ISIC 2024 - Skin Cancer Detection

Solution of Team „42”

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This is a Draft version

Our goal is to achieve the offered grade. The current solution is still under development.

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Introduction, Objectives, Motivation

Skin cancer can be deadly if not caught early, but many populations lack specialized dermatologic care. Over the past several years, dermoscopy-based AI algorithms have been shown to benefit clinicians in diagnosing melanoma, basal cell, and squamous cell carcinoma. However, determining which individuals should see a clinician in the first place has great potential impact. Triaging applications have a significant potential to benefit underserved populations and improve early skin cancer detection, the key factor in long-term patient outcomes.

Dermatoscope images reveal morphologic features not visible to the naked eye, but these images are typically only captured in dermatology clinics. Algorithms that benefit people in primary care or non-clinical settings must be adept to evaluating lower quality images. This competition leverages 3D TBP to present a novel dataset of every single lesion from thousands of patients across three continents with images resembling cell phone photos.

Our team will develop AI algorithms that differentiate histologically confirmed malignant skin lesions from benign lesions on a patient. Our work will help to improve early diagnosis and disease prognosis by extending the benefits of automated skin cancer detection to a broader population and settings.

Previous Solutions, Their Advantages, Disadvantages

Current mobile applications in the field of skin cancer detection primarily rely on the established techniques of "classical" image processing and traditional medical knowledge. While advancements have been made, the performance metrics of state-of-the-art models such as EfficientNetV2, which achieves an accuracy of approximately 0.15, while the best solutions are around 0.17. In comparison, MobileNet lacks a clear benchmark for evaluation, as there has been limited competitive effort in Kaggle tournaments to explore its capabilities in this context. Given these challenges, our project has set more modest and realistic goals, focusing on creating an accessible and efficient solution.

System Design

The system is designed to deliver accurate and relevant predictions for any given input image, focusing exclusively on image data without relying on additional external information. By utilizing a deep learning model, the system is capable of learning the intricate characteristics of skin lesions, enabling it to classify them effectively. To enhance performance and expedite development, the design incorporates a pre-trained model, leveraging its existing capabilities to achieve faster and more accurate results in detecting and analyzing skin abnormalities.

Database(s)

The implementation of our system is entirely based on the dataset provided by the Kaggle competition, ensuring consistency and alignment with the competition's parameters. To process the data effectively, we utilized metadata from the train-metadata.csv and test-metadata.csv files, which allowed us to extract the unique identifiers for each image. These identifiers were then used to locate and retrieve the corresponding image data stored in files with the .hdf5 extension. This structured approach ensured a seamless workflow for accessing and utilizing the dataset for training and testing our model.

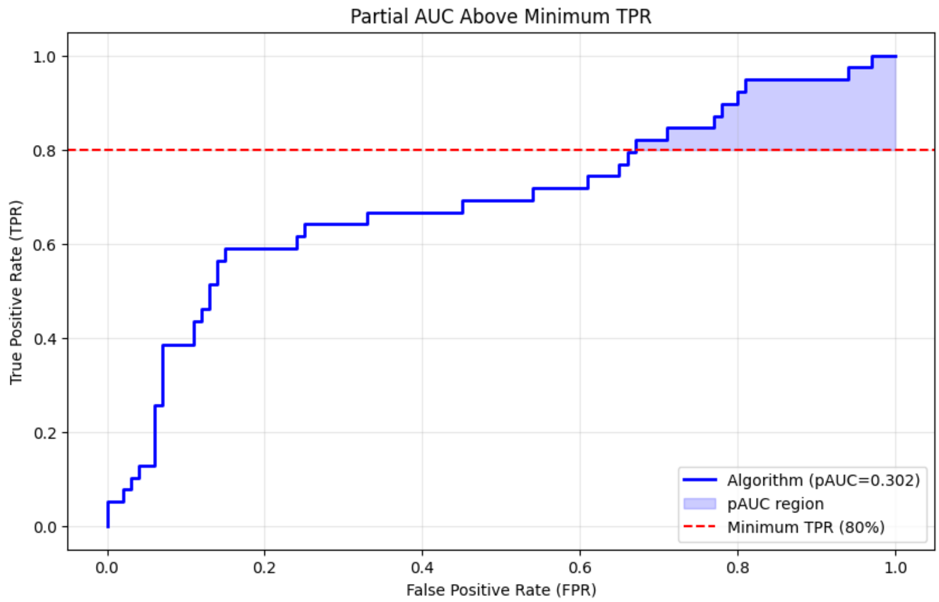
Architecture, Training, Difficulties and Their Solutions

The architecture of our system is built upon the database provided in the Kaggle competition, which serves as the foundation for the training dataset. At its core, the model's design leverages the principles of transfer learning, enabling it to benefit from prior knowledge embedded in pre-trained models. Specifically, we have employed EfficientNetV2 as the base model, which offers a robust and efficient starting point for feature extraction. On top of EfficientNetV2, we have constructed a multilayer convolutional neural network to further refine and enhance the representation of image features. Finally, the output from this convolutional network is fed into a fully connected network, which performs the final classification tasks, completing the architecture in a cohesive and efficient manner.

Results and Their Evaluation

Kaggle challange submissions are evaluated on **partial area under the ROC curve (pAUC)** above 80% true positive rate (TPR) for binary classification of malignant examples.

The receiver operating characteristic (ROC) curve illustrates the diagnostic ability of a given binary classifier system as its discrimination threshold is varied. However, there are regions in the ROC space where the values of TPR are unacceptable in clinical practice. Systems that aid in diagnosing cancers are required to be highly-sensitive, so this metric focuses on the area under the ROC curve AND above 80% TRP. Hence, scores range from [0.0, 0.2].



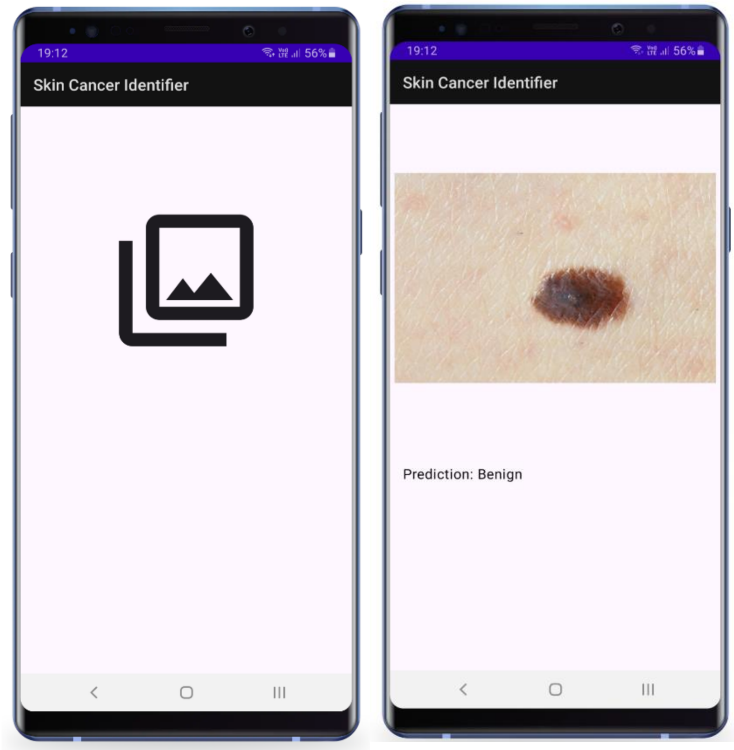
1. figure Partial area under the ROC curve

Demo

If you wish to try the Android demo application:

1. After running deep-learning-42_milestone2.ipynb, download the model.tflite file.
2. Run the Metadata.ipynb with the model.tflite. This adds metadata to your model.
3. After downloading this final model.tflite, replace the one in the SkinCancerIdentifier application with it.
4. Open the SkinCancerIdentifier application using Android Studio and try it using an emulator or a physical device.
5. On the home screen of the application, click on the figure and then select the appropriate image from the ones on the device.

6. The application will write out its prediction using the model.



2. figure Scin Cancer Identifier application

Summary

Our project demonstrates the potential of leveraging advanced deep learning techniques, in the critical field of medical image processing. By using EfficientNetV2 and integrating it into a compact, accurate model, we aim to create a tool that can assist in skin cancer detection. The foundation of our work lies in developing a solution that is not only effective but also practical for deployment on mobile devices, thereby making preventive healthcare more accessible. Although our system is still under development, it embodies the spirit of innovation and dedication to solving real-world problems.