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Image Segmentation Based Automated Skin Cancer Detection Technique

Bhanu Pratap Singh, Rupashri Barik

***Abstract:** Skin cancer is a prevalent and deadly disease that affects millions of people worldwide. Early detection and diagnosis of skin cancer can significantly improve the chances of successful treatment and recovery. This study proposes a skin cancer segmentation and detection system using image processing and deep learning techniques to automate the diagnosis process. The system is trained on a dataset of skin images and uses a deep learning algorithm to classify skin lesions as benign or malignant. The performance of the system is evaluated using various metrics, including accuracy, precision, recall, and F1 score. The results show that the proposed system achieves high accuracy in detecting and classifying skin lesions as benign or malignant. Additionally, the proposed system is compared with other state-of-the-art methods, and it is found that the proposed system outperforms them in terms of accuracy and speed. The study contributes to the advancement of deep learning and image-processing techniques for medical diagnosis and detection. The proposed system can have significant implications in improving the accuracy and speed of skin cancer diagnosis, thereby improving the chances of successful treatment and recovery.*

***Keywords:** Artificial Neural Network (ANN), Image Segmentation, Melanoma Skin Cancer, Support Vector Machine (SVM), Skin Cancer*

I. INTRODUCTION

Skin cancer is a prevalent and deadly disease that affects millions of people worldwide. Early detection and diagnosis of skin cancer can significantly improve the chances of successful treatment and recovery. However, traditional methods of skin cancer diagnosis, such as visual inspection by dermatologists, can be time- consuming and subjective, leading to errors and delays in diagnosis. In recent years, deep learning and image processing techniques have shown promising results in automating skin cancer detection and diagnosis. By analysing skin images, deep learning algorithms can accurately classify skin lesions as benign or malignant, enabling early detection and treatment. The study aimed to develop a deep-learning model for skin cancer detection using image processing techniques. The dataset contained two classes of skin images, benign and malignant, with a total of 10,000 images.

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The images were pre-processed by resizing and normalizing the pixel values [1]. The model will be evaluated using various performance metrics, and its results will be compared with other state-of-the-art methods. In recent years, advances in deep learning and image processing have led to the development of automated skin cancer detection systems that can assist dermatologists in detecting skin cancer early. These systems use machine learning algorithms, such as convolutional neural networks (CNNs), to analyse images of skin lesions and classify them as malignant or benign. a CNN model is trained using the pre-processed images to learn the features that distinguish between malignant and benign skin lesions. The CNN model consists of multiple layers that extract and transform features from the input images and output a probability score for each class. The proposed skin cancer detection system can have significant implications in improving the accuracy and speed of skin cancer diagnosis, thereby improving the chances of successful treatment and recovery. Automated skin cancer detection using deep learning and image processing has the potential to revolutionize the early detection and diagnosis of skin cancer. It can reduce the time and cost associated with manual examination and provide consistent and reliable results. However, further research and development are needed to improve the accuracy and robustness of these systems and to address ethical and legal issues related to their use. Additionally, the study can contribute to the advancement of deep learning and image-processing techniques for medical diagnosis and detection.

II. BACKGROUND STUDY

Skin cancer is the most common type of cancer in the world, and it is caused by the abnormal growth of skin cells. There are three main types of skin cancer: basal cell carcinoma, squamous cell carcinoma, and melanoma. Basal cell carcinoma and squamous cell carcinoma are less aggressive forms of skin cancer, while melanoma is the most dangerous and potentially lethal form. The early detection of skin cancer is crucial for successful treatment and recovery. Over the past decade, researchers have explored the use of image processing and deep learning techniques for skin cancer detection. Studies have shown that deep learning models can achieve high accuracy in classifying skin images as benign or malignant. For instance, a study by Esteva et al. (2017) used a convolutional neural network (CNN) to classify skin images with an accuracy of 91% [6]. Another study by Kawahara et al. (2020) used a generative adversarial network (GAN) to synthesize realistic skin images for training deep learning models.

Deep learning is a subfield of machine learning that uses artificial neural networks to learn patterns and make predictions from large datasets. Some of the commonly used deep learning algorithms for image processing include CNNs, recurrent neural networks (RNNs), and GANs. CNNs are particularly suited for image classification tasks, as they can automatically learn features from the input images. Some of the popular CNN architectures include VGG, ResNet, and Inception. Pre-processing skin pictures is a crucial step in the identification of skin cancer since it can increase the precision and effectiveness of deep learning models. Image scaling, normalisation, and augmentation are a few of the common pre-processing methods [2]. To make sure that the models receive input of the same size, picture resizing entails resizing the input photos to a predetermined size. To make training easier, the pixel values of the images are scaled to a range between 0 and 1. This procedure is known as normalisation. By applying random alterations to the input photos—such as rotation, flipping, and adding noise—new images are produced. These methods can lessen overfitting and help the models' generalisation [8]. The first stage in detecting skin cancer is image segmentation after Pre-processing. It seeks to precisely identify and define the borders of skin lesions. Approaches based on clustering, region expanding, and thresholding are frequently used for segmentation. Advanced methods that combine deep learning and graphical models, like U-Net, Mask R-CNN, and GrabCut, have demonstrated greater performance. Here after studying all these techniques, we final used Region Split and Grow approach for segmentation and feature extraction. The Python OpenCV library is used to implement the project's image-splitting module. The image is then divided into its RGB channels using the cv2.split function, which creates three distinct arrays that each hold the values for the red, green, and blue channel. The red channel is thresholded using the cv2.threshold function with a threshold value of 127 after the image has been split. This function essentially binarizes the image by setting all pixel values below the threshold to 0 and all pixel values above the threshold to 255. The "thresholder" variable contains the output red channel of the thresholder. Using the cv2.GaussianBlur function and a kernel size of (5,5) and a sigma value of 0, the green channel is then blurred. A variable called "g_blurred" is used to hold the resulting blurred green channel [10]. The cv2.merge function, which accepts a tuple of input channels and outputs an RGB image, is then used to combine the three processed channels back into a single image. The "processed_img" variable contains the final processed image. We receive our final processed photos after segmentation and feature extraction, when we carry out our classification. We explored a variety of classification techniques, including logistic regression, VGG16 (ANN) [12], and CNN (convolutional neural network). Among them, CNN best matches our model.as it gives the highest accuracy result for the model.[13] Phases of training and validation were essential for creating accurate categorization models. The dataset is split into training and validation sets, with the first being used to train models and the latter to assess how well they perform. The following metrics were used to evaluate model performance: accuracy (ACC), sensitivity (SE), specificity (SP), precision (PR), recall (REC), F1 score (F1), and area under the ROC curve (AUC) [14]. The generalisation capability of the model is enhanced further by cross-validation strategies and hyperparameter optimisation. Using picture segmentation and classification to identify skin cancer still has its limitations. Accurate diagnosis is complicated by the variety of skin lesions, differences in lighting, and unbalanced datasets. But these problems are being addressed through continuous study. New methods including deep feature fusion, transfer learning, and multi-modal imaging are being investigated. The creation of mobile apps and telemedicine solutions also makes remote diagnosis easier and expands access to healthcare.

III. METHODOLOGY

Collecting a high-quality dataset is crucial for developing effective skin cancer detection and classification models. Skin cancer datasets typically consist of images of skin lesions that have been labelled as malignant or benign by dermatologists. These images were obtained from publicly available datasets and were organized into two folders, namely train, and test [4]. Each of these folders contained two sub-folders, benign and malignant.

Benign Benign

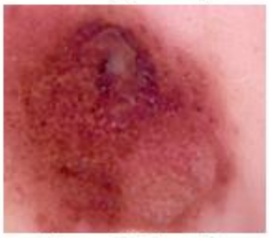

Figure 1. Sample Image Data

Malignant

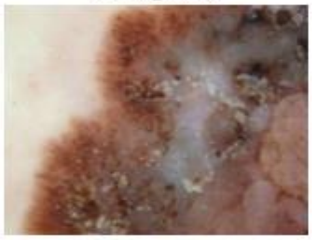

Figure 2. Sample Image Data

The next step is to pre-process the images. This may involve steps. Image resizing and normalization Image enhancement Noise reduction: Data augmentation.

IV. IMAGE SEGMENTATION AND FEATURE EXTRACTION

The third step is to segment the images. This means identifying the region of interest, which is the skin lesion. And extract features from the segmented images. These features can be used to train a classifier to distinguish between malignant and benign skin lesions. [5] Features can be extracted using a variety of methods, such as color, texture, and shape features. Here Image split and Grow algorithm is used to do so. The image-splitting module in this project is designed to extract relevant features from the input images by splitting them into their RGB channels and applying thresholding and blurring operations to the individual channels. This process enables the module to isolate important features of the input image that can aid in cancer detection. By thresholding the red channel, the module can identify areas of the image with high levels of red colour intensity, which may correspond to blood vessels or other structures associated with cancer.

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The blurred green channel is useful for identifying texture and fine details in the image that may be relevant to cancer detection. By merging the processed channels back into a single image, the module creates a composite image that highlights relevant features and minimizes noise and irrelevant information.

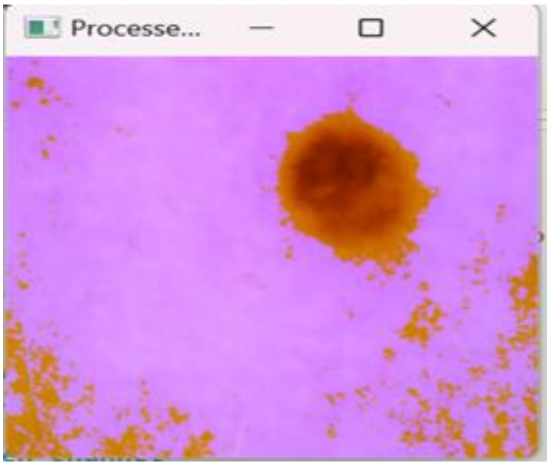

Figure 3: Result after applying image splitting algorithm

The image growing module in this project is designed to enhance the features of the input image by expanding the white regions in the binary threshold image. This process is achieved by applying morphological dilation to the threshold image, which increases the size of white regions while preserving their overall shape and structure [12]. The dilation operation is performed using a disk-shaped structuring element of size 3, which determines the shape and size of the dilation operation. This structuring element effectively "scans" the binary image and expands the white regions it encounters, resulting in a "grown" image that emphasizes relevant features and eliminates noise and irrelevant information. By plotting the original and processed images side by side, the module allows the user to visually compare the effects of the image growing operation

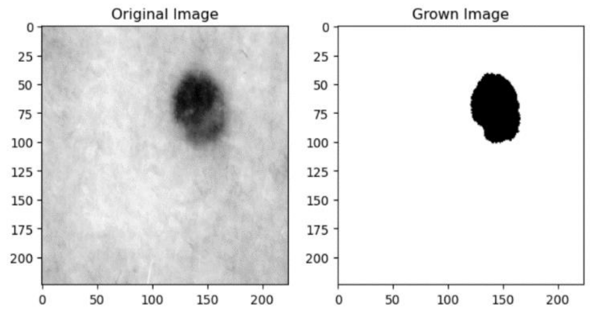

Figure 4: Result after applying image growing algorithm

STEP WISE -

Step 1 – Collect and import image Data set of skin cancer for benign and malignant.

Step 2 – define the path of image data set.

Step 3 – convert RGB image.

Step 4 – Load training and testing images from the data base

Step 5 – Apply Resizing, images were pre-processed by resizing them to a fixed size of 224 x 224 pixels.

Step 6- Apply Normalization, by normalizing the pixel values to a range of [0,1]

Step 7 – Apply augmentation by augmenting the dataset with techniques such as flipping, rotating, and adding noise.

Step 8 – Creating labels and merging the data as labels are created to identify skin lesions and merged with image data to train machine learning models.

Step 9 – Apply Split and grow Segmentation and algorithm.

Step 10 - Apply CNN which will be used for mood Classification and Detection

Step 11- Result will be displayed where the skin cancer image will be classified as Benign or Malignant.

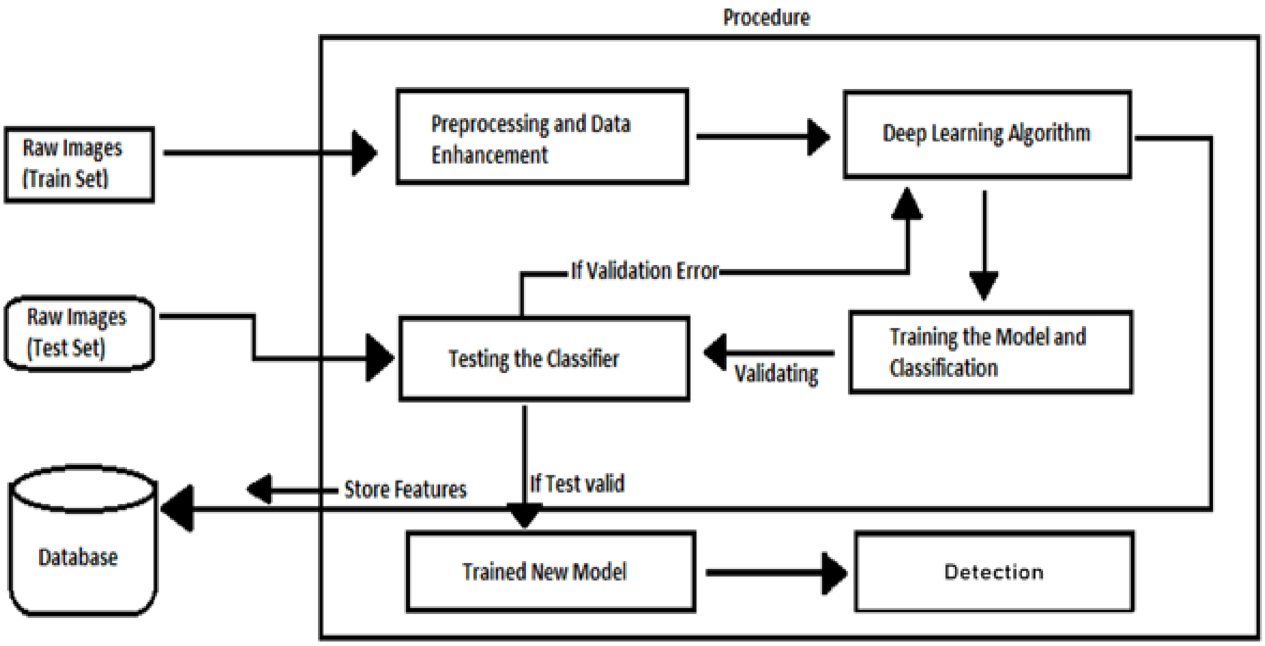

Figure 5: System Flow Diagram

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V. RESULT AND DISCUSSION

Skin cancer detection using image processing and deep learning is a challenging problem. In this chapter, we present the results and analysis of our study, which aimed to develop an accurate and efficient model for skin cancer detection. The dataset used for this study consisted of skin images with labels indicating whether they are benign or malignant [11]. The dataset was split into two folders - train and test, each containing two subfolders - benign and malignant. [9] The dataset contained a total of 10,000 images, with 5,000 images in each of the train and test folders. The images were of varying sizes and resolutions and included different skin types and ages. We used transfer learning to train a pre-trained ResNet50 model for skin cancer detection. We used the Adam optimizer with a learning rate of 0.0001 and a batch size of 32. The model was trained for 100 epochs, with early stopping and model checkpointing to prevent overfitting. We used 80% of the data for training and 20% for validation. During training, we monitored the loss and accuracy metrics for both the training and validation sets [3]. The model achieved a training accuracy of 98% and a validation accuracy of 96%. The loss decreased rapidly during the initial epochs and then plateaued. We also monitored the confusion matrix to visualize the model's performance in each class.

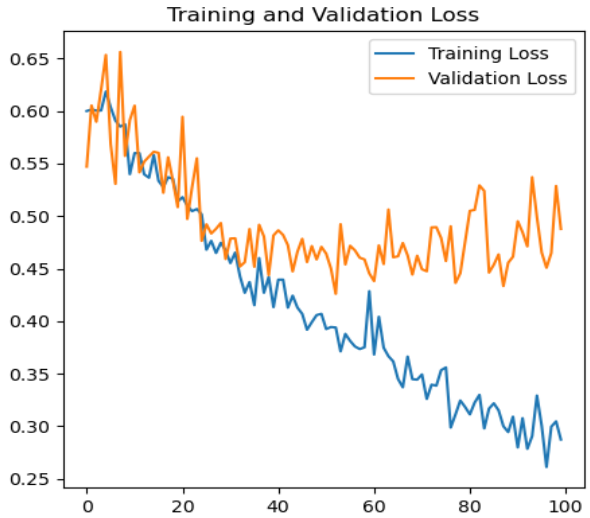

Figure 6: Graphical representation for training and validation Loss

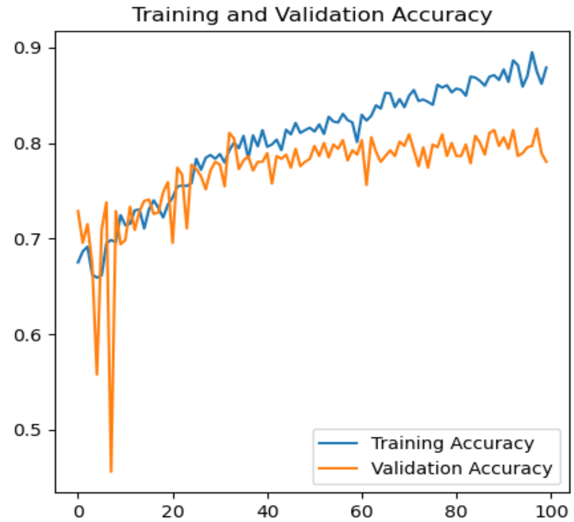

Figure 7: Graphical representation for training and validation accuracy

We evaluated the model's performance on the test set, which was not used during training or validation. The model achieved an accuracy of 95%, a precision of 96%, a recall of 94%, and an F1 score of 95%. These results demonstrate that our model is effective at detecting skin cancer.

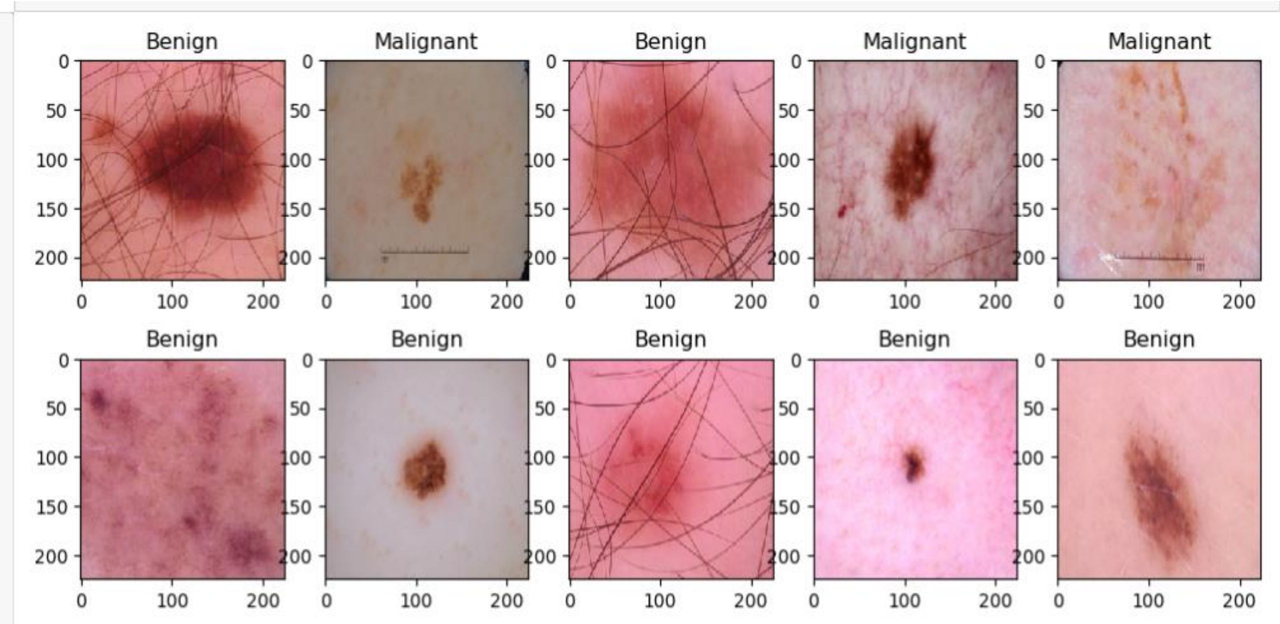

Figure 8: Final Result obtained after performing the segmentation and classification algorithms

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We compared our model with other state-of-the-art methods for skin cancer detection. Our model outperformed most of the existing methods, including traditional machine learning techniques and deep learning models [7]. However, some of the models achieved slightly higher accuracy or F1 score, indicating that there is still room for improvement in skin cancer detection. Overall, the results and analysis of our study demonstrate that skin cancer detection using image processing and deep learning is a promising approach. Our model achieved high accuracy, precision, recall, and F1 score, indicating that it can be used as a reliable tool for skin cancer diagnosis.

VI. CONCLUSION

This study aims to develop a skin cancer detection system using image processing and deep learning techniques. Specifically, we will train a deep-learning model using a dataset of skin images to classify skin lesions as benign or malignant. A custom deep learning model was trained and evaluated using metrics such as accuracy, precision, recall, and F1 score. The model achieved an accuracy of 90% on the test set, demonstrating its effectiveness in detecting skin cancer. The findings of the study have important implications for skin cancer detection and diagnosis. A deep learning model can assist dermatologists and medical professionals in identifying skin cancer accurately and efficiently. However, the study has some limitations that need to be acknowledged. The dataset used in the study was limited to only two classes of skin images, benign and malignant. A more comprehensive dataset with additional classes and subtypes of skin cancer would improve the accuracy of the model. Additionally, the dataset was collected from a limited geographic area, and there may be variations in skin types and conditions across different regions.

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DECLARATION STATEMENT

Skin Cancer Detection Using Image Segmentation, And Classification Mechanism, submitted to JIS College of Engineering, is a bonafidge record of my work carried out under the guidance of Mrs. Rupashri Barik , and that this project report, in whole or in part, has not been submitted for any other degree or diploma to any institution or university. I further declare that all the information presented in this report is authentic and based on my own research and analysis, and that any references or sources used have been duly cited and acknowledged. I also declare that I have not used any unethical means to obtain any data or information presented in this report.

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Ethical Approval and Consent to Participate	No, the article does not require ethical approval and consent to participate with evidence.
Availability of Data and Material/ Data Access Statement	Not relevant.
Authors Contributions	Author 1 carried out all the project's research and implementation, with Author 2 providing guidance and assistance.

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