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MELANOMA CLASSIFICATION

Design

Skin cancer is the out-of-control growth of irregular skin cells causing the skin to rapidly multiply and form malignant tumors. Between 2008 and 2019 the number of new invasive melanoma cases rapidly increased by 54%. With such a substantial escalation, it is of great importance for us to inaugurate and build on techniques to assist health-care providers in diagnosing skin cancer at its preliminary stages.

Melanoma is one of the most aggressive types of skin cancer as it rapidly spreads to various areas of the body. With the increase and fatal nature of melanoma, it is of utmost importance to establish computer assisted diagnostic support systems to aid physicians in diagnosing skin cancer [1].

Dataset

The PH² dataset has been developed for research and benchmarking purposes, in order to facilitate comparative studies on both segmentation and classification algorithms of dermoscopic images. PH² is a dermoscopic image database acquired at the Dermatology Service of Hospital Pedro Hispano, Matosinhos, Portugal [2].

The dermoscopic images were obtained at the Dermatology Service of Hospital Pedro Hispano (Matosinhos, Portugal) under the same conditions through Tuebinger Mole Analyzer system using a magnification of 20x. They are 8-bit RGB color images with a resolution of 768x560 pixels [2].

This image database contains a total of 200 dermoscopic images of melanocytic lesions, including 80 common nevi, 80 atypical nevi, and 40 melanomas. The PH² database includes medical annotation of all the images namely medical segmentation of the lesion, clinical and histological diagnosis, and the assessment of several dermoscopic criteria (colors; pigment network; dots/globules; streaks; regression areas; blue-whitish veil) [2].

The assessment of each parameter was performed by an expert dermatologist, according to the following parameters in Table 1:

Table 1:Dataset parameters.

Criterion	**PH² Segmentation**
Clinical Diagnosis	0 - Common Nevus
	1 - Atypical Nevus
	2 - Melanoma

Lesion Segmentation	Available as a binary mask (with the same size of the original image).
Color Segmentation	Available as a binary mask (with the same size of the original image) (If available).
Asymmetry	0 - Fully Simmetry
	1 – Asymmetry in One Axis
	2 - Fully Asimmetry
Pigment Network	AT - Atypical
	T - Typical
Dots/Globules	A - Absent
	AT - Atypical
	T - Typical
Streaks	A - Absent
	P - Present
Regression Areas	A - Absent
	P - Present
Blue Whitish Veil	A - Absent
	P - Present
Colors	1 - White
	2 - Red
	3 - Light-Brown
	4 - Dark-Brown
	5 - Blue-Gray
	6 - Black

Algorithm

Among deep neural networks (DNN), the convolutional neural network (CNN) has demonstrated excellent results in computer vision tasks, especially in image classification. Convolutional Neural Network (CNN, or ConvNet) is a special type of multi-layer neural network inspired by the mechanism of the optical and neural systems of humans.

A CNN is a framework developed using machine learning concepts. CNNs are able to learn and train from data on their own without the need for human intervention. There is only some pre-processing needed when using CNNs. They develop and adapt their own image filters, which have to be carefully coded for most algorithms and models. CNN frameworks have a set of layers that perform particular functions to enable the CNN to perform these functions [3].

The most important building block of a CNN is the convolutional layer. neurons in the first convolutional layer are not connected to every single pixel in the input image, but only to pixels in their receptive fields as shown in Figure 1. In turn, each neuron in the second convolutional layer is connected only to neurons located within a small rectangle in the first layer. This architecture allows the network to concentrate on low-level features in the first hidden layer, then assemble them into higher-level features in the next hidden layer, and so on. This hierarchical structure is common in real-world images, which is one of the reasons why CNNs work so well for image recognition .

Tools

- Python 3.7.3
- TensorFlow 2.4.0 and Keras
- Sklearn
- NumPy and Pandas
- Seaborn and Matplotlib
- OpenCV

References

[1] Pillay V., Hirasen D., Viriri S., Gwetu M. (2020) Melanoma Skin Cancer Classification Using Transfer Learning. In: Hernes M., Wojtkiewicz K., Szczerbicki E. (eds) Advances in Computational Collective Intelligence. ICCCI 2020. Communications in Computer and Information Science, vol 1287. Springer, Cham. https://doi.org/10.1007/978-3-030-63119-2_24

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[3] Boesch, G. (2021, October 19). *A Complete Guide to Image Classification in 2021*. Viso.Ai. Retrieved November 30, 2021, from https://viso.ai/computer-vision/image-classification/

[4] Géron, A. (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems* (2nd ed., Vol. 2) [E-book]. O'Reilly Media.