

Automatic detection of skin phototypes based on features extraction from face images and neural networks

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Azehoun Pazou, Géraud (1,2); Agbodoyetin, Aurel (1), Azoma, Alphonse (2); Assogba, Kokou (2); Adegbidi, Hugues (3); Nait-Ali, Amine (4), Vianou, Antoine (5)

1=UNSTIM, 2=LETIA/EPAC/UAC, 3=FSS/UAC, 4=LISSI/UPEC, 5=Lab-CTMAE/EPAC/UAC

Introduction:

The Fitzpatrick skin type (or phototype) is a way to classify the skin by its reaction to exposure to sunlight [1]. It makes it possible to estimate the risk associated with exposure to the sun for each type of skin and to determine the importance of the necessary protections. For example, people with phototypes 1 to 3 have a higher risk of skin cancer during sun exposure given the relative lack of pigmentation (see below)

Fitzpatrick Scale & Skin Types

SKIN TYPE	TYPE 1	TYPE 2	TYPE 3	TYPE 4	TYPE 5	TYPE 6
SKIN Color	Light	Light	Medium	Medium / Dark	Dark	Black
Hair Color	Red	Blond	Brown	Brown / Black	Black	Black
Eye Color	Green	Blue	Brown	Brown / Black	Black	Black

Identify one's phototypes is not easy, except for professionals [2]. The aim of this work is to propose a framework for automatic classification of phototypes based on face skin images digital processing

Materials & Methods:

Material

- SFA database : more than 3000 samples of 35 x 35 size skin images. [3]
- Python : matplotlib 3.3.4 ; numpy 1.19.2 ; opencv 4.5 and scikit learn 0.24.2

Methods

- Color features are used to classify images using KMeans algorithm
- For each of the three color channels, we compute the following color features : standard deviation, median and mean pixel values)

we calculate correlation matrix to see how each feature explain the phototype

- We trained our model using random forest supervised learning method

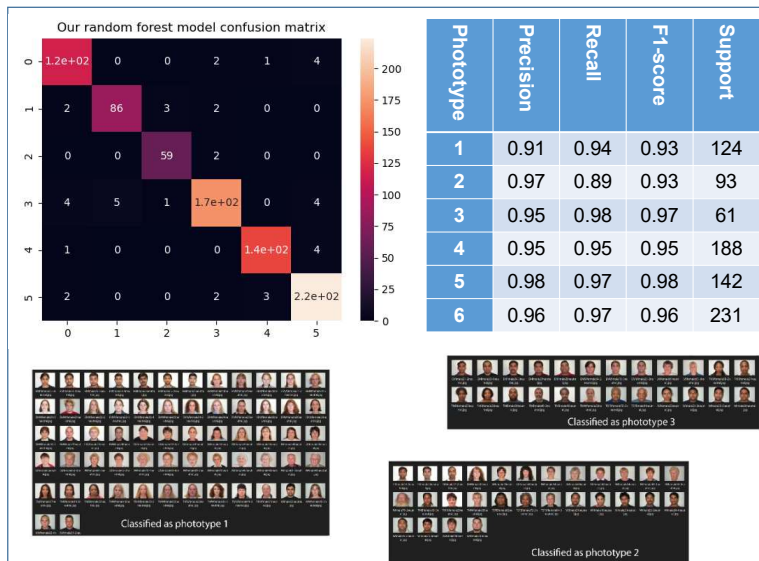
- For each image in our dataset, we compute some texture features and color features described in [4]

- We automatically selected a 35 x 35 size piece of skin, from the original picture then calculate our features on it.

- We use the calculated features as input to our trained model.

- Prediction is made based on input vector

Results & Discussion:



From results obtained after test, we can say that for phototype 1, 5 and 6, obtained classification is generally good, despite inaccuracies. On the other hand, with regard to phototypes 2, 3 and 4, classification is less accurate. The calculated general accuracy is 38%. Several reasons can explain such low precision :

- camera flash : it can increase the clarity of certain parts of the face skin
- random selection of 35 x 35 patches : program can extract a region which does not represent the face well
- etc.

Conclusions:

The major contribution of this work lies in the fact that it paves the way for the development of a mobile application to detect phototypes and provide medical advices on this basis: cosmetics. The idea is to perform the detection base on selfie image taken with cellphone; this justifies the choice of face images.

Although the precision obtained with trained model needs to be improved, the approach is promising because it could be improved by including the detection of eye color and some hair characteristics.

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