A Novel Facial Appearance Appreciation with Pooled Color for Adaptive Skin Color Extraction

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Abstract

The assistance of my works are two parts, The First one is shows that face model fitting algorithms advantage from well-defined color features that are able to differentiate between the changed regions of a face, such as the skin, the lips, and the eyebrows. However, these parts have only insignificant differences in color and therefore, the resolution principle must be well chosen. Each and every person color differs from one to others. The color clarification method is very important in the real life time. The proposed technique is Adaptive Skin Color Extraction. The technique is adapts to the person and to the context first, and then classifies skin color via common method color classifiers. This process managing the real-time performance and obtains high precision, which makes it suitable for a mixture of applications such as face model fitting, gape opinion, and facial expression recognition.

Keywords: *Adaptive Skin Color Extraction, facial expression recognition*

I. PREAMBLE

Emotions and each and every-day life feelings part a most important character in every-day life of human beings. Information from the surroundings determines separate to mutually understand other persons' intentions, goals, thoughts, feelings and emotions and to change the behaviour for that reason [1]. In real-world life, color is an important information indication that makes objects characteristic from their surroundings. The feature extraction module of model-based image interpretation systems whose use has been describe in frequently gifted of extracting color features from the image. For the advantages of face model fitting applications the features skin color, lip color, tooth color, and hair color describe the location and the geometric shape of human faces and their parts well. The skin color region clearly boundaries the eyes, the lips, the eyebrows, the hair, and the background. Skin color classifiers are the computational modules that determine for every pixel whether it is skin-colored or not and accumulate this information to the skin color image, which is depicted in the lower row. However, extracting this information from real-world images energetically represents a challenging task. The motivation is that specific features that are associated to the context conditions, the image, and the able to be seen person vary skin color extensively, such as lighting conditions, camera type, camera settings, the person's tan, and the person's ethnic group. Skin color is change into each and every person and every climate position. Skin color is accumulating correctly [2] this method. In contrast, these image characteristics are fixed making an allowance for one single image only. So, all skin color pixels look in the same way and skin color occupies a much smaller and more compact cluster, which facilitates skin color classification.

Figure Skin Color Classifications

Overview of Skin Color Classification represents an important source of information to a variety of computer vision applications and therefore, a lot of research is conducted in this area. Vezhnevets et al. [3] give a comprehensive overview of recent work within that area describing common color spaces and categorize the detection techniques.

Terminology for Face Image Processing

In Model-Based Coding different kinds of image processing, analysis and synthesis are performed. In order to process the face image, works have to process different stages. The five stages are: Face Detection, Facial Feature Extraction, Face/Facial Feature Tracking, Face Parameter Coding and Face Synthesis. Usually the application of the previous processing benefits the next one, decreasing the quantity of information to transmit.

Face Model Parameters

Face model parameters followed by three kinds of parameters need to be transmitted in a model-based coding scheme.

1. Shape parameters: The parameter refers to pleased information about the shape and contours of the face. It is full viewed 3D-based shape model.
2. The texture: The second parameter is an image to be mapped onto the face model. This model fully contains the compress of information in shape and figure.
3. The animation: These parameters consist of global and local motion parameters. This model refers to the rotation and translation of the face is modeled.

The Normalized RGB Color Space

Commonly RGB color space is not suitable to depict skin color. A common way to cope with this limitation is to switch over to the normalized RGB color space (NRGB), which uses the proportional rate of each component of RGB, The suitable equation is used to calculate the normalized RGB color spaces. In this work, the color vector cx=(r, g, base) T denotes the color of a pixel x in the NRGB color space.

$$base = R + G + B$$
$$r = R / base$$
$$g = G / base$$
$$b = B / base$$

II. PREVIOUS WORKS

The previous works are Model-based image interpretation contributes extremely to the capable approaches of automatically recognizing facial expressions. This image interpretation scheme is known to greatly facilitate the interpretation of real-world scenes in general. A deformable model stores a priori information about human faces. Fitting this face model to the camera image represents an intermediate step for facial expression interpretation. In a subsequent step, high-level descriptors are derived from the model parameters more easily. This happens to be much more accurate than inferring the information directly from the image or from low-level image features. Nevertheless, model-based image interpretation unavoidably requires correctly detecting the model within the image and accurately tracking it through a sequence of images in real-time. This nontrivial task that has been coined model fitting has not been sufficiently solved yet. With special focus on facial expression interpretation, this work is addresses two issues of model fitting that it considers being most important. These are the extraction [4] of salient image features and the formulation of a robust objective function. The task of fitting models to images relies on the extraction of salient image features that describe the correct model parameters more accurately than the plain image pixels. This improves the robustness of this task. Image features are appropriate if they correlate with the correct parameterization. In addition[5], the value of these features must be independent of side conditions as well Skin color regions are considered to be salient features for fitting a face model to images. The previous works are run time consuming, not sufficient future extraction, not proper adaptive color skin matching, model based fitting and accurate the information.

III. PROPOSED WORK

The proposed technique is exploits this coincidence by a two-phase approach. First approach is determines the features of the image and adapts a common usage of color classifier consequently. Second approach is extracts the skin color pixels with this adjusted classifier, which delivers highly accurate results. The proposed of this approach to color classification are as follows:

1. It determines the image-specific and person-specific characteristics automatically.
2. It adapts common usage and general purpose skin color classifiers to images using these characteristics.
3. Its high accuracy and its high speed turn it appropriate for real-world applications.
4. Formulates the image-specific and person specific characteristics that are responsible for the variations of skin color.
5. Introduces three general purpose skin color classification techniques and adapts them via the image-specific and person-specific characteristics.

Adjusting Skin Color Classifiers

The calculation set of laws of pixel-based skin color classifiers shape out if a pixel is skin-colored by allowing for its color character only. The cluster within color space that they identify to include all skin-colored pixels is typically fixed. The additional features will have an effect on the skin color cluster's location, size, and shape, because these character usually describe characteristics of the full image.

Cuboid-based Skin Color Classifier

This classifier specifies a cuboidal cluster within NRGB color space that is aligned to the axes of the color space. It treats any color within this cuboid to be skin-colored. The cuboid is described by a lower and an upper bound for each dimension of the color space: l_r, l_g, l_{base}, u_r, u_g, and u_{base}. The equation is

skin-colored ($(l_r< r< u_r) \wedge (l_g< g< u_g) \wedge (l_{base}< base< u_{base})$ (1)

Ellipsoid-based Skin Color Classifier

This classifier specifies an ellipsoidal cluster within NRGB color space. The ellipsoid is computed such that the Mahalanobis distance from the center of the ellipsoid μ to any location c_x within the cluster is less than a given threshold value t. The location and the size of this cluster is not permanent, but described by the parameters μ, S, and t. The calculation equation is

Skin-colored ($(c_x - \mu)^T S^{-1}(c_x - \mu) <= t$ (2)

Rule-based Skin Color Classifier

This classifier specifies a complexly shaped cluster within NRGB color space. The cluster is permanent if the rule stimulation algorithm is provided with the pixels' color features only. The equation is
skin-colored ($(r > 0.38) \wedge (g \_ 0.33) \wedge (base > 200)$ (3)

IV. EXPERIMENTAL EVALUATION

This experimental evaluations are calculated the above classifier and using these equations. These equations are mentioned image location and size of the locator. Referring to the contributions, this segment calculated two critical aspects of this work approach. This experimental First find out the how exact is the acquisition of the image-specific and person-specific characteristics. Second this work how accurately the introduced skin color classifiers determine skin color, both with and without adaptation to the image. The data set are collected from previous work and many places for evaluating skin color classifiers work select it for this evaluation as well. This database consists of some image sequences that are taken from multiple places.

Obtaining the Image-specific Characteristics

The first evaluation compares two different approaches that approximate the image-specific and person-specific characteristics. Both of them extract a reasonable number of pixels from the image, which they regard as to be skin-colored. Afterwards, they apply Equation 1 and 2. This evaluation shows the difference between these approximated values and the correct values. Note that the correct values are computed by selecting the pixels that are manually specified to be skin-colored. The first approach of this comparison is color segmentation a straightforward approach that consists of low-level vision modules.

The second approach of this comparison is our approach that extracts skin color pixels via a grouping of a face detector and a learned skin color mask to give the result suitable equation and table shows the relative error between the obtained results and the correct value.

		Color Segmentation			Proposed Approach Face Locator,Skin Color		
Seq	Frames	μ_r	μ_g	μ_{base}	μ_r	μ_g	μ_{base}
2	72	0.9%	0.8%	11.1%	0.8%	0.4%	6.5%
4	110	7.1%	5.7%	4.6%	1.0%	0.4%	0.5%
6	72	5.7%	2.2%	16.9%	0.1%	0.0%	2.8%
7	76	5.3%	5.8%	15.2%	1.0%	0.6%	3.9%
8	73	5.1%	1.2%	10.6%	1.1%	0.1%	4.2%
9	72	0.9%	2.2%	10.5%	0.7%	0.3%	1.2%
10	73	6.0%	1.2%	16.5%	0.6%	0.3%	3.2%
11	233	3.6%	1.1%	1.5%	0.4%	0.9%	4.1%
15	75	4.1%	1.3%	1.4%	0.2%	0.1%	3.1%
Average		4.3%	2.2%	10.6%	0.6%	0.3%	4.2%

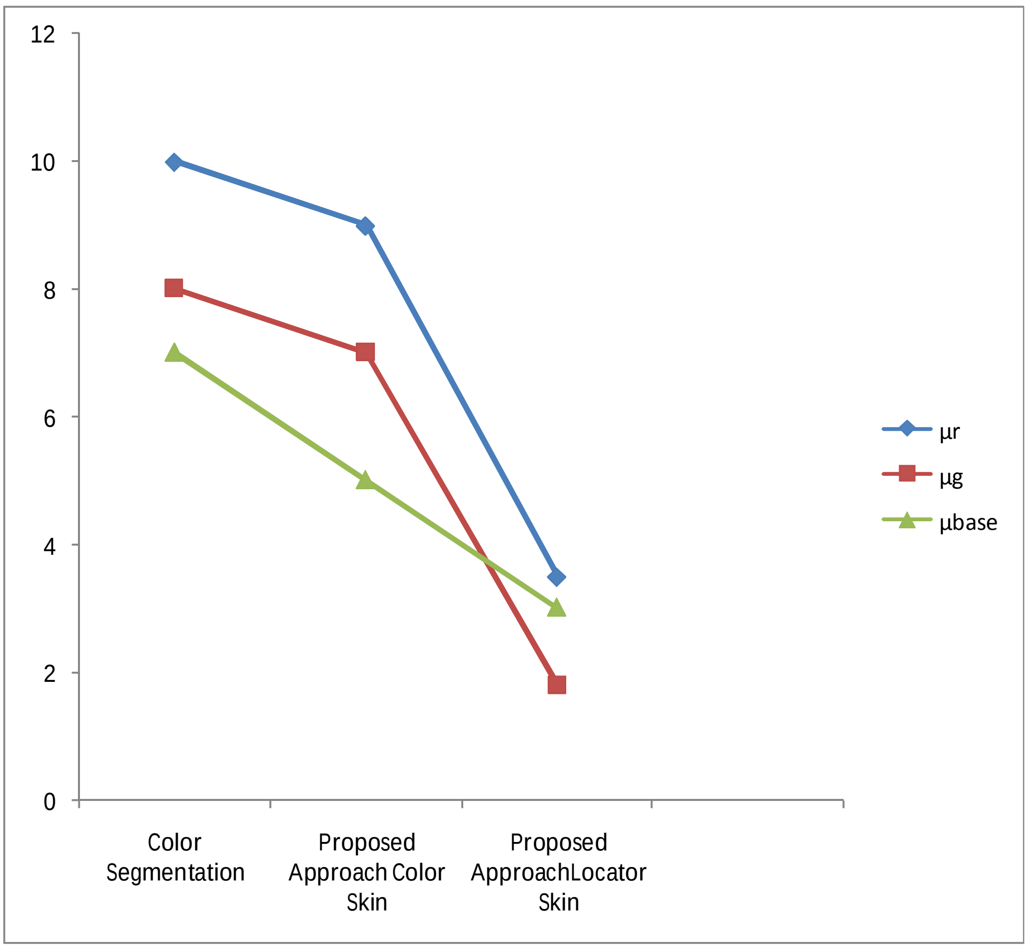


Table 1: Comparing two approaches

This table illustrates the distance between the result of these approaches and the true value of µ. For normalization purpose, the denoted values are scaled by the value of µ. of a specific sequence. The combined approach with the face locator and the skin color mask determines the entire vector µ more accurately than color segmentation.

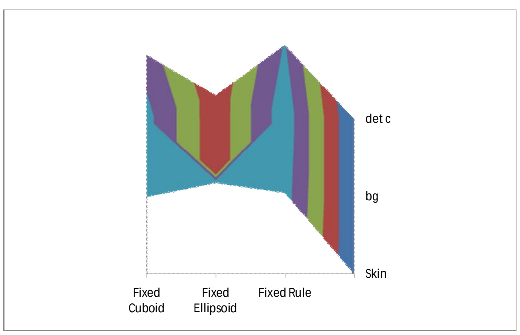
Extracting Skin Color Pixels

The second evaluation compares the classification accuracy of the three dynamic skin color classifiers from section, cuboid-based, ellipsoid-based, and rule-based. This approach compares three kinds of adapting them to the processed image sequence:

Seq	Fixed Cuboid			Fixed Ellipsoid			Fixed Rule		
	Skin	bg	det(C)	skin	bg	det(C)	skin	bg	det(C)
2	84.4	86.1	70.5	99.8	26.1	25.9	88.9	92.6	81.5
4	72.3	66.3	56.2	86.7	44.2	29.7	75.7	96.2	72.7
6	70	64.3	54.5	80.5	43.0	28.4	74.2	95.7	70.6
7	71.2	63.3	53.3	79.4	41.9	22.8	71.5	90.0	69.7
8	69.7	61.0	50.2	72.0	39.5	21.6	68.9	89.5	67.2
9	74.5	65.0	47.7	65.9	38.1	20.9	66.3	77.2	66.9
10	88.7	53.9	38.9	90.9	22.2	23.9	76.5	84.7	79.2
11	74.9	73.7	67.8	97.4	25.7	22.7	87.6	89.2	77.7
15	66.2	65.7	44.9	94.5	23.7	15.9	52.6	69.0	89.9
Avg	74.6	66.5	53.7	85.7	33.8	23.5	73.5	87.1	75.0

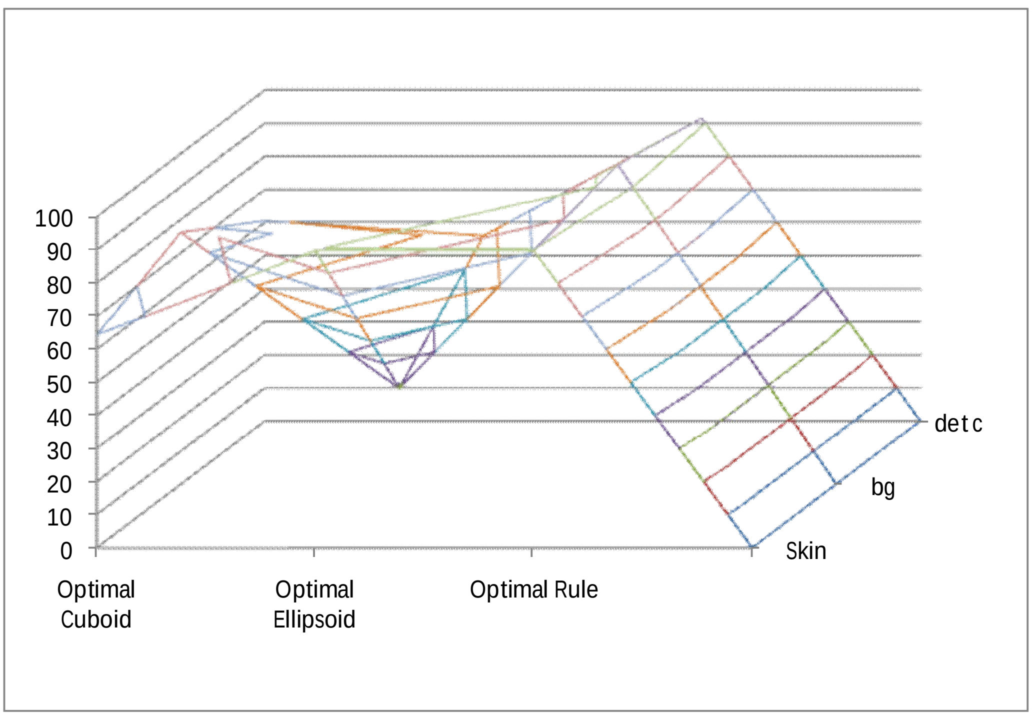
Table 2: No adaptation, optimal adaptation, and Automatic adaptation approach.

The cuboid-based and the ellipsoid-based classifiers require specifying some parameters, Equation 1, 2 and Equation 3. The rule-based classifier requires providing the image-specific characteristics to the rule induction algorithm. The parameters of the cuboid-based and the ellipsoid-based classifiers are computed from the annotated skin color pixels of each image. The rule-based classifier is learned for each image individually.



Seq	Optimal Cuboid			Optimal Ellipsoid			Optimal Rule		
	Skin	bg	det(C)	skin	bg	det(C)	skin	bg	det(C)
2	64.4	76.1	60.5	89.8	29.1	55.9	89.9	96.6	91.5
4	72.3	66.3	56.2	86.7	44.2	29.7	75.7	96.2	72.7
6	70	64.3	54.5	80.5	43.0	28.4	74.2	95.7	70.6
7	71.2	63.3	53.3	79.4	41.9	22.8	71.5	90.0	69.7
8	69.7	61.0	50.2	72.0	39.5	21.6	68.9	89.5	67.2
9	74.5	65.0	47.7	65.9	38.1	20.9	66.3	77.2	66.9
10	88.7	53.9	38.9	90.9	22.2	23.9	76.5	84.7	79.2
11	74.9	73.7	67.8	97.4	25.7	22.7	87.6	89.2	77.7
15	66.2	65.7	44.9	94.5	23.7	15.9	52.6	69.0	89.9
Avg	74.6	66.5	53.7	85.7	33.8	23.5	73.5	87.1	75.0

This approach acquires the image-specific characteristics automatically and adapts the classifiers accordingly. These optimal techniques cannot be applied to real-world scenarios, because they require annotating images beforehand.

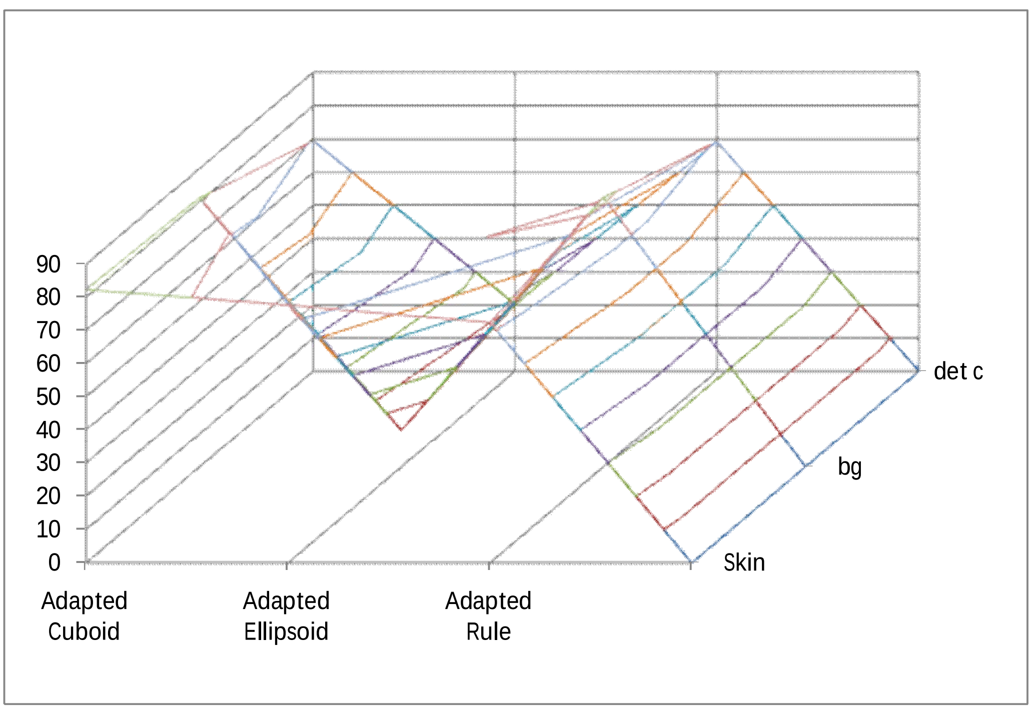


The table clearly illustrates the increase of classification accuracy. The upper limit of approached well. For the ellipsoid-based classifier, the determinant of the confusion matrix rises from fixed to adapt. This table proof-of-concept for recognizing facial expressions by model-based image interpretation integrates this technique as the feature extraction module.

Seq	Adapted Cuboid			Adapted Ellipsoid			Adapted Rule		
	Skin	bg	det(C)	skin	bg	det(C)	skin	bg	det(C)
2	82.4	81.1	69.5	77.8	11.1	20.3	72.4	81.3	69.2
4	74.1	47.3	48.2	96.7	34.2	29.7	65.7	76.2	52.7
6	69.7	69.3	57.5	70.5	53.0	19.4	84.2	75.7	90.6
7	77.2	59.2	45.3	99.4	51.9	18.8	51.5	80.0	79.7
8	54.7	47.8	67.7	62.0	49.5	11.6	78.9	89.5	57.2
9	34.5	51.0	41.4	75.9	58.1	40.9	46.3	87.2	86.9
10	77.7	49.5	35.8	80.9	32.2	33.9	86.5	94.7	89.2
11	65.9	66.3	66.2	67.4	65.7	2.7	77.6	99.2	97.7
15	69.2	63.7	37.4	74.5	13.7	5.9	62.6	49.0	59.9
Avg	67.2	59.4	52.1	78.3	41.0	20.3	69.5	81.4	75.9

Table 3: Adapting three different skin color classifiers

This table compare three kinds of adaptation no adaptation, optimal adaptation, and automatic adaptation via the proposed approach.



This chart shows the accuracy of distinguishing between the skin color pixels (skin) and the non-skin color pixels (bg). The values represent the true positives and the true negatives of the classification process and they are denoted in percent. The fixed ellipsoid-based classifier results very good accuracy for skin, but a very poor one for bg.

V. CONCLUSION

The works are concluded Extracting skin color characteristics from the unprocessed image data provides significant information cues for a variety of applications. Depending on the context conditions, such as the camera settings and the able to be seen person, the color of human skin appears in a different way right the way through the images, which makes regular skin color extraction a hard challenge. Nevertheless, within one image these conditions are unchanging and skin color pixels look similarly. This work proposes a two-phase approach that is able to robustly extract skin-colored regions from the pixel values. First, this technique determines the image characteristics that roughly described the appearance of skin color within a exacting image. It concluded learned skin color mask, since, the utilized face locator represents a sophisticated vision module, which robustly specifies the location of a human face, highly accurate results. Second, the determined image characteristics adapt general-purpose color classifiers to the Outlook on Skin Color Classification specific image, which makes them greatly correct for extracting skin color pixels from this image.

VI. FUTURE ISSUES

Further issues work on adaptively extracting the color of the different facial regions will consider additional features to be provided to the color classifiers in order to improve the classification accuracy. Extracting skin color characteristics from the unprocessed image data provides significant information cues for a variety of applications. In additionally, taking the information about the location of the pixel into account will more extensively utilize the quality of the face locator and size of the image location is determined using suitable algorithm and tools.

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