Visual Computing MAGAZiNE

Melanoma identification using deep learning.

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Abstract

Melanoma is considered one of the most fatal cancer in the world, this form of skin cancer may spread to other parts of the body in case that it has not been diagnosed in an early stage. Thus, the medical field has known a great evolution with the use of automated diagnosis systems that can help doctors and even normal people to determine a certain kind of disease, particularly in deep learning, have provided new

opportunities for early detection and diagnosis of melanoma. By utilizing sophisticated algorithms and machine learning techniques, the application developed for melanoma diagnosis aims to improve the accuracy and efficiency of detecting suspicious skin lesions. By segmenting and classifying these lesions, the mobile application assists in providing timely and reliable information, empowering individuals to seek further medical evaluation and potentially save lives.

1. Introduction

Melanoma, a type of skin cancer, is a serious condition that requires attention (Figure 1). Early detection plays a crucial role in improving patient outcomes. However, accurately identifying and segmenting melanoma lesions from medical images can be challenging. In recent years, artificial intelligence (AI) and computer-aided diagnosis (CAD) systems have emerged as promising tools for automating melanoma screening and diagnosis [1]. Deep learning techniques, such as convolutional neural networks, can be trained to accurately segment and detect suspicious melanomas. These advancements in AI-based technologies have the potential to enhance the accuracy and efficiency of melanoma diagnosis and treatment planning.

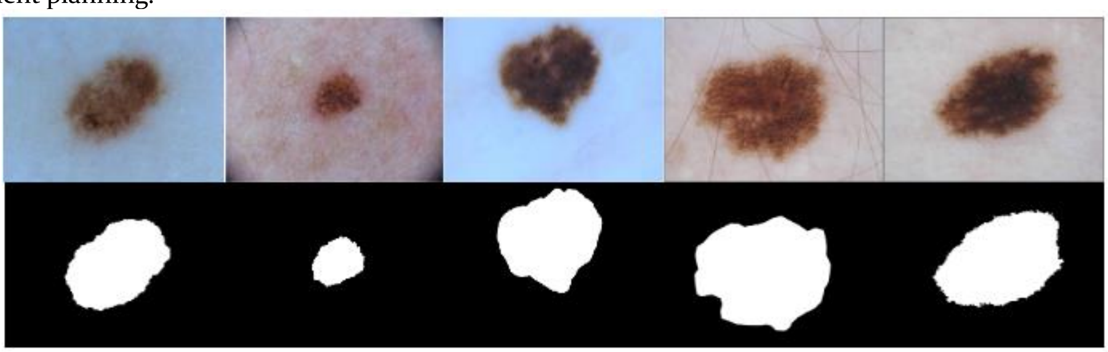

Figure 1. Example of skin cancer images and ground truth.

2. Method

The project's objective is to develop an advanced model for predicting melanoma. Creating such an application involves a series of vital steps. These steps include collecting and pre-processing relevant data, developing segmentation and classification models, training and evaluating these models, and finally integrating the AI model with the application. Through this comprehensive process, the aim is to build a robust and effective tool that can accurately predict and identify melanoma, enhancing early detection and improving patient outcomes.

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2.1 Data collection and pre-processing

The first crucial step in this project is to gather two types of data:
For segmentation, a diverse and representative dataset comprising photos of melanoma lesions along with corresponding ground truth data is necessary. The ground truth data provides accurate outlines and labels for the lesions.

For classification, a dataset of melanoma images representing both benign and malignant cases is required for the classification aspect of the deep learning model. This comprehensive dataset allows for effective training of the model and enables accurate predictions when using the application.
To enhance the dataset and improve the performance of the deep learning model, various techniques for data augmentation were employed (Figure 2). Data augmentation involves applying transformations to the existing images, such as rotation, flipping, scaling, and adding noise. These techniques can create additional diverse examples, expanding the dataset and helping the model generalize better to unseen.

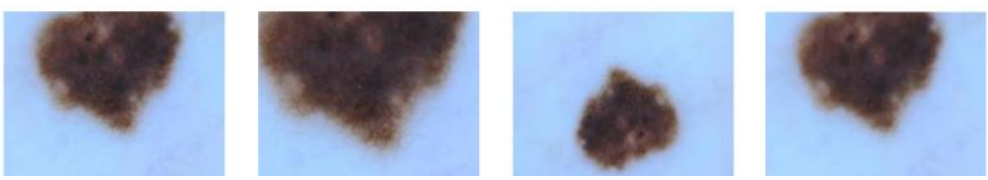
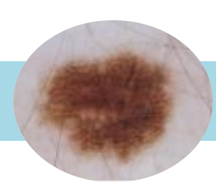


Figure 2. Example of data augmentation operations;

2.2 Image Segmentation

Image segmentation plays a crucial role in the accurate analysis of melanoma cancer. By segmenting the melanoma lesions from medical images, such as dermoscopic images or histopathological slides, the boundaries and characteristics of the cancerous tissue can be precisely delineated, aiding in diagnosis, treatment planning, and monitoring of the disease.

The U-Net architecture, widely known for its effectiveness in medical image segmentation[2], was implemented for the segmentation task in this project (Figure 3). This model has shown great success in accurately delineating melanoma lesions. By incorporating U-Net into the application, the system can reliably identify and analyze melanoma, contributing to improved diagnostics and treatment for patients.



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2.3 Skin lesion classification

Skin lesion classification involves several essential steps to achieve accurate and reliable results. These steps are crucial in the melanoma diagnosis process, as they assign a specific class to each detected lesion. These steps include:
-Data preprocessing: Using Keras ImageDataGenerator class for performing data augmentation on the database to increase the diversity of training data.
-Model selection: Choosing an appropriate classification model is crucial for obtaining good results. We utilized four pre-trained models (ResNet50, Inception V2, InceptionResNet V2, and EfficientNet) to achieve the best possible outcome.
-Model training: Training involves adjusting the model's parameters based on the training data to minimize prediction error. This process may require multiple iterations to achieve optimal performance.
-Model evaluation: The model is evaluated using independent test data. Evaluation metrics such as accuracy, precision, recall, and F-score are calculated to measure the model's performance.

Multiple models were trained and evaluated but ResNet50 was selected as the preferred model for classifying melanoma lesions. The superior performance of ResNet50 ensures reliable and precise predictions, thereby enhancing the overall effectiveness of the application.

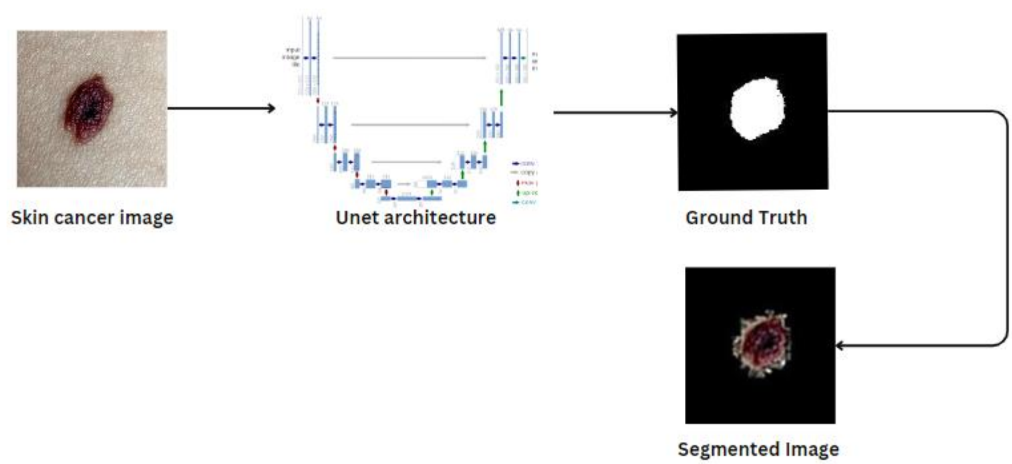
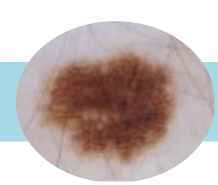


Figure 3. Segmentation methodology.



3 Results

After rigorous training and evaluation, excellent results were achieved. The segmentation model attained an accuracy of 89 percent, ensuring precise delineation of melanoma lesions (Figure 4, table1). Additionally, the classification model achieved an impressive accuracy of 93 percent, accurately identifying whether the lesions were benign or malignant (Figure 5, Table 2). These high accuracies demonstrate the effectiveness of the models in accurately diagnosing melanoma, contributing to the overall success of the app in providing reliable predictions and aiding in early detection and treatment.

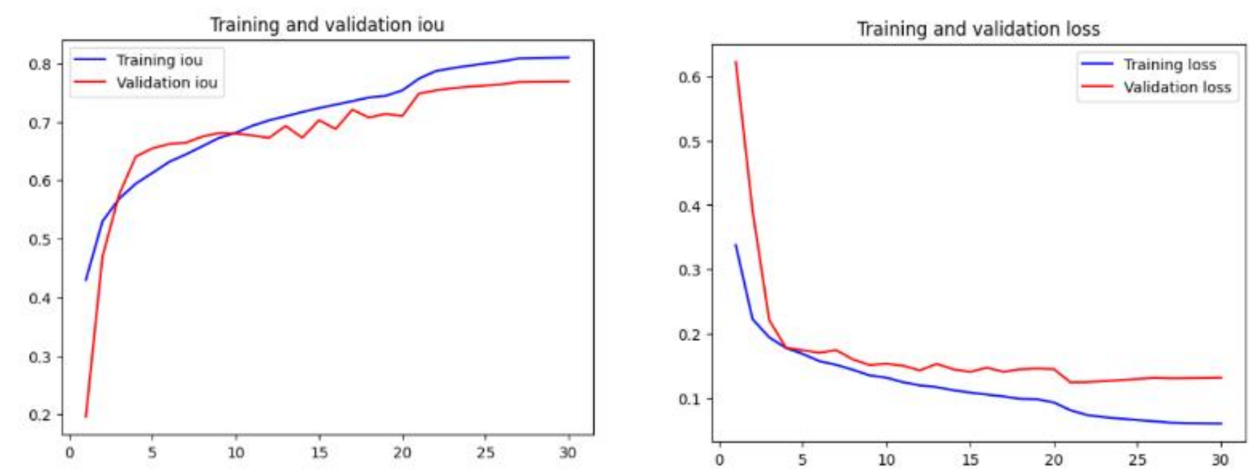
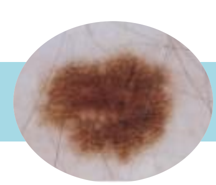


Figure 4. Segmentation results.

Epoch	number of image	Iou	Loss
30	20 000	85.7	0.046
30	54 000	80.96	0.0607

Table 1. The training report for segmentation.



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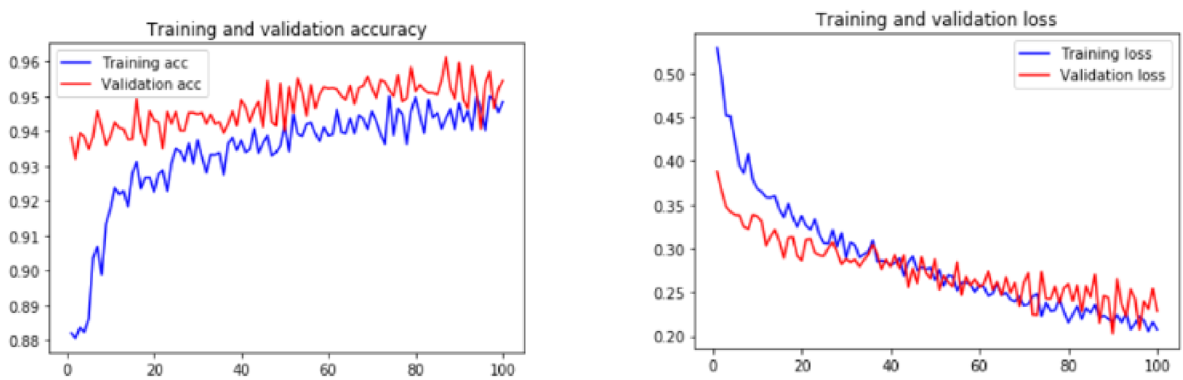

Figure 5. Classification results.

Model	Accuracy	Loss
Resnet 50	93,98	0.2583
Inception V2	77.5	0.426
Inception ResNet V2	89.1	0.2874

Table 2. Training report for classification.

References

[1] J. Daghrir, L. Tlig, M. Bouchouicha, and M. Sayadi, \Melanoma skin cancer detection using deep learning and classical machine learning techniques: A hybrid approach," in International Conference on Advanced Technologies for Signal and Image Processing, (Sfax, Tunisia), Sept. 2020.
[2] W. Baccouch, S. Oueslati, B. Solaiman, and S. Labidi, \A comparative study of CNN and U-Net performance for automatic segmentation of medical images: application to cardiac MRI," in CENTERIS - International Conference on ENTERprise Information Systems., vol. 219, (Lisbonne, Portugal), pp. 1089-1096, Nov. 2022.