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A Comprehensive Study of Different Skin Cancer Detection Models Using Deep Learning Techniques

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Abstract—Skin cancer is a highly prevalent disease that exhibits rapid growth worldwide. The timely identification and accurate diagnosis of skin cancer are of paramount importance in the context of preventive measures. The identification of skin cancer in its early stages poses a significant challenge for dermatologists. In recent years, machine learning techniques have been widely employed in both supervised and unsupervised learning tasks to address this issue. In this study, different existing techniques to detect different types of skin cancers and the evaluation metrics to assess their performance are dealt with.

Keywords — Machine Learning; Melanoma; Precision; Skin Cancer.

I. INTRODUCTION

In modern day society, skin carcinoma has emerged as a significant ailment comparable to other commonly diagnosed forms of cancer. There are two types of skin cancer: melanoma (malignant) and non-melanoma. Even if they are not always hazardous, patches of dark spots, scars, other disfigurements on the skin, or patches that resemble them, may be indicators of skin cancer. Changes in the size, shape, color, or sensitivity of the skin are all signs of skin cancer. It will not be possible to conclude that it is cancerous until the patient is thoroughly examined both physically and clinically. It may result in both cutaneous bleeding and excruciating pain. The direct exposure of harmful UV radiation is leading cause of skin cancer.

The biopsy of skin is to be performed to diagnose melanoma. Machine learning techniques permits the differentiation between benign as well as malignant melanoma.

In this technological era, experience is something that can only be acquired through consistently repeated results in various cases. Doctors with their experience assist patients in many ways but no one else can. Despite evidence from academic research suggesting that technological advancement is leading, it is always highly desirable to rely on doctor's judgment through clinical findings rather than technology alone.

Numerous studies have focused on the classification of melanoma images automatically using many deep learning models and artificial intelligence techniques. The features identified through the classification approach and the segmentation of the skin lesions have a substantial effect on the performance of the classification of conventional machine learning. It is believed that malignant melanoma affects only 4% of people, but it is responsible for 75% of the people who are dying with skin cancer all over the world.

Malignant melanoma is one of the most lethal and dangerous forms of cancer. Melanoma is curable if detected or diagnosed early and treated immediately. Late-stage melanoma, however, expanded to more anatomical regions and advanced to an even greater extent within the region of epidermis, making treatment extremely challenging.

Melanocytes are responsible for the development of melanoma. UV radiation exposure is is a significant contributing factor in the formation of melanomas. Dermoscopy is a method for analyzing the structure of the epidermis. Both

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dermoscopy and an observation-based method can be utilized to detect melanoma.

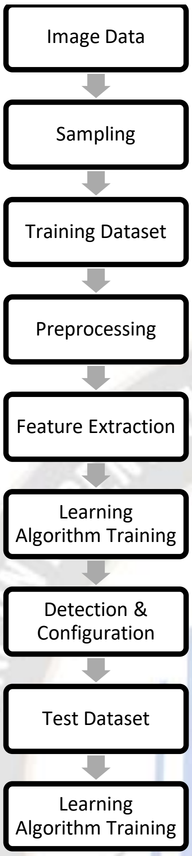

Figure 1. Flow chart showing the Methodology of Skin Cancer Detection

In this paper, Section II discusses previous techniques on this work. Section III discusses types of skin cancers. Section IV outlines the evaluation metrics of skin cancer detection methods. Section V summarizes the work.

II. LITERATUE REVIEW

Recent advancements in the implementation of machine learning techniques have led to major advances in the identification of skin cancer. Manual screening and visual inspection have long been the gold standards for spotting skin cancer. Nevertheless, manual screening is prone to error, complicated, and time-consuming [2]. It is impossible to make an accurate diagnosis of skin cancer due to the complicated nature of the images of the skin lesions.

Aldwgeri et al. [3] developed a CNN-based classification and transfer learning model to classify skin diseases in order to resolve the issue. InceptionV3, DenseNet121, Xception, VGGNet, and ResNet50 are used to train the models. Ultimately, an ensemble model is evaluated by combining the previously evaluated models. The outcomes demonstrate a precision of 97%.

Majtner et al. [4] proposed a technique for increasing accuracy by combining pretrained AlexNet model and Linear Discriminant Analysis (LDA). The outcomes demonstrated an enhanced accuracy of 85.8%.

A transfer learning and deep learning network was built by Khalid et al. [5] for the categorization of skin cancer. The AlexNet architecture was utilized in conjunction with transfer learning to identify cutaneous lesions. The outcomes demonstrate a precision of 98.33%.

Bisla et al. [6] created an automated approach for the identification of melanoma that is based on deep learning. The ResNet50 architecture was utilized and it was fine-tuned. The data augmentation or generation techniques were employed to address the issue of limited datasets.

Jayapriya et al. [7] developed the framework of Fully Convolutional Networks (FCNs) for detecting melanoma lesions. FCN is a convolution network-based deep learning model that uses image pixels to predict melanoma disease. It used VGG16 and GoogLe Net designs to enhance segmentation and a support vector machine for classification after gathering features from a fragmented lesion using deep networks and customised features. Through the use of Efficient Net B6 and the examination of pictures of skin lesions, Zhang et al. [8] were able to construct a CNN-based model for the identification of melanoma. A score of 90% was given to the approach that was suggested by AUCROC.

III. TYPES OF SKIN CANCER

Cancers that originate in the Merkel cells, basal cells, or squamous cells of the epidermis are examples of the types of nonmelanoma skin cancers. Melanoma is a cancer that develops in melanocytes of the epidermis.

1. Non melanoma skin cancer

The cancers of squamous cells, basal cell carcinoma, and carcinoma of Merkel cells are the most prevalent types of non-melanoma skin cancer, but there are many others.

a) Basal cell carcinoma

Basal cell carcinoma is the most commonly observed type of malignancy in the United States of America, with over millions of cases diagnosed annually. This malignancy arises inside the basal cells, which are one of the three distinct cell populations constituting the outermost stratum of the epidermis. The appearance of basal cell carcinoma can vary significantly, but may resemble:

i) A waxy bulge
ii) A scar
iii) A pink or white patch

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iv) An uncovered sore
v) A raised expansion with rolled borders
vi) A growth that develops a crust, itches, bleeds.

Consult a dermatologist if you notice any changes in your epidermis that are unusual. Basal cell carcinoma infrequently spreads and is typically successfully treated, however delaying treatment might lead to problems and increase the risk of the cancer returning.

b) Squamous cell carcinoma

Cancer of the squamous cells, which are thin and numerous on the skin's surface, is called squamous cell carcinoma. Squamous cell carcinoma, in contrast to basal cell carcinoma, can arise in parts of the epidermis that are not directly exposed to solar radiation, such as the genitals and other areas of the body. It might appear as:

i) Scaly red spot
ii) Hardened and thickened skin patch
iii) Enhanced expansion with a depression

Although squamous cell carcinoma is relatively frequent and usually responds well to treatment, it is essential to seek medical attention immediately if you discover an abnormality on your skin. If treatment is delayed, this form of skin cancer can spread and become extremely dangerous.

c) Merkel cell carcinoma

Cancer of the Merkel cell is extremely uncommon and often deadly. This form of cancer typically manifests as a red, shiny pink, or bluish mass that grows rapidly and originates from Merkel cells deep within the epidermis. Merkel cell carcinoma is a severe condition, but many cases can be successfully treated if detected early.

2. Melanoma skin cancer

Melanoma is a form of epidermal malignancy that arises from melanocytes, the pigment-producing cells located in the epidermis. Melanoma has the ability to develop in anatomical regions that are not typically exposed to solar radiation. If you notice any of the warning signs of melanoma, you should see a dermatologist as soon as possible, such as a mole that

i) It is dissimilar in size, shape, or color to other lesions on your body.
ii) Contains brown, multiple tan or black tones.
iii) Not a precise circle; has an irregular border.
iv) Gradual alteration in hue or form

Fig.1 Different types of skin cancer [1].

DATA SET

The dataset known as HAM10000 (which stands for "Human Against Machine with 10,000 training images") from the Harvard Dataverse [9] was the one that was used. The dataset is made up of 10015 dermatoscopic images that have a very high pixel resolution. Dermatofibroma (DF), Benign Keratosis (BKL), Vascular Skin Lesion (VASC), and Melanocytic Nevi (NV) are examples of disorders that are considered to be benign. Melanoma (MEL) and Basal cell carcinoma (BCC) are malignant.

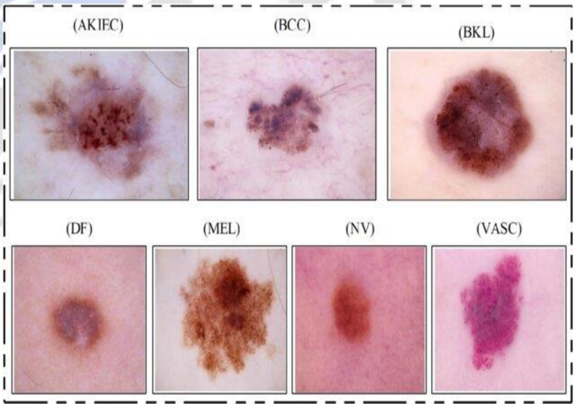

Fig.2 Sample skin lesion types from the HAM10000 dataset [9].

IV. EVALUATION METRICS

For evaluating the performance of the skin cancer detection model precision, recall, specificity, and F1 score are employed.

a) **Recall** refers to the quantity of hazardous cases that can be accurately identified from a certain set of risky cases.

$$\text{Recall} = \frac{\text{True positive}}{\text{positive}}$$

b) The **specificity** of a case is the number of cases which are benign that can be identified from an entire set of suitable cases.

$$\text{Specificity} = \frac{\text{True negative}}{\text{Negative}}$$

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c) The **precision** of a model is the proportion of menacing cases it accurately predicted out of all the cases it correctly predicted as dangerous.

$$\text{Precision} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$$

To comprehend how this system operates, the F1-score combines recall and accuracy.

V. CONCLUSION

Amongst all the cancers skin cancer is lethal diseases in the world and should be diagnosed early. Detection of skin cancer must therefore be performed rapidly by employing the sophisticated automatic detection methods. For the identifying the type of skin cancer in the initial investigations, researchers utilized a small data set. Until now, the availability of a huge, reliable dataset posed the greatest obstacle in the identification of skin cancer. In terms of accuracy, precision and confusion matrix, the efficacy of the models is evaluated.

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