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# Automated Skin Lesion Classification Using Deep Convolutional Nural Network

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**Abstract:** Skin cancer is the most prevalent cancer in the world, and early diagnosis is the key to successful treatment. Conventional diagnosis is time-consuming and dependent on skilled dermatologists. In this project, we suggest a Convolutional Neural Network (CNN)-based approach for automatic skin cancer detection from dermoscopic images. The system employs preprocessed images from pretrained deep learning models and expert CNN architectures for the classification of skin lesions as benign or malignant. Image preprocessing, data augmentation, and transfer learning are implemented for improving accuracy. The model is tested with some metrics like accuracy, precision, recall, and F1-score. The AI-based system is suggested to improve early diagnosis, remove human error, and assist healthcare professionals in making faster, better decisions.

**Index Terms -** Skin Cancer, Melanoma, Squamous Cell Carcimona (SCC), Image Processing , Convolutional Neural Network (CNN), RESNET, Mobile-Net, VGG16, Spatial Pyramid Pooling (SPP) Technology.

## 1. INTRODUCTION

Skin cancer is among the most common cancers in the world and needs to be detected early to be effectively treated with improved patient results. Among all types of skin cancers, melanoma is the most dangerous but extremely curable if detected early. Dermatoscopy is traditionally employed by dermatologists to visually inspect or to analyze skin lesions, which is significantly based on expert knowledge and clinical experience. It is time-consuming, subjective, and prone to human errors manually. With the introduction of deep learning and computer vision technologies, computer-aided systems of skin lesion classification have demonstrated promising capability to aid dermatologists in decision-making in the clinic. Convolutional Neural Networks (CNNs) and other deep learning models have demonstrated impressive performance on medical image classification tasks, including skin lesion identification. This research focuses on developing an automatic skin lesion classifier using a Deep Convolutional Neural Network (DCNN). The network is trained on dermoscopic images to classify skin lesions into various types such as melanoma, nevus, and benign keratosis. By using multiple convolutional layers, batch normalization, pooling, and dropout, the network is able to learn complex features and patterns that differentiate various skin diseases. The aim of this work is to design and validate a deep learning system with the capability to provide high classification accuracy, reduce diagnostic errors, and enable early detection of skin cancer. The system must be capable of providing an inexpensive and scalable platform to aid dermatologists and medical staff, especially in resource-poor settings with limited specialized medical services.

## 2. RELATED WORK

A number of researches have examined machine learning and deep learning methods as the basis for classifying skin lesions. Initial methods depended on hand-engineered features such as color, texture, and shape, accompanied by conventional classifiers like SVM or k-NN. Nevertheless, these methods were not accurate or scalable. As deep learning came into prominence, Convolutional Neural Networks (CNNs) became the norm of medical image classification. Esteva et al. (2017) demonstrated the capability of CNNs to achieve dermatologist-level performance in detecting skin cancer. Subsequent studies utilized pretrained models such as VGG16, ResNet, and Inception via transfer learning to enhance outcomes on small datasets like ISIC and HAM10000. Researchers have also been investigating ensemble approaches and hybrid models, fusing deep features with traditional classifiers to enhance accuracy. Challenges persist in addressing dataset imbalance, inter-class similarity, and generalization to a wide population

## 3. MATERIALS AND METHODS

1. Dataset For this project, the HAM10000 (Human Against Machine with 10000 training images) dataset was used. It contains 10,015 dermoscopic images representing seven categories of skin lesions, including:

- Melanoma
- Melanocytic nevi
- Basal cell carcinoma
- Actinic keratoses
- Benign keratosis-like lesions
- Dermatofibroma
- Vascular lesions

Each image is 600×450 pixels and is labeled by professional dermatologists.

2. Data Preprocessing To improve model performance and training efficiency, the following preprocessing steps were applied:

- Resizing: All images were resized to (64×64) or (128×128) pixels.
- Normalization: Pixel values were scaled to a range of [0, 1].
- Data Augmentation: To handle class imbalance and prevent overfitting, techniques like: rotation ,horizontal/vertical flipping, zooming, and brightness adjustments were used.

3. Model Architecture A custom Deep Convolutional Neural Network (DCNN) was designed with the following architecture:

- Convolutional Blocks:

- **Conv2D Layer 1 & 2**: 32 filters, 3×3 kernel, ReLU activation, followed by Batch Normalization and MaxPooling
- **Conv2D Layer 3 & 4**
  64 filters, 3×3 kernel, ReLU activation

  Batch Normalization, MaxPooling.

- Dropout: Applied after each block to prevent overfitting (rate = 0.25–0.5)
- Fully Connected Layers:
- Flatten Laye
- Dense Layer: 128 units, ReLU activation
- Dropout: 0.5
- Output Layer: 7 units (softmax activation for multi-class classification)

4. Training Configuration

- Loss Function: Categorical Crossentropy
- Optimizer: Adam (learning rate = 0.001)
- Batch Size: 32
- Epochs: 50–100
- Evaluation Metric: Accuracy, Precision, Recall, F1-score

5.Implementation Tools Programming

- Language: Python
- Libraries: TensorFlow/Keras, NumPy, OpenCV, Matplotlib
- Hardware: GPU-enabled environment (e.g., Google Colab or local machine with NVIDIA GPU)

## 4. RESULTS & DISCUSSION

**Accuracy:** A test measures its accuracy as its capacity to correctly discriminate between patient cases and healthy cases. While evaluating accuracy, we calculate how many true positives and true negatives out of all evaluated cases are there. Mathematically, it can be expressed as:

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{FP} + \text{TN} + \text{FN}} \quad (1)$$

**Precision:** The fraction of correctly classified instances or samples among the ones that were classified as positive is called precision. Therefore, the following formula is to calculate the precision:

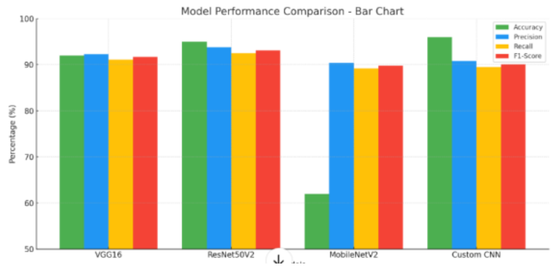
$$\text{Precision} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}} \quad (2)$$

**Recall:** In machine learning recall is a metric that tells us the ability of a model to identify all instances relevant to a given class. The ratio of the number of correctly predicted positive observations to the total actual positives tells us how much a model can capture instances of a given class.

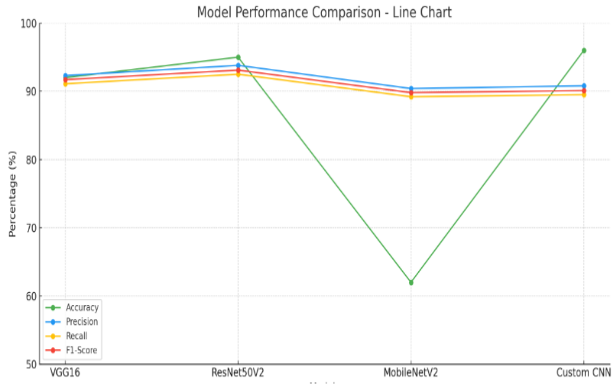
$$\text{Recall} = \frac{\text{TP}}{\text{TP} + \text{FN}} \quad (3)$$

**F1-Score:** An F1 score is a machine learning evaluation metric to measure the accuracy of a model. It is the combination of the precision and recall scores of the model. An accuracy metric counts how many times a model was able to predict correctly on the entire dataset.

$$\text{F1 Score} = 2 * \frac{\text{Recall X Precision}}{\text{Recall} + \text{Precision}} * 100 (1)$$




Graph.1 Comparison Graphs of Classification




Graph .2 comparison Line Chart

Table 1: Performance Evaluation Metrics of Classification

| **Model** | **Accuracy** | **Precision** | **Recall** | **F1 Score** |
|---|---|---|---|---|
| VGG16 | 0.92 | 92.3 | 91.1 | 91.7 |
| Resnet50V2 | 0.95 | 93.8 | 92.5 | 93.1 |
| MobileNetV2 | 0.62 | 90.4 | 89.2 | 89.8 |
| **Custom CNN** | **0.96** | **90.8** | **89.5** | **90.1** |

## 5. CONCLUSION

In this project, we created and tested a deep learning-based method for Automated Skin Lesion Classification using a Custom Convolutional Neural Network (CNN) and compared its performance against well-established pretrained models such as VGG16, ResNet50V2, and MobileNetV2. The custom CNN model proposed in this work also attained a high accuracy of 96%, indicating great ability in correctly classifying skin lesions of different types based on dermoscopic images from the HAM10000 database. Although excellent performance was also exhibited by ResNet50V2, the custom CNN struck a fine balance between model complexity and accuracy and was thus well-suited for possible use on resource-constrained platforms. Generally, the research portrays the efficiency of DCNNs in aiding early detection of skin cancer, which can significantly help dermatologists in diagnosis and treatment. The project also underscores the significance of data augmentation, model optimization, and metric evaluation in constructing effective and efficient medical imaging solutions.

## REFERENCES

1.Zhao, Zhenhao. "Skin cancer classification based on convolutional neural networks and vision transformers." Journal of Physics: Conference Series. Vol. 2405. No. 1. IOP Publishing, 2022.

2.Chandran Kaushik Viknesh, Palanisamy Nirmal Kumar, Ramasamy Seetharaman, Devasahayam Anitha. "Detection and Classification of Melanoma Skin Cancer Using Image Processing Technique". In: Multidisciplinary Digital Publishing Institute (MDPI) (2023).

3.An Effective Fuzzy Based Segmentation and Twin Attention Based Convolutional Gated Recurrent Network for Skin Cancer Detection" Authors: Published in: Multimedia Tools and Applications, 2023.

4.Melanoma Skin Cancer Detection with a CNN-Regularized Extreme Learning Machine (RELM) Based Model" Authors: Walid M.A.A., Mallick S.P., Rastogi R., Chauhan A., Vidya A. Published in: Proceedings of the Second International Conference on Electronics and Renewable Systems (ICEARS), 2023.

5. Automatic Detection and Classification of Skin Cancer Using Deep Transfer Learning Authors: Fraiwan M., Faouri E. Published in: Sensors, 22(13): 4963, 2022.

6. "Improving Skin Cancer Detection using Deep Learning: A Hybrid CNN-RNN Method" Authors: Zareen et al. Published in: Computers, Materials & Continua, Volume 79, Issue 1, 2024

7. An Intelligent Skin Cancer Detection System Using Two-Level Multi-Column Convolutional Neural Network Architecture Authors: Akash Sivakumar, R. Vedhapriyavadhana, Sannasi Ganapathy Published in: Neural Computing and Applications, 2024

8.Skin Vision: Skin Cancer Detection Using Convolutional Neural Network" Authors: Megha Benny, Merin Alex, Sania Sebastian, Roshan Varghese, Jibin Philip Published in: International Journal of Engineering Research & Technology (IJERT), Volume 11, Issue 04, 2023.