# Emerging Technologies for Identification and Classification of Image Based Skin Cancer

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***Abstract*- Skin Cancer is largely associated with molecular defects to build up the tissue and cells within the frame. The factors of molecular defects are four type's cellular aging, hormonal aging, accumulative damage, and metabolic aging. The result of these molecular defects can occur wide variety of problems like loss of strength, mental weakness and memory loss, Loss of muscles tone and rigidity, skin disorders, and chronic diseases like diabetes, heart stroke, lungs defects, etc. The aggressive problem of the skin disorder is a cancer are most important, interesting and quite topic to investigate. The diagnosis of skin cancer is an incredibly challenging task for dermatologists. In recent days, advanced technology deep learning methods used for dermoscopic images to diagnose the longitude problem of skin cancer with possible accurate prediction. The scope of this paper discussed the importance of machine learning and deep learning techniques in healthcare field, specifically at skin cancer analysis, detection and classification methods and finally described the metrics system could be evaluated for predicting the accuracy of the skin cancer stages.**

***Keywords*: Artificial Intelligence, Deep Learning, Dermatology, Machine Learning, Skin Cancer.**

## 1. Introduction

Deep learning or Deep structured learning is the one of the popular technologies of computerized depth knowledge strategy. It is the sub-part of machine learning model on artificial neural network, which has the collection of layers working like the human brain to analyse data and making decision based on representation of learnings. These learnings can be supervised, unsupervised and semi-supervised. The supervised machine learning takes input as labelled data set to training the network that would classify the data with accurate prediction. The problems in supervised learning falls under the category of classification problems for predicting the label or class and regression predicting the quantity continuously. The unsupervised machine learning takes input as unlabelled data to find the pattern and discover the output. It will analysis the problem of clustering which involves the grouping of similar data based on defined criteria and dimensionality reduction reduces the number of variables being considered to find the exact information required. The semi-supervised machine learning is the part of both supervised and unsupervised learning.

In international Data Corporation, analysis worldwide data will grow 61% to 175 zettabytes by 2025[1] in the form of unstructured type like images, videos, audio etc., deep learning play an important role in the data revolution era. The major advancement of deep learning is easy access to massive sets of labelled data, increased computing power and many pre-trained models.

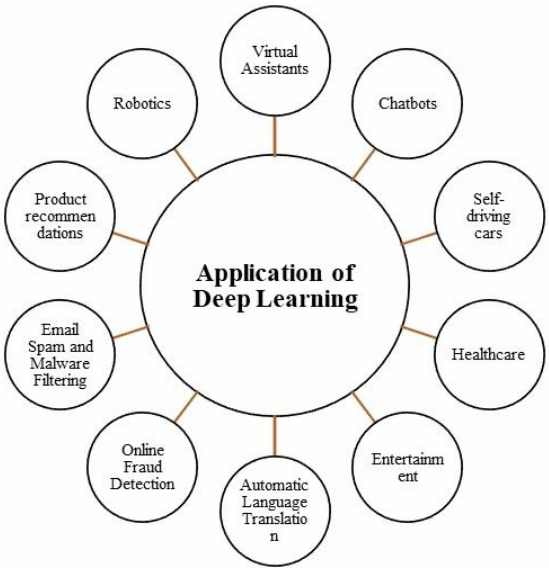



Fig.1 Application of Deep Learning

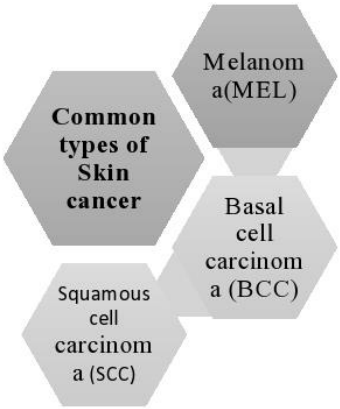
Fig.1 shows the important application of deep learning method. In that healthcare sector is the one of the important application in deep learning. Deep learning healthcare system to provide various process for prediction of diseases as early. The precision of medical care taken under the proper diagnostic, it might be in various type of images like x-rays, CT, MRI, MRA etc.

The diagnosis of skin cancer is an incredibly challenging task for dermatologist's medical care. According to the International Agency for Research for Cancer (IARC) statistics, 19.3 million new cases were diagnosed with cancer, with a mortality rate of about 10 million people in 2020[2]. When all cells within the body, including skin cells, form and are replaced all the time to assure the health of the tissue they form. When the processes goes wrong in skin cells, their growth can come abandoned and a collection of abnormal cells (excrescence) can develop during a part of the skin [2], i.e., melanoma. The major causes of skin cancer are overexposure to ultraviolet radiation from the sun, some environmental and inheritable factors like pollution, fair complexion, family history, hormone changes, disinclinations, poisonous chemicals, and many specifics inputs for longitude clinical problems [3]. The early opinion of skin cancer is preventable so the field of computer wisdom and engineering introduces the advanced technology of Artificial Intelligence in part of a deep learning model that tackles the challenges of automated diagnosing skin cancer using the dermatologist images. The following parts of the paper discussed with the basic information of skin structure and cancer cells.

The skin is the largest organ of the body it gives us production, regulation, and sensation to our body. It is made up of three layers they are epidermis, dermis, hypodermis and these layers of skin consist of six main types of cells are present to regulate activities based Basal cell, Squamous cell, Melanocyte cell, Keratinocyte cell, Langerhans cell, and Markel cell.

The first outermost layer the epidermis, which contains the primary protective structure of the skin the keratinocyte cell, a protein inside skin cells along with other proteins, sticks together to form this layer. This layer protects our body from bacteria and germs entering into causing infections and makes new skin cells every 30 days, Langerhans cells are the part of the body's immune system that helps to fight germs and infections, and melanocyte cells, the pigment that gives its color of skin, hair, and eyes.

The second middle layer is the dermis, the fibrous layer that supports and strengthens the epidermis. The dermis layer makes up 90% of skin thickness, and collagen is a protein that makes the skin cells stronger, elastin keeps the skin flexible. The root of hair follicles are attached to the dermis, nerve receptors also help you feel pain, oil glands prevents skin from absorbing too much water, sweat gland regulates body temperature and blood vessels provide nutrients to the epidermis and also keep the skin layer healthy. Finally, the third layer is hypodermis i.e., the subcutaneous layer of fat beneath the dermis that supplies nutrients to the other two layers. The cushions (fat) protect from injury, and the connective tissue connects the layers of skin to muscles and bones and regulates the body temperature




. Fig.2 Types of skin cancer

They are three common major types of skin cancer is diagnosed with more than three million Americans each year [3].They are melanoma (MEL), basal cell carcinoma (BCC), squamous cell carcinoma (SCC) in Fig.2.

Melanoma (MEL) There are dispelled cells called melanocytes where the epidermis meets the dermis. These cells produce the coloring of the skin color. Melanoma starts in melanocytes, and it is the most serious type of skin cancer that constantly develops in a mole or abruptly appears as a new dark spot on the skin [4]. Melanoma has an irregular shape and other than one shade. Moles affected by melanoma can feel itchy and can bleed; also, their size can exceed normal moles

Basal cell Carcinoma (BCC)-Basal cells are the round cells initiated in the lower epidermis. Basal cell melanoma most frequently develops on the head and neck and sun exposure to the skin is the main occasion. This type of skin cancer generally grows sluggishly and infrequently spreads to other regions of the body [5].

Squamous Cell Carcinoma( SCC) is a type of skin cancer that attacks regions of the body that are frequently exposed to sun, similar to the legs, arms, lips, ears, face, neck, and head(cancer.net). This complaint is not too aggressive as other skin cancers. This complaint tends to grow sluggishly and fluently through non-surgical remedies if beforehand diagnosed [6].

Skin cancer is in the body, which tends to replicate and spread through lymph nodes to destroy surrounding tissues. The damaged cells develop a mole on the external skin layer, categorized as malignant or benign, whereas melanoma was considered cancer because it is more dangerous and life-threatening [7]. To overcome these challenges for diagnosing skin cancer with the advanced techniques for artificial intelligence approaches to help diagnose skin cancer in early detection Moreover, computer-aided diagnostic (CAD) tools save time and effort compared with existing clinical approaches [8].

## 2. Related works

Skin cancer is a common type of cancer but some of them are considered to be life threading because those types of cancer very quickly spread to other parts of the body so early diagnosis is needed with the help of dermatologists. Moreover, the skin lesions were seems to be looking the same type of color, texture, and shape it goes very difficult to diagnose the skin lesions that are affected

by cancer with the stages being or malignant. The nature of the skin is automatically healing the repaired skin within a particular period but if any of the skin lesions do not recover for a long time, means need to consult a dermatologist. During diagnosis, an expert dermatologist performs a series of steps, starting with a visual inspection of a skin lesion by the naked eye; then a dermoscopic, which may be a magnifying lens to view lesion patterns in detail; and finally, a biopsy. These conventional methods are time-consuming, expensive, and laborious [9].

Numerous experts dissect lesions predicated on the expansion ABCD rule [9], ABCDE rule [10], and ABCDEF rule [11]. The Common signs are A-asymmetry, B- border irregularity, C- color variation, D- periphery, E-Evolution, and F- Funny looking. It highlights the consequence of developing pigmented lesions as compasses above 6 mm is considered cancer. In recent advanced method deep learning for detecting skin cancer with efficient time and computational complexity in Table 1.

| ***Author & Publication*** | ***Dataset*** | ***Architecture*** | ***Description*** | ***Scope*** |
|---|---|---|---|---|
| [12] Talha Mahboob Alam[1] et all.,*Diagnostics*,2022 | HAM10000 | CNN, TL (AlexNet, InceptionV3, and RegNetY-320) | RegNetY-320 perform well in both balanced and imbalance dataset. | The accuracy of proposed framework 91% gives better performance compared to other two TL. |
| [13] Walaa Gouda [1,2,* et al.,] *Healthcare* ,2022 | ISIC2018 | ESRGAN,CNN, & TL(Resnet50 and InceptionV3) | Comparison between two transfer learning inceptionV3 gives best result for medical image analysis. | It will employ Dense net, VGG, or AlexNet to analyze the cancer dataset. |
| [14] Mohammad Fraiwan *and Esraa Faouri, *Sensors,2022* | HAM10000 | CNN, TL(SqueezeNet, GoogLeNet , Inceptionv3 , DenseNet-201, MobileNetv2 etc) | Comparison of all TL model | It will focus on improving the balance of the dataset |
| [15] Ranpreet Kaur 1,* et al., Sensors,2021 | ISIC 2016, ISIC2017, and ISIC 2020 | DCNN | multi-view filtered transfer learning network, which exploits information from different image views by a novel multi-view weighing representation module, multi-view filtered transfer learning network, which exploits information from different image views by a novel multi-view weighing representation module, The design of DCNN are the selection of multiple filters and their sizes, employing proper deep learning layers, choosing the depth of the network, and optimizing hyper parameters. | It perform well on large and balanced dataset |
| [16] Jianxiao Bian and Shaoqiang Wang , ,IEEE Access,2022 | ISIC 2017 | CNN ,MFTL | Multi-view filtered transfer learning network, which exploits information from different image views by a novel multi-view weighing representation module, | It perform well on ISIC 2017 dataset. |

| | | | | |
|---|---|---|---|---|
| [17] Akhilesh Kumar Sharma et al.,IEEE Access,2022 | HAM10000 | CNN and ensemble | The proposed system extract colour and texture to implemented classification of eight type of skin cancer. | It perform well on HAM10000 dataset |
| [18] Kausar, N et all, | ISIC 2018 and ISIC 2019 | TL(ResNet, InceptionV3, DenseNet, InceptionResNet V2, and VGG-19) and ensemble. | Compared to transfer learning ensemble gives the better accuracy 98%. | Combination of TL and ensemble gives the better performance. |

Table-1 Discussed the deep learning model for existing paper used Datasets, Architecture, Advantages and Focuses.

## 3. Cancer Dataset Analysis, Detection, and classification. Skin Methods

### 3.1. Data Analysis for Skin Cancer

Data analysis is the process, which involve the gathering information from various sources and analysis the gathered information to be prepared for proper dataset.The quality of data is a major task for model performance, the dermoscopic images to learn the proper prognosis for the opinion of the skin cancer is being or malign. For that reason, the artificial intelligence-grounded deep learning method automates the image feature extraction and classifies the skin cancer image as being or malignant [17].

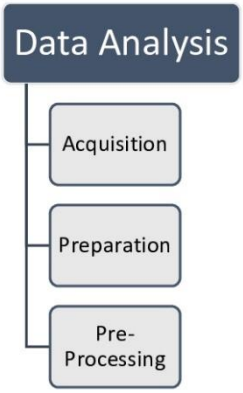



Fig.3 Steps for Data Analysis

### 3.2. Image acquisition

In Fig.3, the first step is the image acquisition process is to collect the data in both structured and unstructured formats because deep learning requires a large number of dermoscopic images to train the machine to extract the feature of the individual skin lesion. Table 2 shows the numerous skin lesion datasets are openly accessible on the internet these datasets were created substantially for experimenters to enhance their knowledge in the dermatology field [18].

| ***SNO*** | ***Dataset*** | ***Number of dermoscopic images*** | ***No of classification*** | ***References*** |
|---|---|---|---|---|
| 1 | HAM10000 | 10015 | 7 | [17] |
| 2 | ISIC 2019 | 25331 | 8 | [18] |
| 3 | ISIC 2020 | 33126 | 7 | [6] |
| 4 | ISIC Archive | 23,906 | 7 | [6] |
| 5 | ISIC 2016 | 1279 | 2 | [20] |
| 6 | ISIC 2017 | 2000 | 3 | [20] |
| 7 | PH2 | 200 | 2 | [9] |

Table 2. Available open-source skin lesions dermoscopic image datasets

### 3.3. Image preparation

In Fig.3, the second step is image data preparation is the process of analysis the benchmark dataset to handle the missing, irrelevant, duplicate data into suitable manner. For that data preparation step to ensure the dataset format. This step extract the meaningful data from vast dataset became easier for further processing.

### 3.4. Image pre-processing

In Fig.3, the third step is image processing its goal is the enhancement of image data by enhancing many features while removing some unwanted deformations. Enhancing the features depends on specific operations like restoration, morphological, augmentation, segmentation and normalization process techniques [20]. Image processing makes all the images as same size, removes the noise over the image data, and performs geometric and pixel luminance.

## 4. Skin Cancer Detection by Deep Learning Methods

### 4.1. Convolutional neural network (CNN)

Convolutional Neural Network (CNN) or feedforward neural network is a deep learning algorithm used to extract the features of the image from the vast repository. The main idea of the convolutional neural network is to reduce the dimension of the image and extract the features without affecting the original image. It consists of four important layers are convolutional layer or kernel, rectified linear layer (RELU), Pooling layer, and completely connected layer. The function of the first, the convolutional layer is to convert the input image into an array- suchlike 2dimensional or 3dimensional and extract the feature of the image and its reducing dimensionality. The alternate layer relu to convert the negative figures into zero, also the third layer pooling will progress to reduce the dimensionality of the input image and control the overfitting problem and eventually completely connected network combined the extracted features and represents a new model.

### 4.2. Transfer Learning (TF)

Transfer learning is a machine learning system where we exercise a pre-trained model to transfer knowledge from one model to another. ImageNet, Alex Net, VGG19, InceptionV3, Resnet50, Xception, and Inception are typical instances of models that have the base of Transfer learning. In addition, to the limited number of available skin lesions datasets, these datasets are not suitable to train a deep network from the morning, due to their small number of images. Transfer learning was the best result to overcome this problem. [5] Transfer learning in three ways. First, opt for the pre-trained model; in the alternate step, several layers form at the end. In the third step, we exercise and acclimate the model layers for substitute tasks by using fine-tuned layers.

### 4.3. Ensemble Model (EM)

The ensemble model is a machine learning method that combines several base models to produce one optimal prophetic model. Ensemble modeling is an important way to enrich the performance of the model [18]. In the fields of decision-making and risk analysis, where information is derived from several experts and added up by a decision-maker. In general, the aggregation of the opinions of the experts increases the accuracy of the prognosis. To the best possible accurateness considering our image classification scenario [20].

There are three important classes of ensemble learning approaches. First bagging, involves fitting numerous decision trees on different samples of the same dataset and making up the prognostics. Second, mounding involves proper numerous different models, and types on the same data and using another model to learn how to combine the best model for prognostics. Third boosting involves adding ensemble members consecutively that correct the prognostics made by previous models and produce a weighted standard of the prognostics. Each of these terms is substantially considered in prophetic modeling.

## 5. Skin Cancer Classification by Machine Learning Methods

In supervised machine-learning model for skin cancer classification, which train the labelled data and predict the class label of skin cancer types with a combination convolutional layer technique. The most commonly used classification machine learning models are support vector machine, k-nearest neighbor, decision tree, random forest, naves byes and artificial neural network Table 3.

| ***Supervised Machine Learning Algorithm*** | ***Advantages*** | ***Disadvantages*** |
|---|---|---|
| Support Vector Machine (SVM) [24] | It is a clear margin of separation between classes.<br>It well worked with high dimensionality<br>Efficient memory | It not suitable for large dataset<br>Perform not well on noisy dataset<br>It is not a probabilistic model |

| | | |
|---|---|---|
| K-Nearest Neighbor (K-NN) [27] | It is easy to implement<br>It is easy to implement for multi-class problem<br>Variety of distance criteria | Does not work well with large dataset<br>Does not work well with high dimensionality<br>Sensitive to noisy and missing data<br>Feature Scaling |
| Decision Tree (DT) [26] | It requires less effort for data preparation during pre-processing.<br>does not need for normalization of data<br>Missing values does not affect the process | Any changes in data set it will effect throughout the data.<br>Complex Calculations.<br>Expensive for both time and complexity |
| Random Forest (RF) [30] | Overcome overfitting problem<br>Work well on both categorical and continues values<br>Normalization is not required | It requires much computational power<br>More time to train data<br>More number of tree is constructed to combine to aggregate the result. |
| Artificial Neural Network (ANN) [27] | Storing information on the entire network<br>Distributed memory<br>Parallel processing capability | Hardware dependent<br>Time complexity<br>Computational Complexity |

Table 3. Frequently used machine-learning algorithm for skin cancer classification.

**6. Evaluation Metrics**

The classification interpretation criteria are estimated in different ways similar to accuracy (ACC) precision (PRE), recall (REC),), specificity (SPE), and F1- Score. The criteria accuracy measures the overall interpretation of the classifier, the precision measures the number of total positive observations, the recall measures the number of true positives correlated suitably, the particularity measures the number of factual negatives linked rightly and the F1 score is measure the weighted normal of precision (PRE) and recall (REC). Its valuation range is between (0, 1) the best value of the F1 score is 1 and the worst is 0. Eventually, the exact formulas to compute the valuations of these criteria.

1) Accuracy $= \frac{TP+FP}{TP+FP+TN+FN}$ (1)

2) Precision $= \frac{TP}{TP+FP}$ (2)

3) Recall $= \frac{TP}{TP+FN}$ (3)

4) F1 Score $= 2 * \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}}$ (4)

Where in such fine formulas, TP represents the true positive while the data is positive it's rightly prognosticated as positive.TN represents the true negative in this case while the data is negative it's rightly prognosticated as negative. FP represents the false positive where the data is negative it is improperly prognosticated as positive. FN represents the false negative where the data is positive and improperly prognosticated as negative.

**7. Conclusions**

This study, discussed the multiple explorations predicated on the skin cancer detection and classification exploited by the dermoscopic images that are openly accessible on the internet for the main ambition is truly applicable for the experimenters to exploit and research the field of diagnosing skin cancer classification. In recent the progressive technology of artificial intelligence is the smart way to diagnose skin cancer classification with the source of machine learning algorithms and deep learning models. The present paper discussed the deep learning importance for early prediction of skin cancer diagnostic by number of open source dermoscopic datasets with specified deep learning techniques. In future, to overcome the dataset challenges in data balancing, overfitting and under fitting problems during the deep learning model build.

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