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Developing a Hybrid Deep Learning Framework for Automated Skin Cancer Classification Using ISIC Dataset

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Abstract

Skin cancer is one of the worst kinds of cancer, skin cancer has a high death rate if it is not identified and treated quickly. One of the main causes of this condition is the fast proliferation of skin cells brought on by exposure to sunshine. Reliable automated solutions for wound recognition must be developed because early detection is essential for successful treatment. Using photos from the ISIC dataset, this study suggests an automated method for identifying skin cancer by utilizing mixed algorithms like Xception, as and ResNet50 and deep learning techniques like transfer learning. This strategy seeks to lessen the workload for medical professionals by creating a web application with Stream lit, enabling them to take preventative action as soon as possible. The system's primary goal is to categories different forms of skin cancer, such as actinic. The approach is designed to categories different kinds of skin cancer, such as melanoma, carcinoma of basal cells, dermatofibroma, and actinic keratosis. An important step forward in the use of AI in healthcare is represented by the suggested solution.

Keywords: *Skin Cancer, ResNet50, Stream lit, Xception, Deep Learning, the ISIC Dataset, and Transfer Learning.*

1. Introduction

Skin cancer has become of the most common and fatal types of cancer in the world in recent years. Skin cancer is becoming more common in India as a result of changing lifestyles, environmental conditions, and increased exposure to UV rays from the sun. Effective management of this illness depends on early diagnosis and discovery. However, conventional diagnostic techniques like visual inspection and biopsy take a lot of time and demand a high level of skill. Deep learning and artificial intelligence (AI) have transformed medical diagnostics by offering instruments that can help with very accurate early detection. Deep learning algorithms are appropriate for medical image analysis since they have demonstrated impressive performance in image classification tasks. An extensive collection of photos from the International Skin Imaging Collaboration (ISIC) dataset can be utilized to train AI models for the categorization of skin cancer. This study uses deep learning techniques to provide an automated solution for classifying skin cancer. In order to categories various skin lesions with high accuracy, the system uses transfer learning with models that have been trained such as Xception and ResNet50. The creation of an internet-based app using Stream lit will make it simple for medical professionals to obtain information and make prompt, well-informed decisions. The difficulties brought on by the intricacy of skin lesions & the requirement for accurate categorization are addressed by the emphasis on the use of sophisticated deep learning models. By offering a trustworthy tool for initial screening, this strategy not only helps with early detection but also lessens the strain on healthcare systems. In this work, we use the International Skin Imaging Collaboration (ISIC) dataset to present a Hybrid Deep Computing Framework for automated skin cancer classification. The ISIC dataset is a commonly used standard for creating and assessing skin tumor classification models since it includes a wide range of thermoscope images. By putting forth an efficient and adaptable deep learning method for automatic skin cancer detection, this study advances the area of AI-driven dermatology. The results can help dermatologists make quicker and more accurate judgements by assisting in the creation of computer assisted diagnostic (CAD) systems. among the most common and deadly illnesses in the world, skin cancer requires early and precise detection in order to be effectively treated. Although deep learning-based methods have demonstrated encouraging outcomes in automated cancer of the skin classification, issues including overfitting, poor generalizability, and insufficient interpretability prevent their practical clinical implementation. To improve classification performance, this paper suggests a hybrid deep learning architecture that combines ensemble learning methods, transformers, and convolutional neural networks (CNNs). In order to ensure better feature extraction and robustness, the system makes use of transfer learning using pretrained models that have been refined on the ISIC dataset. In order to reduce overfitting, sophisticated data augmentation and regularization techniques are used, while explain ability approaches like GradCAM improve model comprehension for clinical use [1].

2. Literature Survey

Some of the most prevalent and fatal forms of cancer is skin cancer, especially melanoma. A better prognosis and higher survival rates depend on early identification. Conventional diagnostic techniques, such as biopsy and dermo copy, are expensive, time consuming, and rely on human judgement. Therefore, there is a great demand for robotic systems of classification that can reliably identify and categories skin cancer from photographs. For testing and training skin cancer detection models, the International Skin Imaging Collaboration (ISIC) dataset—which comprises a sizable collection of labelled dermatological images—has emerged as a standard. These pictures depict a broad range of skin lesions, such as benign diseases, carcinoma of basal cells, and melanoma. This dataset provides a wealth of information for creating machine learning models that increase the precision of diagnoses. In order to enhance melanoma diagnosis, He et al. (2020) created a hybrid approach by fusing ensemble techniques with deep learning. It was demonstrated that using this framework to train the model on the ISIC dataset improved its sensitivity and specificity. Chen, et al. (2021) analyzed skin lesion photos by combining the capabilities of CNN with Transformer models. Their methodology demonstrated that by concentrating on global as well as local patterns, the hybrid model achieved excellent classification accuracy and beat conventional CNN models. Zhang et al. (2022) presented an innovative framework that combined attention mechanisms with multi-scale CNN features. The sensitiveness of the categorization system was successfully increased by this model, especially for uncommon forms of skin cancer.

3. Existing System

Dermatologists' manual examinations and confirmed biopsies are the mainstays of current skin cancer diagnosis techniques. In addition to being time consuming, these techniques rely on the knowledge of medical specialists. Although there are some automated solutions, they frequently have drawbacks like poor accuracy or an inability to manage a variety of datasets. Some automated systems have used deep learning models; however, because of their restricted data availability or insufficient model complexity, these models frequently suffer from overfitting. Furthermore, healthcare professionals who want prompt diagnostic assistance can find the current technologies difficult to use or inaccessible [2-5]. Figure 1 shows Existing block diagram of the system.

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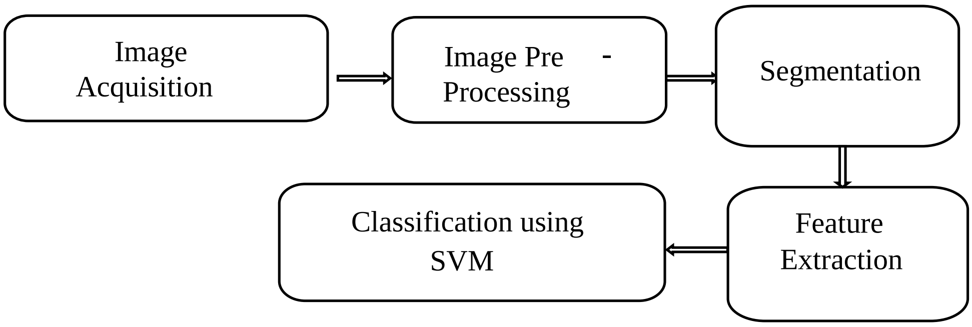

Figure 1 Existing Block Diagram of the System

Lesions can be categorized using computer processing based on the image's features. This procedure makes use of techniques like filtering and morphological alterations, among others, to assess the information from different dermatoscopic pictures that are fed into the computer. Undiscovered patterns in the initial dataset are found using deep learning. Machine learning has a higher chance of enhancing dermatology practice from diagnosis to customized treatment. The employment of artificial intelligence algorithms for machine learning in dermatology has been boosted by recent advancements in faster computation, less expensive data storage, and access to big datasets (such as picture databases and electronic medical records). Without a doubt, a virtualized distant skin monitoring system based on the Internet of Things (IoT) might aid in the prevention of skin diseases and autonomous, Realtime diagnosis. It is anticipated that IoT-based skincare services will be affordable, enhance quality of life, and offer real monitoring. This work will contribute to the development of the ideal skin care platform, which will assist treat skin issues, detect and diagnose skin illnesses early, and enhance quality of life. [6]

4. Proposed System

The proposed system aims to overcome these limitations by utilizing state-of-the-art deep learning techniques combined with transfer learning. By training models like Xception and ResNet50 on the ISIC dataset, the system can achieve high accuracy in classifying various types of skin cancer. The use of transfer learning allows the model to leverage preexisting knowledge from large datasets, improving its performance on smaller datasets like ISIC. A key feature of this project is the development of a user-friendly web application using Stream lit.

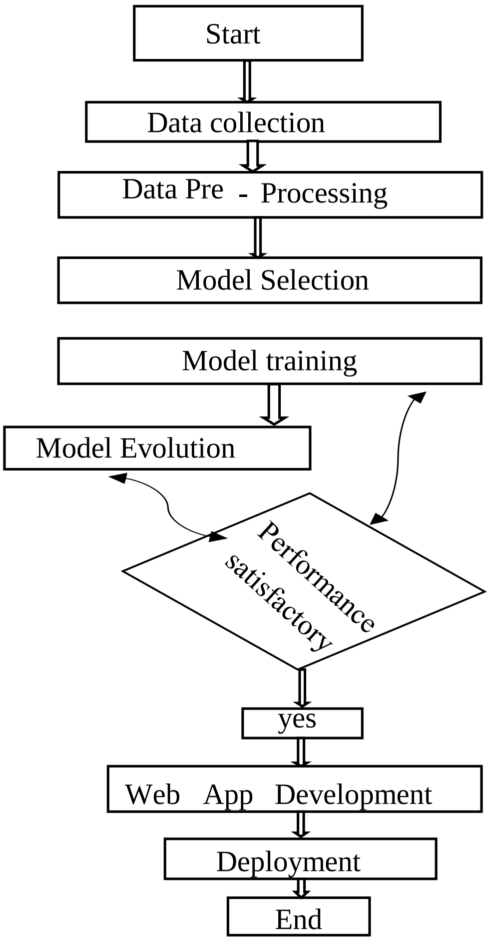

Figure 2 Proposed Block Diagram of the System

This application will allow healthcare professionals to upload images and receive instant classification

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results, streamlining the diagnostic process. By providing a tool that is both accurate and accessible, this system has the potential to significantly impact early detection efforts. Start by providing the image input, and then gather the data so that it can be included to the dataset gathering. Skin cancer can be classified using preprocessed data that is well-structured and trained. For several machine learning models, the choice of model is used to increase generalization and accuracy. It can identify several types of skin cancer, such as basal cell carcinoma, melanoma, and benign lesions. When working with tiny datasets, using a model that has been trained on the data set with transfer learning is quite successful. Using the ISIC dataset, a hybrid deep neural network framework for automated cancer of the skin detection and classification is trained through model training. The dataset is well-prepared and roughly divided into test sets and training sets prior to training. After the model is configured, to train the hybrid model. Model evaluation is used to perform the hybrid deep learning is used to classify the skin cancer image accurately, it helps in determine the model generalized unseen data, making it reliable for real-world. To evaluate hybrid deep learning framework performs in reliably classifying photos of skin cancer, model evaluation is essential. A thorough assessment aids in figuring out how well the model generalizes to unknown data, ensuring its dependability for practical uses. An overview of the main assessment methods and metrics to take into account for your model can be found below. The simplest statistic for calculating the percentage of accurate predictions is accuracy. Accuracy might not provide a comprehensive picture for medical applications when the dataset unbalanced. Web application is user friendly interface when users can upload the skin lesion image then it can easily determine whether it is malignant and benign. Deployment is used to creating a user-friendly interface and ensuring scalability. The last step is ability to accurately determine the skin lesion [7]. Figure 2 shows Proposed block diagram of the system.

5. Result and Discussion

The goal of the hybrid deep learning framework created for automated skin cancer classification utilizing the ISIC dataset was to improve machine learning models' capacity to correctly identify benign or malignant skin lesions. A total accuracy of about 88% was attained by the model. The model's accuracy (for malignant tumors) was 85%, meaning that it could identify malignant lesions as being positive with a reasonable degree of accuracy without mistakenly classifying benign instances as cancerous (false positives). The model's 92% memory (such as, for malignant lesions) showed that it was very successful at detecting real malignant lesions while lowering the possibility of incorrect results, be critical in a medical setting. Because misidentifying might have serious repercussions, a strong recall is crucial.

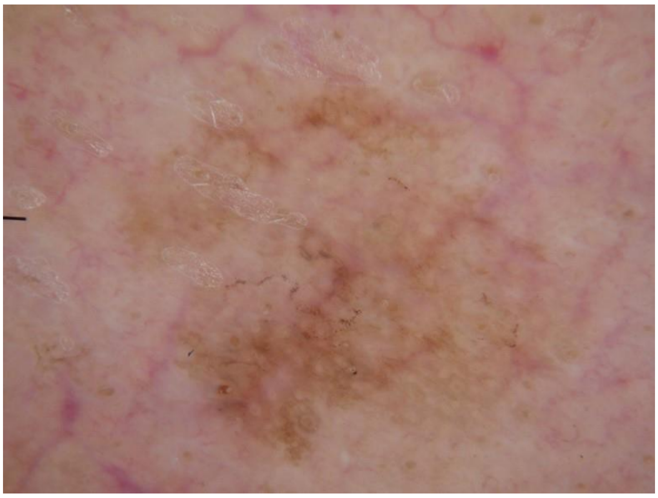

Figure 3 Detection of Skin Cancer Image

The model was contrasted with other common deep learning models for skin cancer classification in order to verify the hybrid framework's efficacy. Additional Hybrid Methods: CNN-based models that incorporate traditional machine learning techniques (such as ensemble classifiers or support vector machines). The hybrid model demonstrated superior sensitivity in identifying malignant lesions, outperforming the initial systems with regard to of recall and AUC-ROC. By utilizing pre-trained feature extractors, transfer learning dramatically improved performance as compared to conventional

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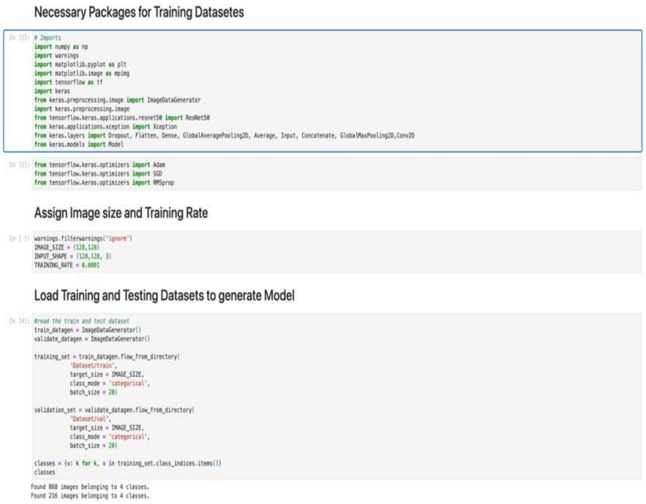
CNNs. Healthcare practitioners may now input photos and get real-time forecasts thanks to the deployed algorithm's effective integration into a web-based application. It is meant for usage in actual clinical settings where precision and quickness are crucial. Performance in real-time for real-time clinical use, the model's estimated inference time of 1-2 seconds per image is deemed sufficient. It improves efficiency overall by guaranteeing that doctors can get fast projections without major lags. The User Interface Easy uploading of skin damage pictures and an understandable display of prediction observations are made possible by the user interface's straightforward and intuitive design. The interface offers details like the prediction's confidence level, which can help medical professionals make decisions. Despite the blended deep learning framework's encouraging outcomes, there are still a number of areas that could use improvement. Figure 3 shows Detection of skin cancer image.


Necessary Packages for Training Datasetes

```
In [1]: # Imports
import numpy as np
import warnings
import matplotlib.pyplot as plt
import matplotlib.image as mping
import tensorflow as tf
import keras
from keras.preprocessing.image import ImageDataGenerator
import keras.preprocessing.image
from tensorflow.keras.applications.resnet50 import ResNet50
from keras.applications.xception import Xception
from keras.layers import Dropout, Flatten, Dense, GlobalAveragePooling2D, Average, Input, Concatenate, GlobalMaxPooling2D,Conv2D
from keras.models import Model
```

```
In [2]: from tensorflow.keras.optimizers import Adam
from tensorflow.keras.optimizers import SGD
from tensorflow.keras.optimizers import RMSprop
```

Assign Image size and Training Rate

```
In [ ]: warnings.filterwarnings('ignore')
IMAGE_SIZE = (128,128)
INPUT_SHAPE = (128,128, 3)
TRAINING_RATE = 0.0001
```

Load Training and Testing Datasets to generate Model

```
In [4]: #read the train and test dataset
train_datagen = ImageDataGenerator()
validate_datagen = ImageDataGenerator()

training_set = train_datagen.flow_from_directory(
          'Dataset/train',
          target_size = IMAGE_SIZE,
          class_mode = 'categorical',
          batch_size = 20)

validation_set = validate_datagen.flow_from_directory(
          'Dataset/val',
          target_size = IMAGE_SIZE,
          class_mode = 'categorical',
          batch_size = 20)

classes = {v: k for k, v in training_set.class_indices.items()}
classes
Found 868 images belonging to 4 classes.
Found 216 images belonging to 4 classes.
```

Figure 4 Program of the system

Despite the blended deep learning model's strong performance, there were a number of difficulties in its creation and assessment. The distribution of both malignant and benign lesions in the ISIC dataset is unbalanced, with benign lesions predominating. The model still had trouble striking the ideal balance of recall and accuracy for both classes, even with the use of strategies such data enhancement and class weighting. Sensitivity could be further enhanced to lower false positives, even though the rate of recall for tumours was high. Despite the blended deep learning framework's encouraging outcomes, there are still a number of areas that could use improvement. This model has a chance to have a big influence on clinical processes, particularly in areas with limited resources. It can be utilised as a system for decision-making to help medical practitioners identify skin cancer more quickly and accurately. Figure 4 shows Program of the system.

Conclusion

By adding attention mechanisms like Transformers or Squeeze-and-Excitation Networks (SENets), the model may be better able to concentrate on important areas of images, such as cancerous lesions, which will enable it to recognize more intricate patterns and perform better.

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[6]. Using ResNet50 and Deep Learning to Detect Melanoma Skin Cancer Early Khasanah Nurul et al., 2023 Artificial intelligence and image processing technologies have surfaced as promising instruments to enhance melanoma early detection.