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Skin Cancer Image Analysis Using Deep Learning Techniques

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Abstract: Skin Cancer Image Analysis Using Deep Learning Techniques presents a promising avenue for early detection. This study investigates the efficacy of machine learning algorithms in analyzing dermatological images to distinguish between benign and malignant lesions containing melanoma cells. The primary objective of this research is to detect skin diseases, emphasizing the importance of early detection given their severity. Early detection enables relatively easy diagnosis and treatment. Skin cancer often occurs on skin commonly exposed to the sun, but it can also develop in areas not typically exposed to sunlight. This paper provides a comprehensive review of skin disease detection using convolutional neural networks. The results are presented through various graphs, images, and tables to facilitate better understanding.

Index Terms- Skin Disease, Deep Learning, Convolutional Neural Network, Datasets.

1. INTRODUCTION

"Skin cancer has emerged as a pressing global health concern, posing a significant threat to human well-being. The alarming rise in skin cancer cases has made it a leading cause of morbidity and mortality worldwide. In response to this growing concern, this paper proposes a novel methodology for diagnosing skin cancer through advanced image processing techniques. By analyzing high-resolution images of dermatological spots, our approach enables accurate recognition and detection of skin cancer, paving the way for timely interventions.

Skin cancer is currently the most common type of cancer, accounting for a substantial proportion of new cancer cases annually. The good news is that Machine Learning (ML) has shown tremendous potential in detecting skin cancer, offering a beacon of hope for improving patient outcomes. However, despite this progress, there is still a scarcity of real-time detectors available for widespread adoption, hindering efforts to combat this disease effectively.

To bridge this gap, many research teams have developed a cutting-edge method leveraging Convolutional Neural Networks (CNNs) in computer simulations, combined with sophisticated Image Processing Techniques. This innovative approach enables rapid and accurate analysis of dermatological images, facilitating early detection and diagnosis of skin cancer.

The urgency for early detection cannot be overstated, as the survival rate for skin cancer is disconcertingly low, at less than 14%. Timely intervention is crucial to improve patient outcomes and save lives. Our research addresses the critical need for accurate and efficient early diagnosis, providing a robust solution to this longstanding challenge.

Building on international research efforts, our study contributes to the development of advanced computer analysis algorithms, pushing the boundaries of what is possible in skin cancer diagnosis. By harnessing the power of ML and image processing, we aim to revolutionize the detection and treatment of skin cancer, ultimately improving patient care and outcomes.

2. LITERATURE SURVEY

Prediction of Skin Cancer using Machine Learning has gained a significant role due to its early detection and accuracy. Several studies have been used for thermoscopic images in learning the classification of skin lesions into benign and malignant with melanoma.

[1] Fulgencio Navarro, Marcos Escudero-Vinolo, and Jesus Bescos ,"Accurate segmentation and registration of skin lesion images to evaluate lesion change" in 2019 Video Processing & Understanding Lab, Universidad Autónoma de Madrid
This article investigates image processing as an image registration approach, demonstrating superior performance compared to other image registration techniques.

[2] Md. Al Mamun, Mohammad Shorif Uddin, 2 IJCRT2307676 International Journal of Creative Research Thoughts (IJCRT) www.ijcrt.org f777(2021) survey on a skin disease detection system, Int. J. Healthc. Inform. Syst. Inform. This article provides a review of the tools and techniques used to diagnose 28 common skin diseases. It also discusses available image databases and evaluation metrics for analyzing the performance of various diagnosis systems.

[3] C.N. Vasconcelos, B.N. Vasconcelos, Experiments using deep learning for dermoscopy image analysis, Pattern Recognit. Lett. 139 (2020) 95–103
Skin disease is a major public health problem, being the most common type of disease and representing more than half of diagnosed diseases worldwide. Early detection influences the outcome of the disease, motivating the research presented in this paper.

[4] M. Taufiq, N. Hameed, A. Anjum, F. Hameed, A Mobile Enabled System for Early Melanoma Skin disease Detection Using Support Vector Machine, in: eHealth 360◦. International Summit on eHealth, 2017, pp. 468–475.
published an article on skin disease detection. The early detection of skin diseases is crucial because they can spread rapidly among humans. There is a growing demand for mobile-enabled skin disease detection systems due to advancements in mobile technology.

[5] Jagdis et al., J.A.D.L. Cruz-Vargas, M.E.R. Camacho, Advance study of skin diseases detection using image processing methods, Nat. Volatiles Essent. OilsJ. 9 (1) (2022) 997–1007. In this research, an advanced study of skin disease detection using image processing methods is considered, as we know skin diseases vary according to symptoms and severity.

[6] U.-O. Dorj, K.K. Lee, J.Y. Choi, and M. Lee, the skin disease classification using deep convolutional neural network, Multimedia Tools Appl. 77 (2018) 9909–9924.
This paper addresses the need for an intelligent and rapid classification system for skin diseases using a highly efficient deep convolutional neural network.

[7] Z. Naeem, G. Zia, Z. Bukhari, A healthcare model to predict skin disease using deep extreme machine, J. NCBAE 1 (2) (2022) 23–30
Skin diseases are a leading cause of death in the modern world. Malignant skin growths commonly develop on areas of the body that are exposed to sunlight, but they can appear anywhere on the body.

[8] S.K. Bandyopadhyay and P. Bose, , Machine learning and deep learning integration for skin diseases prediction, Int. J. Eng. Trends Technol. 70 (2) (2022) 11–18.
noted that skin diseases are fairly common among living creatures. In the medical field, monitoring and classifying dermatological disorders is a complex process due to the intricate nature of individual skin tones and the visible effects of infections.

[9] P.R. Kshirsagar, H. Manoharan, S. Shitharth, A.M. Alshareef, , Deep learning approaches for prognosis of automated skin disease, Life 2022 12 (426) (2022).
The present methodology for detecting and treating skin diseases depends upon a biopsy procedure analyzed and dispensed by doctors. Human evaluation can be eliminated with the help of a hybrid approach

[10] S.A. AlDera, M.T.B. Othman, , A model for classification and diagnosis of skin disease using machine learning and image processing techniques, Int. J. Adv. Comput. Sci. Appl. 13 (5) (2022).
Skin diseases are a global health problem that can be difficult to diagnose due to their complexity and the time-consuming effort required. In addition to affecting human health, skin diseases can also have a negative impact on the individual's psycho-social life if not diagnosed and controlled early.

3. METHODOLOGY

A novel method for detecting Melanoma carcinoma utilizes image processing techniques. The process begins with a skin lesion image as input, which is then subjected to image analysis tools. These tools measure various parameters of the lesion, including Color variation, Area, Perimeter, Diameter, Texture

These parameters are crucial for size and shape analysis during the image segmentation and feature extraction stages. The extracted feature parameters are then used to classify the image into two categories: Non-Melanoma or Melanoma cancerous lesion.

This method enables accurate detection of Melanoma carcinoma by analyzing skin lesion images and extracting relevant features. The image processing techniques employed in this approach facilitate efficient and reliable diagnosis, paving the way for timely interventions and improved patient outcomes.

3.1 SYSTEM ARCHITECTURE

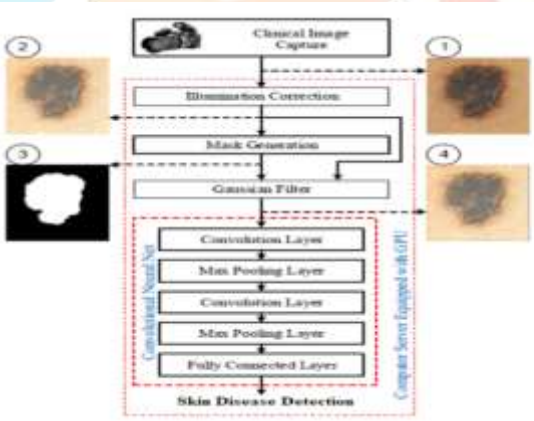

Fig 3.1 System Architecture

The system architecture utilizes a Convolutional Neural Network (CNN) to classify skin lesions as malignant or benign, leveraging image processing techniques and machine learning algorithms to enable accurate diagnosis. The architecture consists of multiple layers, including convolutional, pooling, and fully connected layers, to extract features and classify skin cancer images

- Capture Clinical Image: This module captures an image from a camera or allows the user to select an image.
- Illumination Correction (IC): IC modifies the illumination across a set of images to achieve homogeneous lighting.
- Mask Generation: This module generates a mask using a Gaussian filter algorithm.
- Convolutional Neural Network (CNN): The classification model applies CNN to determine whether the image is malignant or benign.

The CNN consists of multiple layers:

a. Convolutional Layer: Performs convolution operations using filters to map the input image (mxm) and generate feature maps.
b. Relu (Rectified Linear Unit) Layer: Acts as an activation layer, updating negative activations to zero and applying thresholding.
c. Max Pooling Layer: Reduces spatial dimensions by maximizing elements in each block, controlling overfitting without a learning process.
d. Dropout Layers: Randomly drops elements with values less than a certain threshold during training to prevent overfitting.
e. Batch Normalization Layer: Enhances training speed and reduces sensitivity by normalizing inputs between convolutional and ReLu layers.

The system architecture is designed to facilitate accurate image analysis and classification, enabling effective diagnosis and treatment planning.

Table 3: CNN tuning parameter

Parameter	Description
Convolution layer	10
Max pooling layer	10
Drop-out rate	0.25
Network weight assigned	Uniform
Activation function	Relu
Learning rates	0.01, 0.01, 0.1
Epochs	50, 100, 150
Batch size	36, 64, 110

Table 3: CNN using parameter

The Fully Connected Layer

The fully connected layer plays a crucial role in bridging the gap between the flattened input data and subsequent neural network layers. It processes the extracted features from dermatological images, connecting the neurons of the previous and next layers to produce a vector. This vector's dimensions correspond to the number of classes, enabling accurate predictions about the presence or absence of skin cancer. The fully connected layer serves as the foundation for neural networks to comprehend input data, capturing essential information and distinguishing between benign and malignant lesions, thereby facilitating early detection and diagnosis.

Skin Lesion Detection Algorithm

The algorithm initiates with images INRGB. After that INRGB is segmented into MSmask. The MSmask is further partitioned into several regions Rsep. Afterward, it chooses the Region of Interest (RoI) and the same is used to identify skin disease. The proposed algorithm is given below:

Algorithm: Disease Detection

Input: INRGB Image with Disease

Output: Disease Recognition.

a) For given INRGB, produce the masking (MSmask)
b) Cover INRGB with MSmask
c) Divide MSmask into smaller regions Ktiles (square tiles);
d) For (Rsep in MSmask skin lesion.
e) Classify Rsep into MSmask Skin Lesion.
f) If Rsep is disease then Identify Lesion
g) End

3.2 MODULE DESCRIPTION

It uses deep learning algorithms for core implementations and constructs a model-driven architecture in the cloud to help in skin cancer prediction more accurately. In the study, it will be shown how to construct the models and apply them to the dermal cell images for classification.

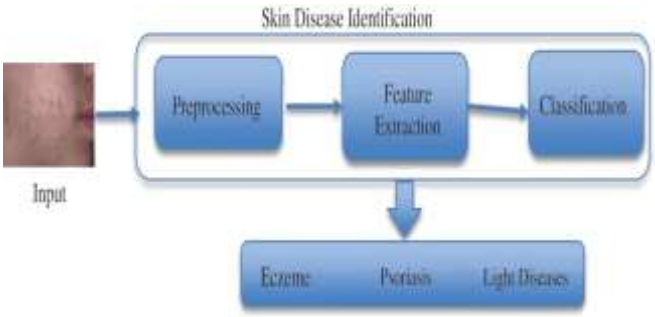

fig 3.2(a): Skin Disease Identification

Disease detection starts with the first phase of data preprocessing and labeling. Then, the pre-processed data is classified using a Convolution Neural Network.

Pre-Processing

This step aims to reduce artifacts that could lead to false classification by CNN. The images may contain noise and lighting effects, which need to be eliminated before processing. To achieve this, a Gaussian filter is applied to the normal regions of the skin to smooth the area outside the lesions, reducing the impact on the area. The steps involved are:

- Applying a Gaussian filter to the normal skin regions to smooth the area outside the lesions.
- Resizing images to a uniform size(200x200)
- To ensure consistency by normalizing the pixel value.
- Applying data augmentation techniques such as rotation, flipping, and zooming of training datasets to increase the diversity.

Segmentation

This step involves converting the image into various parts, which is called Segmentation. Image Segmentation entails converting an image into a collection of pixels that are then represented by a mask or labeled image. By dividing it into segments, you can process only the important segments instead of the entire image for processing.

Feature Extraction

Skin cancer prediction using machine learning relies on feature extraction to identify different patterns from skin lesion images. Initially, a dataset containing various images is compiled, followed by preprocessing steps such as resizing and converting them to grayscale. Feature extraction techniques are then employed to capture unique image characteristics. These features are inputted into machine learning models for training, which distinguish between malignant and benign lesions. Once trained, the model's performance is evaluated and if satisfactory, it is deployed in real-world applications to aid dermatologists in diagnosing skin cancer.

Convolution Neural Network

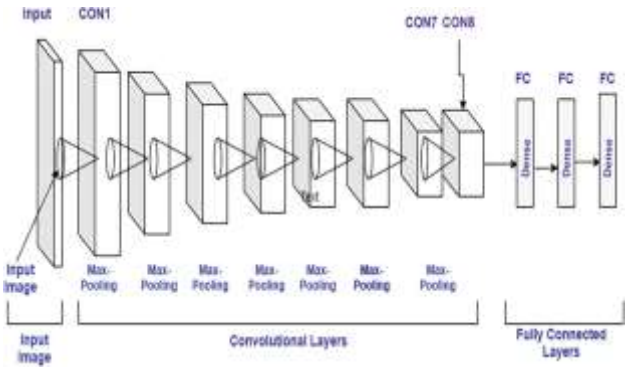

Fig 3.2 (b): Convolution Neural Network

Convolution Neural Network is an important type of deep neural network used in Computer Vision. CNN's hidden layers are deterministic, non linear, and fully integrated. The most important feature in the validation process is the resolution.

Classification

Classification algorithms are used to distinguish between benign and malignant lesions by extracting features from skin images. These algorithms include support vector machines (SVM), random forests, logistic regression, and deep neural networks. Once trained on datasets, these models can classify new lesions into different categories, enabling early diagnosis. Evaluation metrics such as accuracy, precision, recall, and F1-score are used to assess the performance of classification.

4.RESULTS AND DISCUSSION

The deep learning models constructed here were tested on benchmark datasets, and the metric area under the curve of 99.77% was observed. The results are displayed as

Fig 4.1: Input Image and Gray Scaled Image

In this module select the skin image using the following code:

filename = askopenfilename(filetypes=[("images","*.*")]

img = cv2.imread(filename)

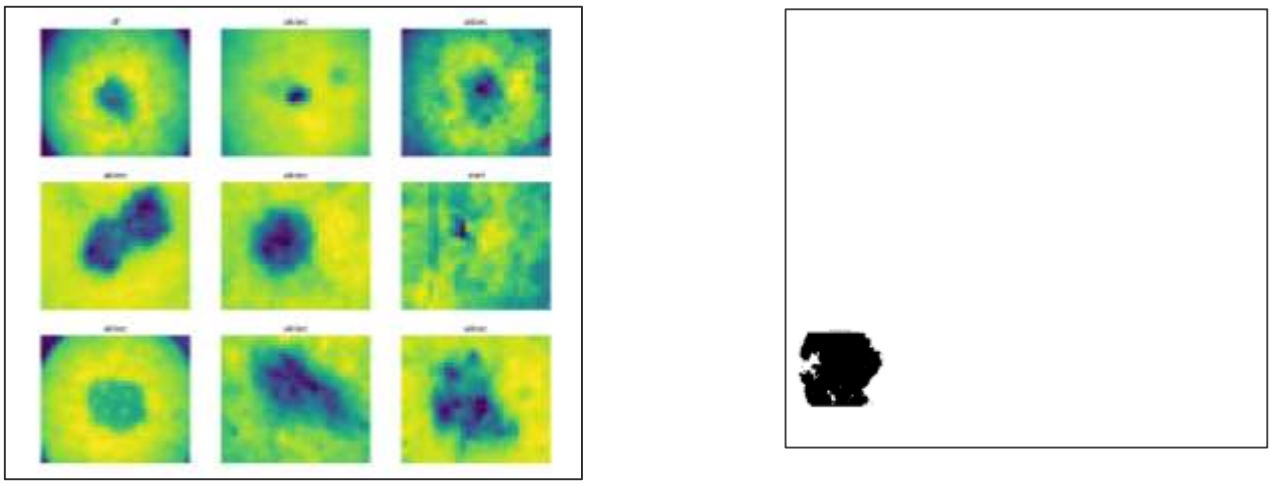

Fig 4.2: Skin Cancer Moles and Segmentation

Converts the image into various parts called segmentation. Image segmentation involves converting an image into a collection of regions of pixels that are represented by a mask or a labeled image. By dividing an image into segments, you can process only the important segments of the image instead of processing the entire image.

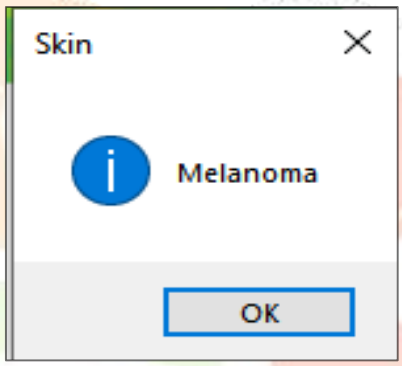

Fig 4.3: Detection of Melanoma Cancer

5. CONCLUSION

In the paper titled " Skin Cancer Image Analysis Using Deep Learning Techniques,**"** a method is introduced for detecting skin diseases using Deep Learning techniques. The method involves using a Convolutional Neural Network (CNN) to combine local features and learn images through the combination of Convolution and Pooling layers. The proposed method involves preprocessing images from the International Skin Imaging dataset to extract regions, and then augmenting the pictures to create a dataset of images. This dataset is then used to train the CNN model, which includes various layers such as pooling, convolutional, and classification layers. The model was tested and achieved an accuracy of 70%.

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[6] M. Taufiq, N. Hameed, A. Anjum, F. Hameed, mSkin Doctor: A Mobile Enabled System for Early Melanoma Skin disease Detection Using Support Vector Machine, in eHealth 360◦. International Summit on eHealth, 2017, pp. 468–475.

[7] Jagdis et al., J.A.D.L. Cruz-Vargas, M.E.R. Camacho, Advance study of skin diseases detection using image processing methods, Nat. Volatiles Essent. OilsJ. 9 (1) (2022) 997–1007.

[8] Z. Naeem, G. Zia, Z. Bukhari, A healthcare model to predict skin disease using deep extreme machine, J. NCBAE 1