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A Review of Skin Disease Classification Techniques based on Machine Learning

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ABSTRACT

Dermatology is one of the most unpredictable and difficult field to diagnose. In this field, more tests are needed to be carried out so as to decide the skin condition the patient may be facing. The time to diagnose may vary according to the different dermatologist. Machine learning and image processing can be used to efficiently detect the skin diseases. There are seven different categories of skin cancer-melanocytic nevi, melanoma, benign keratosis, Basal cell carcinoma, actinic keratosis, vascular lesions and dermatofibroma. The purpose of this review is to outline types, diagnosis, methodology and treatment of skin cancer.

Key words: BCC, Dermatology, Image processing, Machine learning, melanoma, SCC, Skin cancer.

1. INTRODUCTION

1.1 Skin

The skin is the largest organ of the body and it protects the body against infection and injury. The skin is an organ that separates human body and environment. It acts as a barrier that protects body against UV-radiation, tanning and infections etc.

1.2 Skin Cancer

Skin cancer is the most deadly kind of cancer all over the world including both melanoma and non-melanoma [1].Skin diseases occur due to several factors like exposure to UV radiation, tanning, dust, pollution etc. The incidence level of both the types of skin cancer has been increasing over the past years [4].The cure rate can be reached up to 90 percent, if the lesion is detected in the primary stage.

In general, there are many types of skin lesions like Actinic keratosis, Basal Cell Carcinoma, Benign Keratosis, Dermatofibroma, Melanocytic Nevi, Vascular lesions, Melanoma. Melanoma is most dangerous kind of skin cancer [3] and early detection of the melanoma skin cancer can improve survival rate of the patients and some statistics related to the melanoma disease are shown [2].

In USA, in every hour one person dies due to melanoma. From a research, it is estimated that around 87,110 new cases of melanoma will be diagnosed in 2018. Among them 9,730 will die because of melanoma. The vast majority of melanomas are caused by the sun. From a survey done by a UK University, it is found that 86 percent of melanomas are exposed by UV radiations.
Although melanoma is life threatening diseases and it is found most commonly in fair skin. So, there is a need of automatic skin cancer detection system with high accuracy.

1.3 Types of Skin Cancer

1) Basal cell carcinoma - This is the round cells found in the lower part of epidermis. Approx. 80 percent of cancers are developing from the bcc cells. These cancers are described as BCC and it can be found anywhere on the human skin especially on the head and neck area.

Figure 1: Basal Cell Carcinoma

2) Squamous cell carcinoma - Mostly some of the epidermis cells are made up of flat, scale-like cells called squamous cells and it is caused by sun so it may be diagnosed on many regions of the skin and most commonly it is found on the lips and the skin which is situated outside the mouth etc.

Figure 2: Squamous Cell Carcinoma

3) Melanoma - It is a most dangerous kind of skin cancer that begins in the melanocytes and it is also called malignant melanoma and cutaneous melanoma which is usually appeared in brown or black color.

Figure 3: Melanoma

4) Actinic keratosis **-** It is very common type of skin cancer and usually it has seen as rough and bumpy patch on the skin. It damaged the skin by UV radiations and results from long term exposure to ultraviolet rays. This means that if you already have actinic keratoses therefore you are likely to develop more actinic keratosis (AK) in the future.

Figure 4: Actinic keratosis

5) Benign keratosis **-** It has three main subgroups like (seborrheic keratoses, solar lentigo, and lichen-planus). These groups of lesions may appear different but their biological structures are similar.

Figure 5: Benign keratosis

6) Dermatofibroma **-** It is a common type of benign skin tumor and will not turn into a cancer because it is very small in size, slow-growing and mostly it is found on the legs, also called a fibrous histiocytoma and it is not harmful for the skin and usually have a small diameter.

Figure 6: Dermatofibroma

7) Melanocytic Nevi **-** It is also called moles and this is a common type of benign skin lesion due to a local proliferation of pigmented cells and also known as naevocytic naevus or just 'naevus'. Therefore, it is usually in a brown and black color which is also called pigmented naevus.

Figure 7: Melanocytic Nevi

2. LITERATURE REVIEW

In this section, the literature review related to the skin disease and various methodology that we can be used to implement the android application for early detection of skin cancer are discussed below-

Vidya M, Dr. Maya V Karki [5] proposes different types of classification techniques which is SVM, KNN, Naive Bayes etc. along with the feature extraction algorithms. The disadvantage of this technique is that it increases computation time.

Vijayalakshmi M M [6] proposes a different method for hair removal, image segmentation and classification for the application. The objective of this proposed work is to predict the different types of skin lesions and classify them on the basis of malignant or non-malignant lesions.

A.Noori.Hoshyar [7] provided knowledge about various types of skin cancer detection methods and provides good starting in the field of automatic skin cancer detection and also presents different types of techniques required for the implementation of automatic diagnosis system for skin cancer detection.

J. Velasco, C. Pascion, J. W. Alberio [8] proposes to develop an application to identify the type of skin lesion and generate the output on the spot. The research is based on the exploration of the oversampling and data augmentation technique for imbalanced dataset.

Ahmet Demir, Feyza Yilmaz, Onur Kose [9] proposes different types of classification algorithms with main objective of using transfer learning Inception V3 model which is not very much suitable for mobile applications.

J. More, Maitreyee Nath, Pranali Yamgar, Anjali Bhatt [10] presents an automatic system for skin diseases classification using machine learning models and doctors can directly predict the type of skin cancer with the help of android app. The proposed system helps the user to identify if the spots on the skin are cancerous or benign by using their mobile devices. The main gap of this work is to author doesn't focuses on the various parameters like- noise, blur and hair removal which can affect the accuracy of the model.

K. Phillips, O. Fosu and I. Jouny [11] propose an approach of automatic skin cancer detection. The image of the lesion is taken by the app and sent to a server which would uses SVM algorithm for the image classification. The objective of this work was to develop an android application which could be used for the identification of melanoma in the earliest stage. The disadvantage of this technique is that it needs separate feature selection algorithm along with classification method so it increases the time of computation as well as does not provide the higher accuracy.

EL SALEH, et al. [12] proposes an automatic skin disease classification method which uses CNN. First, all the images are resized to fit in the network using some pre-processing techniques. Next step is to differentiate the images into two sets that are training and validation sets. After that CNN model can predict all eight types of facial skin diseases accurately. The gap in this approach is that it only works on the facial features it doesn't detect the disease which is develop on the other parts of the body.

Patnaik, et al. [13] proposes an approach to automatically predict the type of skin lesions using different types of pre-trained models. Here, basically three types of pre-trained architectures namely InceptionV3, InceptionResnetV2, MobileNets were used.

Vinayshekhar Bannihatti Kumar, et al. [14] proposes a different types of techniques to predict the various kinds of skin disease and it uses a combination of Computer Vision and Machine Learning approaches on histopathological attributes to identify the skin disease and the main gap of this paper is that it can identify only six types of skin diseases and it is unable to predict the real time images or any random image.

Gao, et al. [15] provides an approach for automated recognition of plants and flowers and this approach uses video data. There are multiple steps like data collection, data cleaning etc. and the deep learning algorithms that were subsequently applied. The iOS application was designed to show the result after classification.

N. R. Gavai, et al. [16] proposes a classification model that is pre-trained inception-V3 model which takes high computation power and takes lot of time for the classification. Therefore, this paper presents a performance comparison between MobileNets and Inception-V3 model for flower category classification which can minimize lot of time and space for flower classification.

Ansari, et al. [17] proposes a system which can early detect the skin diseases using SVM. The skin cancer images are taken and it goes under various pre-processing techniques. After that system classifies the image with the help of SVM algorithm into two categories like- benign or malignant.

Sawant, et al. [18] Machine learning and image classification algorithms can be used to detect cancer cells in brain through MRI. With the help of this paper we can more deeply understand the techniques of skin cancer which we can apply on the different types of cancer images to predict the disease. The disadvantage of CNN model with MRI images is that it does not provide the better accuracy on these images as compare to other types of cancers.

3. METHODOLOGY

3.1 Dataset

The HAM10000 images dataset would be taken which consists of 10015 dermatoscopic images. These images were collected from the Department of Dermatology at the Medical University of Vienna, Austria. The dataset contains images which belong to seven classes of skin lesions taken by different angles and rotations. The seven classes of skin lesions included in the dataset are NV, BCC, Benign Keratosis, df, Melanocytic Nevi, Vascular lesions and Melanoma.

3.2 Comparison Table

Here, we will show the comparison between various previously used methods related to the image classification problem.

Table 1: Comparison between Various Papers

Title	**Author/ Year**	**Methods Used**	**Observations**
Skin Cancer detection using machine learning	Vidya M, Dr. Maya V Karki [5],2020	Different types of classification techniques which is SVM, KNN etc.	Skin disease classification using machine learning models with 80% accuracy.
Deep Convolutional	EL SALEH,	Convolutiona l Neural	The perfor-mance of the

neural network for face skin disease identification.	et al.[12] 2019	Network, VGG-16 model.	system can be improved by increasing the size of existing dataset and achieve accuracy up to 88%.
Automated Skin Disease Identification using Deep learning Algorithm.	Patnaik, Sourav Kumar, et al[13] 2018	InceptionV2, InceptionV3, MobileNets.	MobileNets is light weight model and it is useful for mobile application and gives 88% accuracy.
Dermatological disease detection using image processing and machine learning.	Vinay-shekhar Bannihatt Kumar, et al[14]2016	KNN, Decision Tree, Artificial Neural Network.	The system has two stage refinement processes and combining the two stages increases the accuracy up to 95%.
A Mobile Application for Plant Recognition through Deep Learning.	Gao, Min, et al.[15] 2017	Deep Learning using Convolution Neural Network.	This work uses deep learning to classify different types of plants and flowers using CNN with 76.2% accuracy.
MobileNets for flower classification using Tensorflow.	Y. A. Jakhade, R.Bhatta d [16] 2017	Convolution neural network using Mobile Nets.	MobileNets can be used for classification of any images and achieve 85% accuracy.
Skin cancer detection using Image Processing.	Ansari, T. Sarode, [17] 2017	Gray level co-occurrence matrix and SVM to classify.	Detection of cancer using this method is painless and fast compared to biopsy method and achieves accuracy up to 95 %.
Techniques of Brain Cancer Detection from MRI using Machine Learning.	A. Sawant, R. Yadav [18] 2018	Convolution Neural Network using Tensorflow.	Different techniques can be used for detection of brain cancer.

4. CONCLUSION

An all-inclusive has been done on Skin Disease Classification. This paper discusses various techniques proposed by researchers and discusses their advantages and disadvantages. This study essentially clarifies the areas in which improvement may be done or research may be carried out for a better solution.

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