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A REVIEWED STUDY OF DEEP LEARNING TECHNIQUES FOR THE EARLY DETECTION OF SKIN CANCER

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Abstract
An unchecked proliferation of malignant cells may spread throughout the body, causing cancer. Skin cancer is one of the worst types of the disease since it may spread quickly and leave no survivors. Deoxyribonucleic acid (DNA) breaks in skin cells produce mutations, which in turn lead to cancer. In the early stages, skin cancer tends to spread slowly to other areas of the body, thus early detection is critical. The biopsy technique is well recognized by doctors when they are identifying illnesses. The skin is scrapped or detached in the biopsy process, and specific laboratory experiments can be conducted on these skin samples. This process is time-intensive and often frustrating because of this. Computer-aided screening allows early-stage diagnosis of skin cancer. Typically, macroscopic photographs are branded as quantifiable images that are generally used for computer processing, and these images are captured utilizing a typical digital camera and video. Medical photographs have many problems, such as low lighting and the appearance of artifacts such as skin lines, highlights, repetitions and hair in the pictures. Researching skin lesions is very difficult because of these complications. Several measures are involved in detecting skin cancer at the computational level, such as preprocessing, recognizing trends, selecting features, and extraction of features and identification. The area of computer vision, in particular, has benefited greatly from deep learning." Due to deep learning's ability to automatically learn and extract meaningful features from raw data, it removes the requirement for feature engineering altogether. Deep learning has become a potent feature learning technique because to recent advancements in software and hardware technology. Engineering features by hand is a laborious and time-consuming procedure that necessitates the use of human expertise. A overview of deep learning methods for skin cancer early detection is presented in this article. Deep learning techniques are examined.
Keywords: Deep Learning Techniques, Detection, Skin Cancer, Cancer, Deoxyribonucleic Acid, Etc.

1. INTRODUCTION

Skin cancer is a grave concern for the whole human race. Early diagnosis of skin cancer has never been more important than it is now because of the fast development of skin cancer, the high expense of therapy, and the high mortality rate. Image pre-processing and deep learning techniques are now capable of detecting skin cancer because to advancements in the globe. Skin cancer, along with other types of cancer that are prevalent nowadays, has emerged as a significant public health issue. There are two kinds of skin cancer: melanoma (lethal) and non-melanoma (benign). However, it does not necessarily have to be malignant for a patch of dark area, scar, or disfigurement on the skin to indicate that the person is suffering from skin cancer. It's also possible that you have a rash on your skin. Changes in the color, size, form, or itching of the skin are all

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signs of skin cancer. In essence, we won't know for sure until we've been examined. It may cause excruciating discomfort and open wounds on the skin. UV rays are a well-known contributor to skin cancer. One of the most frequent causes of skin cancer is excessive exposure to ultraviolet (UV) light from the sun.

Doctors / dermatologists often do a biopsy to determine whether or not a mole is malignant. Machine learning has made it feasible to distinguish between benign and malignant melanoma in the present situation. In today's technologically advanced world, experience is a coveted commodity that can only be earned through time and through consistent work. Doctors who have dedicated their lives to learning and assisting others. There is some evidence to support the idea that medical technology has overtaken physicians in certain areas of expertise, but a doctor's advice is still required in many situations where technology alone cannot provide the answers. As an added bonus, technology may be utilized to bolster a physician's recommendation if an expert offers one.

Deep learning has been used to identify skin cancer in numerous research since 2016. A Stanford University study from 2017 used a deep learning convolutional neural network (CNN) model trained using 125,000 clinical pictures of skin lesions to arrive at its results. The model's performance was compared to that of experienced dermatologists in detecting cancer after it was verified using fresh pictures of skin lesions. This study shows the effectiveness of deep learning in the detection of skin cancer. There is no way for other researchers to build better models without access to the study's database, which is not accessible to the public.

2. RESEARCH METHODOLOGY

The goal of this systematic literature review was to identify and categorise the best existing Deep learning techniques for skin cancer detection. Systematic literature reviews gather and assess existing studies based on predetermined criteria. Such reviews aid in determining what is already known in the field of research in question. All of the information gathered from primary sources is arranged and examined. Once the systematic literature review is complete, it will provide a more sensible, logical, and rigorous answer to the research's underlying question. The population of articles included in the current systematic literature review included research publications on deep neural network (DNN) approaches for early cancer diagnosis.

Framework for Research

The initial step in this systematic review was to define the review framework. In the systematic literature review, it consisted of an overall plan that was followed. A planning layer, a data selection and assessment layer, and a results generation and conclusion layer comprised the plan's three layers.

3. REVIEWED STUDY OF DEEP LEARNING TECHNIQUES FOR THE EARLY

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DETECTION OF SKIN CANCER

A novel approach for successful segmentation of skin cancer lesions has been introduced through deep learning strategies by **Jafari et al (2016).** Once the input image was pre-processed by eliminating unwanted artifacts, the color and texture features were extracted and these descriptors were fed to the deep Convolutional Neural Network (CNN) and labeled for each image pixel in order to identify the output. In line with this, the mask referred to as the area of concern (affected lesion) was extracted from the surrounding skin. As a final stage, the mask was optimized by post-processing operations.

Antony et al. (2016) suggested the use of machine learning to separate melanoma from non-melanoma skin lesions. Feature extraction and image processing were both performed on the same picture. The lesion was segmented from the input picture using morphological procedures such as erosion and dilation. Different characteristics were then retrieved, such as contrast, correlation, and homogeneity. A classification method is then used to classify the data. For categorization, we used an ANN-based model.

In the research proposed by **Alquran et al. (2017),**With the thresholding method, the dermoscopy picture database was preprocessed and segmented. The gray level co-occurrence matrix and ABCD rule were used to extract the features. The SVM was then used to classify the data. 92.1 percent of the classifications were correct, according to the findings. Researchers Poornima and Shailaja (2017) used image processing methods such as local binary patterns and grayscale conversion to develop a method for the early identification of melanoma. The image of the skin lesion was given into the system as an input, and the picture was then transformed to grayscale before being subjected to a local binary pattern algorithm. "Active contour segmentation was used to extract dermo-scopic characteristics including color, area, perimeter, and texture. Using the active contour technique, only items with a strong contrast to the backdrop are extracted. are extracted. In order to identify cancer as either melanoma or non-melanoma, the collected characteristics were fed into an SVM algorithm.

Seetharani Murugaiyan Jaisakthi et al. (2018) present a semi-supervised learning approach for automatic lesion segmentation for the given dermoscopy images using two stages pre-processing and segmentation. The pre-processing stage makes use of bi-linear interpolation method for image scaling; uneven illumination of image can be upgraded by CLACHE algorithm. Then the Frangivesselness filter and inpainting technique with FMM are used to supplant the hair pixels. The process of segmentation is carried to isolate the lesion regions based on the homogeneity of pixels such as color and texture features. The GrabCut approach uses the boundary and region information for segmenting the foreground image from which the approximate lesion regions are identified and further enhanced by using k-means clustering through that grouping of pixels are done based on RGB color space for predicting the exact lesion regions.

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Through the use of Deep learning techniques, dice co-efficient values can be improved for enhancing the accuracy and this is considered as a future work.

Zhen Yu et al. (2018) proposed a new strategy for lesion detection using deep learning and local descriptor encoding procedure. This presented model is efficient enough to generate various feature values to work among a high amount of variation of lesions. Here for the evaluation of the proposed model, a freely existing ISBI 2016 dataset has been utilized.

Marwan Ali Albahar et al. (2019) discusses the deep learning-based Convolution Neural Network which has the capability to predict the minor changes taking place in the skin are over and done with dermoscopy images. Generally, the diagnosis approach of skin cancer starts with medical screening by dermo-scopic analysis, biopsy and histopathological assessment. The proposed framework makes use of binary classifier, and termed as novel regularizer which helps to classify the lesions effectively. The performance is validated by attaining the area under the curve for nevus, and then comparing that with the lesion images for efficient diagnosis.

In the paper **Pham et al (2019)** the proposed algorithm is very accurate and it depends on the expertise level and skills of the certain specialist. The aim of this paper is to minimize the measure of uncertainty as well as Subjectivity in manual analysis. The authors presented a deep learning model to work on lesion patterns keeping in view that to perform automatic melanoma recognition and segmentation of the lesion from skin images. A set of necessary deep learning algorithms used to match the multiple hypothesis into a single decision point. This affects the actual scenario where one specialist will usually take suggestions from other specialists for cross reference and checking the correctness of the diagnosis results one more time in prior intimation to the patient. "Various deep learning strategies were developed utilizing the same dataset with large scale data augmentation." For identification of melanoma, deep convolutional neural networks including Inception-v4, ResNet-152, and DenseNet-161 were trained for classifying the melanoma images and seborrheic keratosis. For segmenting the lesion, U-Net and U-Net with VGG-16 Encoder were trained to generate the segmentation masks.

In **Nugroho et al (2019)** the CNN model is used as an identification system to identify skin cancer in dermoscopy images of the HAM10000 dataset. The results exhibited that the CNN model can achieve excellent accuracy by utilizing this dataset for training and testing. In another work, the authors, the authors evaluated the performance of some Machine Learning (ML) algorithms for sin cancer diagnosis using datasets obtained from the UCI ML repository. They used information-gain and relief as feature selection methods to improve the classification process and used selected features as inputs to Support Vector Machines (SVM), Random Forest (RF), Recurrent Neural Network (RNN) and CNN methods. The results revealed that deep learning algorithms, especially RNN,

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achieved the best performance compared to other algorithms and efficiently diagnosed cancer.

Seeja et al. (2019) proposes an automatic system to improve the performance of classification for the efficient diagnose of melanoma. The segmentation of lesion region from the dermo-scopic images are done using deep learning approach based on U-Net algorithm and then extract distinguished features with the help of Convolutional Neural Network. The classification of melanoma shows either the lesion is benign or malignant which is performed through VGG16 Net algorithm. The outcomes obtained from classification are based on two categories such as the classification with or without segmented images. The evaluation is done on ISIC 2016 dataset, and it is concluded that the deep learning-based classification with segmented images produce better outcome for improving the performance of diagnosis. The extension of the work can be done by integrating probabilistic graphical models into this network.

Hassan El-Khatib et al. (2020) presents a new decision system NN classifier with improved accuracy in the diagnosis of skin lesions using deep learning-based approaches like neural network and feature based methods. For training the network, make use of two available data sets such as PH2 and ISIC 2019. Then, the training process is initiated for analyzing the NN architecture, and also evaluates few parameters such as accuracy, specificity, and sensitivity and Dice coefficient. With the help of CNN architectures-based transfer learning, they can distinguish the types of lesions. The classical method of image object detection extracts a few features from images, and followed by the classification step are carried out in the proposed system. The stage of classification is implemented using SVM. The results obtained by the proposed system cover higher accuracy.

Dutta et al (2020) There are twelve million individuals who have cancer, and skin cancer is the most significant concern for western countries, especially the USA, with strong sunshine exposure. Around 1 million new skin cancer patients are expected in the USA in 2020. The basic diagnosis approach for detecting cancerous cell or skin cancer is to visually examine the skin by an expert dermatologist. Providing specialized dermatologists and experienced medical assistance to each individual is difficult, and in many cases, people do not go to specialists until the condition deteriorates. Physicians usually detect the biopsy procedure for diagnosing diseases. The skin is scrapped or detached in the biopsy process, and specific laboratory experiments can be conducted on these skin samples. This process is time-intensive and often frustrating because of this. Computer-aided screening allows early-stage diagnosis of skin cancer. Typically, macroscopic photographs are branded as quantifiable images that are generally used for computer processing, and these images are captured utilizing a typical digital camera and video. Medical photographs have many problems, such as low lighting and the appearance of artifacts such as skin lines, highlights, repetitions and hair in the pictures. Researching skin lesions is very difficult because of these complications. Several measures are involved in detecting skin cancer at the computational level, such as

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preprocessing, recognizing trends, selecting features, and extraction of features and identification.

M. Vidya and Maya V. Karki (2020) Every year, the incidence of malignant melanoma, the most deadly form of skin cancer, rises. Artifacts, poor contrast, and similar visualization as a mole, scar, and so on make it difficult to identify skin cancer from a skin lesion. Hence Techniques for lesion detection are used to automatically identify skin lesions based on accuracy, efficiency, and performance requirements. In order to identify skin lesions early, a feature extraction method is presented that utilizes the ABCD rule, GLCM, and HOG feature extraction. Pre-processing is used to enhance the quality and clarity of skin lesions and eliminate artifacts such as skin color, hair, and so on. For feature extraction, Geodesic Active Contour (GAC) segmented the lesion into distinct parts that could be used independently. A scoring technique known as the ABCD scoring method was utilized to extract the symmetry, border, color, and diameter characteristics. Textural characteristics were extracted with the help of HOG and GLCM software programs. Classifiers use various machine learning methods such as SVM, KNN, and Nave Bayes classifier to categorize skin lesions into benign and melanoma based on the retrieved characteristics. The International Skin Imaging Collaboration (ISIC) provided 328 benign skin lesions and 672 melanoma pictures for this study. Classification results using SVM classifiers yielded an accuracy of 97.8% and an AUC of 0.94. The Sensitivity was 86.2 percent, and the Specificity was 85 percent, thanks to the use of KNN.

Qaiser Abbas, FarheenRamzan and Muhammad Usman Ghani (2021) Amyloidosis is a rare and deadly kind of skin cancer that develops on the eyes. Dermo-scopic imaging, used by professional dermatologists, may be used to make the diagnosis. This makes it difficult for dermatologists to distinguish between melanomas and other types of skin cancer. In skin cancer diagnosis, the majority of research is focused on separating melanoma-causing lesions from those that are not. However, there has only been a little amount of study done on the categorization of melanoma subtypes up until now. Dermoscopy and deep learning were used in the present research to see whether they were helpful in identifying melanoma subtypes like AM. To identify skin cancer, we built a new deep learning model for this research. For the categorization of skin lesions, we used a dermo-scopic picture collection from Yonsei University Health System in South Korea. AM detection has been made easier with the use of various image processing and data augmentation methods. A seven-layered deep convolutional network was used to build our bespoke model. A technique known as transfer learning was used to compare the results of our model's training on two different datasets: one for AlexNet and one for ResNet-18. "For AM and benign nevus, we had better results using our new model, which had an accuracy of above 90%." Additionally, we were able to attain an average accuracy of almost 97 percent utilizing the transfer learning technique, which is similar to current best practices. Based on our research and findings, we concluded that our skin cancer classification algorithm worked well. We found that dermatologists may utilize the

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suggested approach in the clinical decision-making process for early detection of AM thanks to our findings.

Table 1: A summary of approach and results of various reviews table detection methods that operate on other deep learning-based concepts.

Author	Year	Approach	Results
Jafari	2016	Successful segmentation of skin cancer lesions has been introduced through deep learning strategies	Mask was optimized by post-processing operations
Antony	2016	The lesion was segmented from the input picture using morphological procedures such as erosion and dilation	The use of machine learning to separate melanoma from non-melanoma skin lesions. Feature extraction and image processing were both performed on the same picture.
Alquran	2017	With the thresholding method, the dermoscopy picture database was preprocessed and segmented. The gray level co-occurrence matrix and ABCD rule were used to extract the features	For identifying cancer as either melanoma or non-melanoma, the collected characteristics were fed into an SVM algorithm.
SeetharaniMurugaiyanJaisakthi	2018	Semi-supervised learning approach for automatic lesion segmentation for the given dermoscopy images using two stages pre-processing and segmentation is presented	By the use of Deep learning techniques, dice co-efficient values can be improved for enhancing the accuracy and this is considered as a future work.
Zhen Yu	2018	a new strategy for lesion detection using deep learning and	generate various feature values to work among a high amount of variation of lesions

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		local descriptor encoding procedure is proposed in this study.	
Marwan Ali Albahar	2019	The deep learning-based Convolution Neural Network which has the capability to predict the minor changes taking place in the skin are over and done with dermoscopy images is discussed.	The performance is validated by attaining the area under the curve for nevus, and then comparing that with the lesion images for efficient diagnosis.
Pham	2019	To minimize the measure of uncertainty as well as Subjectivity in manual analysis.A deep learning model to work on lesion patterns keeping in view that to perform automatic melanoma recognition and segmentation of the lesion from skin images is presented.	Identification of melanoma, deep convolutional neural networks including Inception-v4, ResNet-152, and DenseNet-161 were trained for classifying the melanoma images and seborrheic keratosis. For segmenting the lesion, U-Net and U-Net with VGG-16 Encoder were trained to generate the segmentation masks.
Nugroho	2018	CNN model is used as an identification system to identify skin cancer in dermoscopy images of the HAM10000 dataset	The results revealed that deep learning algorithms, especially RNN, achieved the best performance compared to other algorithms and efficiently diagnosed cancer.
Seeja	2019	An automatic system to improve the performance of classification for the efficient diagnose of melanoma	The outcomes obtained from classification are based on two categories such as the classification with or without segmented images. The extension of the work can be done by integrating probabilistic graphical models into this network.

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Hassan El-Khatib	2020	A new decision system NN classifier with improved accuracy in the diagnosis of skin lesions using deep learning-based approaches like neural network and feature based methods is discussed in this.	The stage of classification is implemented using SVM. The results obtained by the proposed system cover higher accuracy.
Dutta	2020	The basic diagnosis approach for detecting cancerous cell or skin cancer is to visually examine the skin by an expert dermatologist	
M. Vidya and Maya V. Karki	2020	A feature extraction method is presented that utilizes the ABCD rule, GLCM, and HOG feature extraction. For feature extraction, Geodesic Active Contour (GAC) segmented the lesion into distinct parts is utilized.	Classification results using SVM classifiers yielded an accuracy of 97.8% and an AUC of 0.94. The Sensitivity was 86.2 percent, and the Specificity was 85 percent, thanks to the use of KNN.
Qaiser Abbas, FarheenRamzan and Muhammad Usman	2021	The majority of research is focused on separating melanoma-causing lesions from those that are not	It is concluded that our skin cancer classification algorithm worked well. We found that dermatologists may utilize the suggested approach in the clinical decision-making process for early detection of AM thanks to our findings

4. DISCUSSION

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Various deep learning algorithms for skin cancer detection and classification were discussed in this systematic review research. These methods are all non-invasive. Preprocessing and picture segmentation are followed by feature extraction and classification in the detection of skin cancer. For classification of lesion images, this review focused on ANNs, CNNs, KNNs, and RBFNs. Each algorithm has its own set of benefits and drawbacks. The most important factor in achieving the best results is choosing the right classification technique. When it comes to identifying picture data, however, CNN outperforms other types of neural networks since it is more closely tied to computer vision than others.

5. CONCLUSION

The incidence of skin cancer is on the rise all across the globe. Skin cancer occurs when skin cells proliferate uncontrollably and irregularly. Skin cells have suffered DNA damage that has not been repaired or there are hereditary flaws that contribute to this. Thus, the skin's surface cells multiply quickly, resulting in cancerous tumors. Early diagnosis improves the survival probability of skin cancer, which is a frequent kind of cancer. Early detection is critical in the treatment of melanoma, the deadliest form of skin cancer. Thus, creating a system that can detect illness early on may save lives, minimize intervention, and reduce needless expenditures since human expertise in this area is still restricted. A computerized instrument allows spotting small shifts to change the skin's functionality in an early stage. In the Research study, different techniques which are used for segmentation of lesion area in dermo-scopic images that are available in various literatures are discussed extensively.

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