped.

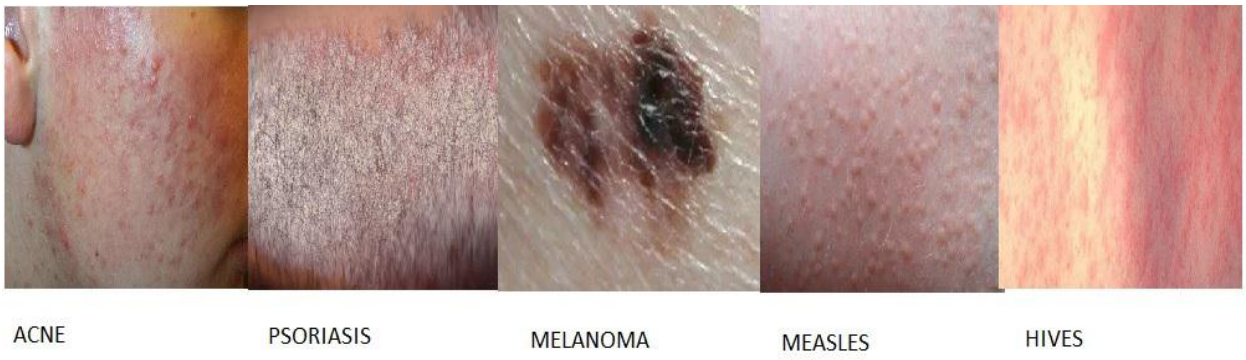


**Fig. 1** Types of Skin Diseases

## B. Convolutional Neural Networks (CNN)

Convolutional Neural Networks are a type of Artificial Neural Networks that are known to be immensely potent in the field of identification as well as image classification. We take an example to explain the same

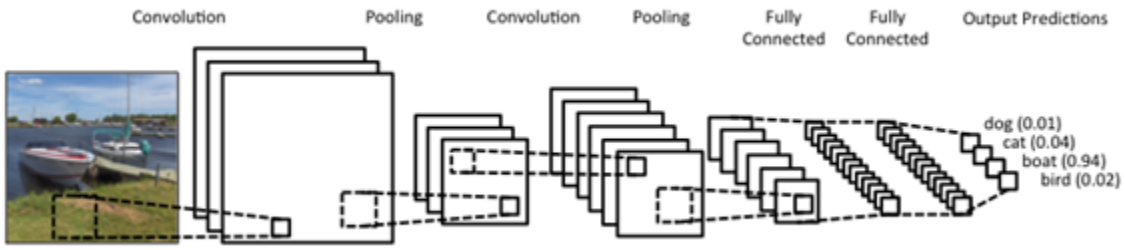


**Fig. 2**. CNN Architecture

Four main operations in the Convolutional Neural Networks are shown as follows:

(i) Convolution: The main use of the Convolution operation in case of a CNN is to identify appropriate features from the image which acts as an input to the first layer.

(ii) Non-linearity: 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.

(iii) Pooling or sub-sampling : Spatial Pooling which is also called subsampling or downsampling helps in reducing the dimensions of each feature map but even while doing so, retains the most consequential information of the map. After pooling is done, eventually our 3D feature map is converted to one dimensional feature vector.

(iv) Classification (Fully Connected layer): The output from the convolution and pooling operations provides prominent features which are extracted from the image. These features are then utilized by Fully Connected layer for relegating the input image into different classes predicated on the training dataset. [2]

## II. RELATED WORK

Dai, Xiangfeng, et al. [1] propose an on-device Inference App, where the classification model is pre-trained and stored on a mobile device, where it is used to perform classification of new data, which, consequently, does not need to be shared externally. We demonstrate the basic principles including its evaluation using a case study, which focuses on skin cancer - one of the most common human malignancies.

Kumar, et al. [2] propose a method to identify whether a given sample is affected with Melanoma or not. The steps involved in this study are collecting labeled data of images that are pre-processed, flattening those images and getting the pixel intensities of images into an array, appending all such arrays into a database, training the SVM with labeled data using a suitable kernel, and using the trained data to classify the samples successfully. The results show that the achieved accuracy of classification is about 90%.

EL SALEH, et al. [3] proposes an automated facial skin disease method using a pre-trained deep convolutional neural network (CNN). In the beginning, the images are regenerated using some pre-processing image techniques in order to augment the size of our database, collected from different sources and resized to fit the network. These images are then used for training and validation purposes. We will show that our model can successfully identify eight facial skin diseases, normal skin class and no-face class and with an accuracy of 88%

Patnaik, et al. [4] provides an approach to use various computer vision based techniques (deep learning) to automatically predict the various kinds of skin diseases. The system uses 3 publicly available image recognition architectures namely InceptionV3, InceptionResnetV2, MobileNet with modifications for skin disease application and predicts the skin disease based on maximum voting from the three networks. These models are pre trained to recognize images upto 1000 classes like panda, parrot etc. The architectures are published for public usage for various applications. The system consists of three phases- The feature extraction phase, the training phase and the testing phase. The system makes use of deep learning technology to train itself with the different skin images. The main objective of the system is to achieve maximum accuracy of skin disease prediction.

Rathod, et al. [5] propose an automated image based system for recognition of skin diseases using machine learning classification. This system will utilize different computational technique to analyze, process, and relegate the image data predicated on various features of the images. Skin images are filtered to remove unwanted noise and process it for enhancement of the image. Feature extraction using complex techniques such as Convolutional Neural Network, classify the image based on the algorithm of softmax classifier and obtain the diagnosis report as an output. This system will give more accuracy and will generate results faster than the traditional method, making this application an efficient system for dermatological disease detection.

Vinayshekhar Bannihatti Kumar, et al [6] provide an approach to detect various kinds of skin diseases. We use a two stage approach which effectively combines Computer Vision and Machine Learning on clinically evaluated histopathological attributes to accurately identify the disease. In the first stage, the image of the skin disease is subject to different kinds of pre-processing techniques followed by feature extraction. The second stage involves the use of ML algorithms to identify diseases based on the histopathological attributes observed on analysing of the skin. Upon training and testing for the 6 diseases, the system produced an accuracy of up to 95 percent.

Gao, et al. [7] describe an approach for image recognition with specific focus on automated recognition of plants and flowers. The approach taken utilizes deep learning capabilities and unlike other approaches that focus on static images for feature

classification, we utilize video data that compensates for the information that would otherwise be lost when comparing a static image with many others images of plants and flowers. We describe the steps taken in data collection, data cleaning and data purification, and the deep learning algorithms that were subsequently applied. We describe the mobile (iOS) application that was designed and finally we present the overall results that show that in the work undertaken thus far, the approach is able to identify 122/125 plants and 47/50 genera selected with degrees of confidence up to 95%. We also describe the performance speed up through the use of Cloud-based resources.

Hameed, et al. [8] an intelligent diagnosis scheme is proposed for multi-class skin lesion classification. The proposed scheme is implemented using a hybrid approach i.e. using deep CNN and error correcting output codes (ECOC) support vector machine (SVM). The proposed scheme is designed, implemented and tested to classify skin image into one of five categories, i.e. healthy, acne, eczema, benign, or malignant melanoma. Experiments were performed on 9,144 images obtained from different sources. AlexNET, a pre-trained Convolutional Neural Network model was used to extract the features. For classification, the ECOC SVM classifier was used. Using ECOC SVM, the overall system accuracy achieved is 86.21%. 10-fold cross validation technique was used to avoid overfitting.

Sawant, et al. [9] Cancer is one of the most harmful disease. MRI is one of the procedures of detecting cancer. ML with image classifier can be used to efficiently detect cancer cells in brain through MRI resulting in saving of valuable time of radiologists and surgeons. This paper focuses on the use of Tensorflow for the detection of brain cancer using MRI.

Gavai, et al. [10] Classification of objects into their specific classes is always been significant tasks of machine learning. Existing recent Google's inception-v3 model comparatively takes more time and space for classification with high accuracy. In this paper, we have shown experimental performance of MobileNets model on TensorFlow platform to retrain the flower category datasets, which can greatly minimize the time and space for flower classification compromising the accuracy slightly.

Hegde, et al, [11] found that there is a lack of information about machine learning algorithms for skin disease classification. To address this problem, we have collected Chronic Eczema, Lichen planus and Plaque psoriasis images using a digital camera and extracted RGB color features and Gray Level Co-occurrence Matrix (GLCM) texture features. Different combinations of features with 4 popular ML algorithms were considered to compare classifier performances. Out of the four algorithms tested, Linear Discriminant Analysis (LDA) and Support Vector Machine (SVM) showed highest classification accuracy.

Cheng Qian, et al. [12] presents an Android application to automatically identify plant species using a single leaf image as input. At the pre-processing phase, we proposed an improved segmentation method to eliminate the noise caused by capturing on non-uniform background so we can obtain the binary image which only contains the leaf shape. Then, several morphological features and Hu moment invariants descriptors were extracted as inputs of a joint classifier which combines the back propagation neural network (BPNN) with a weighted k-nearest-neighbor (KNN) to distinguish 220 species of plants. The outputs of the joint classifier are the top ten species that best match the query leaf image. At the end, we implemented these algorithms on Android OS and the application we developed has been downloaded about a million times.

Alamdari, et al. [13] present several image segmentation methods to detect acne lesions and machine learning methods used to distinguish different acne lesions from each other. Our results illustrated that among texture analysis, k-means clustering, HSV model segmentation techniques, two level k-means clustering outperformed the others with an accuracy of about 70%. In addition, the accuracy of differentiating acne scarring from active inflammatory lesions is 80% and 66.6% for fuzzy-c-means and SVM method, respectively. Finally, the performance accuracy of classifying normal skins from acnes is 100% using fuzzy-c-means clustering.

Ansari, et al. [14] proposed skin cancer detection system using SVM for early detection of skin cancer disease. It is more advantageous to patients. The diagnosing methodology uses Image processing methods and Support Vector Machine (SVM) algorithm. The dermoscopy image of skin cancer is taken and it goes under various pre-processing technique for noise removal and image enhancement. Then the image is undergone to segmentation using Thresholding method. Some features of image have to be extracted using GLCM methodology. These features are given as the input to classifier. SVM is used for classification purpose. The system classifies the given image into cancerous or non-cancerous.

Sawant, et al. [15] Machine learning and image classifier can be used to efficiently detect cancer cells in brain through MRI. This paper is a study on the various techniques we can employ for the detection of cancer. The system can be used by surgeons and radiologists to detect brain tumor easily and efficiently.

Okuboyejo, et al. [16] focus on designing and modeling a system that will collate past Pigmented Skin Lesion (PSL) image results, their analysis, corresponding observations and conclusions by medical experts using prototyping methodology. These wealth of information would be used as a library. A part of the system would use computational intelligence technique to analyze, process, and classify the image library data based on texture and morphological features of the images. Trained medical personnel in a remote location can use mobile data acquisition devices to generate images of PSL, supply such images as input to the proposed system, which in turns should intelligently be able to specify the malignancy (life threatening) or benign (non-threatening) status of the imaged PSL.

Yasir, et al. [17] proposed a method that uses computer vision based techniques to detect various kinds of dermatological skin diseases. We have used different types of image processing algorithms for feature extraction and feed forward ANN for training and testing purpose. The system works on two phases- first pre-process the color skin images to extract significant features and later identifies the diseases. The system successfully detects 9 different types of skin diseases with an accuracy rate of 90%.

Sachdev, et al. [18] have implemented various Deep Convolutional Neural Networks architectures for the process of binary classification task efficient enough in predicting either the input RGB image of the skin lesion is melanoma or not. Diagnosing the skin lesion is the first step towards its treatment. In this work we have assimilated two approaches on the pretrained Convolutional Neural Networks on the ImageNet dataset. Firstly, use the transfer learning approach without any fine tuning and obtained features are fed for linear classification task.

N. Yadav , et al [19] This paper presents a survey of various skin disease diagnosis systems using image processing techniques in recent times. Techniques include filtering, segmentation, feature extraction, image pre-processing and edge detection etc. are part of image processing and are used to identify the part affected by disease, the form of affected area, its area color etc. A comprehensive study of a number of skin disease diagnosis systems are done in this paper, with various methodologies and their performances.

E. G. Amaro, et al [20] A Face recognition systems is proposed. In the first step, a face detection algorithm is used for extracting faces from video frames and generating a face database. In a second step, filtering and preprocessing are applied to images obtained in the previous step. In a third step, a collection of ML algorithms are trained using as input data the faces obtained in the previous step. Finally, classifiers are used for classify faces obtained from video frames. The found results shows the suitability of this approach for analyzing large collections of videos where previous face labels are not available.

Hasija, et al [21] present a completely automated system of dermatological disease recognition through lesion images, a machine intervention in contrast to conventional medical personnel based detection. Our model is designed into 3 phases compromising of data collection and augmentation, designing model and finally prediction. We have used multiple AI algorithms like CNN and SVM and amalgamated it with image processing tools to form a better structure, leading to higher accuracy of 95.3%.

Phillips, et al [22] the goal of our research was to create a mobile melanoma detection application which could be used for the identification of melanoma on the skin in its earliest stages. This application would be run on smartphone devices with cameras which could take a picture of a particular skin abnormality. The image of the lesion would be sent from the smart-phone to a central server/computer which would use color and symmetry based analysis with a Support Vector Machine to classify the image as benign or malignant. The results would be sent back to the user, and assist in expediting the process of determining when to seek professional services.

Rabano, et al [23] Garbage classification is the first step in waste segregation, recycling, or reuse. MobileNet was used to generate a model that classifies common trash according to the following categories: glass, paper, plastic, metal, and other trash. A dataset of 2527 trash images in .jpg extension was used for the training the model used transfer learning from a model trained on the ImageNet Large Visual Recognition Challenge dataset. The TensorFlow for Poets git repository was cloned as a working directory to retrain the MobileNet model in 500 steps. The resulting baseline model, with a final test accuracy of 87.2% was optimized and quantized. In the Andoid app development, the optimized model (with 89.34% confidence) is preferred over the quantized model (with 1.47% confidence) based on the test using a plastic image.

Deepak K, et al [24] propose to develop an application to identify plant species on android platform. We use contour based edge detection for detecting the edges of the leaf from a white background, centroid classification is also done. Usually these kind of applications in the past used Fourier descriptor to compare object contours and object silhouettes, we instead use

Maximally Stable External Regions detector and represent the external contour by FD's. With the great deal of improvements in technological aspects of the mobile phones. These advancements can be used for better understanding of plant species. The basic purpose of Plantopedia is to provide information about plant species in a user friendly manner. These types of applications will be handy for taxonomists and botanists who study different plant species.

Khan, et al [25] present a comparative evaluation of the three milestone architectures i.e. LeNet, AlexNet and GoogLeNet and propose our Convolutional Neural Network architecture for classifying medical anatomy images. Based on the experiments, it is shown that the proposed CNN architecture outperforms the three milestone architectures in classifying medical images of anatomy object.

Esteva, et al [26] demonstrate classification of skin lesions using a single CNN, trained end-to-end from images directly, using only pixels and disease labels as inputs. We train a Convolution Neural Network using a dataset of 129,450 clinical images—two orders of magnitude larger than previous datasets—consisting of 2,032 different diseases. We test its performance against 21 board-certified dermatologists on biopsy-proven clinical images with two critical binary classification use cases: keratinocyte carcinomas versus benign seborrheic keratoses; and malignant melanomas versus benign nevi. The first case represents the identification of the most common cancers, the second represents the identification of the dangerous skin cancer. The Convolution Neural Network achieves performance on par with all tested experts across both tasks, demonstrating an artificial intelligence capable of classifying skin cancer with a level of competence comparable to dermatologists. Outfitted with deep neural networks, mobile devices can potentially extend the reach of dermatologists outside the clinic.

ALEnezi, et al [27] proposed an image processing-based method to detect skin diseases. This method takes the digital image of disease effect skin area, then use image analysis to identify the type of disease. Our proposed approach is simple, fast and does not require expensive equipment other than a camera and a computer. The approach works on the inputs of a color image. Then resize of the image to extract features using pretrained convolutional neural network. After that classified feature using Multiclass SVM. Finally, the results are shown to the user, including the type of disease, spread, and severity.

**Table -1:** Different image classification methods.

| Sl No | Title | Author & Year | Method/Techniques used | Evaluation Measure | Comments/Observations |
|---|---|---|---|---|---|
| 1 | Machine Learning on Mobile: An On-device Inference App for Skin Cancer Detection | Dai, Xiangfeng, et al [1] 2019 | Convolutional Neural Network (CNN) using TensorFlow | Accuracy -- 75.2% | The system can be implemented in android device using Tensorflow lite. |
| 2 | Classification of Skin diseases using Image processing and SVM." | Kumar, N. Vikranth, et al.[2] 2019 | Image Processing, Support Vector Machine (SVM). | Accuracy -- 90% | The system can be extended for classifying other diseases and accuracy can be increased by using polynomial kernels. |
| 3 | Deep convolutional neural network for face skin diseases identification | EL SALEH, et al. [3] 2019 | Convolutional Neural Network (CNN), VGG-16 model | Accuracy -- 88% | The accuracy of the system can be improved by increasing the size of dataset and new deep neural network models can also be considered. |
| 4 | Automated Skin Disease Identification using Deep Learning Algorithm | Patnaik, Sourav Kumar, et al [4] 2018 | Inception V2 Inception V3 MobileNet | Accuracy -- 88% | MobileNet is light weight architecture and fast model, so it is preferred for mobiles and embedded applications. |

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|---|---|---|---|---|---|
| 5 | Diagnosis of skin diseases using Convolutional Neural Networks | Rathod, Jainesh, et al. [5] 2018 | Convolutional Neural Network (CNN) | Accuracy -- 90% | Skin diseases can be diagnosed using CNN technique and also be classified using the same. |
| 6 | Dermatological Disease Detection Using Image Processing and Machine Learning | Vinayshekhar Bannihatti Kumar, et al [6] 2016 | kth Nearest Neighbor (kNN), Decision Trees (DT), Artificial Neural Networks (ANN) | Accuracy -- 95% | The system has two Stage refinement process and combining the two stages increases the accuracy and efficient of the dermatological disease detection. |
| 7 | A Mobile Application for Plant Recognition through Deep Learning | Gao, Min, et al. [7] 2017 | Deep Learning using Convolutional Neural Network (CNN) | Accuracy -- 76.2% | This work uses deep learning to classify different types of plants and flowers using CNN. |
| 8 | Multi-Class Skin Diseases Classification Using Deep Convolutional Neural Network and Support Vector Machine | Hameed, et al. [8] | Convolutional Neural Network (CNN) –AlexNET and Support Vector Machine (SVM). | Accuracy -- 86.21% | Can be implemented on android device using Tensorflow lite with little modifications. |
| 9 | Brain Cancer Detection From MRI: A Machine Learning Approach (Tensorflow) | Sawant, et al. [9] 2018 | Convolutional Neural Network (CNN) using TensorFlow. | Training accuracy of 99% and validation accuracy of 98.6%, | Basic image classification method for brain tumor detection and uses DICOM dataset. |
| 10 | MobileNets for Flower Classification using TensorFlow | Gavai, Nitin R., et al. [10] 2017 | Convolutional Neural Network (CNN) using MobileNets. | Accuracy -- 85% | MobileNets can be used for classification of any images and to develop android applications. |
| 11 | Comparison of Machine Learning Algorithms for Skin Disease Classification Using Color and Texture Features | Hegde, et al, [11] 2018 | Linear Discriminant Analysis (LDA) , Support Vector Machine (SVM), Combined LDA and SVM classifiers | Accuracy -- 82.58% | For higher classification accuracy different features combinations and hybrid classifier can be chosen. |
| 12 | An Android Application for Plant Identification | Cheng Qian, et al. [12] 2018 | Joint classifier which combines the back propagation neural network(BPNN) with a weighted k-nearest-neighbor (KNN) | Accuracy -- 92.8% | An android application identifies plant species and same can be modified to detect plant diseases. |
| 13 | Detection and Classification of Acne Lesions in Acne Patients: A Mobile Application | Alamdari, Nasim, et al. [13] 2016 | Hue, Saturation and Value(HSV) for segmentation and Kmeans for classification | Accuracy -- 80% | Classification produces more accuracy than segmentation method. The two level k-means increases the accuracy and can be used to detect other skin diseases. |
| 14 | Skin Cancer | Ansari, et al. [14] | Gray level cooccurrence | Accuracy -- | Detection of cancer using |

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|---|---|---|---|---|---|
| | Detection Using Image Processing | 2017 | matrix and Support Vector Machine (SVM) to classify. | 95%. | this method is painless and fast compared to biopsy method. |
| 15 | Techniques of Brain Cancer Detection from MRI using Machine Learning | Sawant, Aaswad, et al. [15] | Convolutional Neural Network (CNN) using Tensorflow | --- | Different techniques can be used for detection of brain cancer. |
| 16 | Automating Skin Disease Diagnosis Using Image Classification | Okuboyejo, et al. [16] 2013 | Multilayer Perceptron Classifier (MLP) | --- | Skin Disease Diagnosis Using Image Classification is faster and accurate than segmentation method |
| 17 | Dermatological Disease Detection using Image Processing and Artificial Neural Network | Yasir, et al. [17] 2014 | Feed forward back propagation Artificial Neural Network (ANN) | Accuracy -- 90% | Much higher accuracy can be achieved by gaining a better dataset with high-resolution images. |
| 18 | Melanoma Screening using Deep Neural Networks | Sachdev, et al. [18] 2018 | Convolutional Neural Network (CNN) using ImageNet | Accuracy -- 85% | Accuracy can probably be increased by considering a large data set and can be used for screening other skin diseases. |

## III. CONCLUSION

The survey has done on Skin Disease Classification. This paper displays the different existing strategies proposed by various creators. Here comparison made between existing techniques on the basis of classification methods used and accuracy. The machine learning is very powerful strategy for the detection of the skin diseases. The accuracy of the classification of skin diseases mainly depends on the size of the dataset, quality of the images and number of epochs used for training the model and the method used for classification. The different techniques can be cascaded for higher classification accuracy. There are future scopes of improvements in present techniques as no model guarantee hundred percent accuracy.

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