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Face Identification by Means of Segmentation Algorithm Based on Skin Pigments and Competitive Fuzzy Edge Detection Features

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ABSTRACT

Face , as a complicated pattern , can have various manners that makes it difficult for computer to identify it. One of the effective methods for identifying faces is extract skin regions in an image, so that pigment feature is a useful component for finding these regions in color images, which is today used largely by researchers. Research has shown that division only based on skin pigments is not efficient for determining image edges. This paper suggests a modified tracking algorithm for identifying face. Different models of color spaces especially YCbCr , HIS have been combined by a strong determining techniques called competitive fuzzy edge finder to identify face regions in color images, effectively. Test results show effectiveness and efficiency of this algorithm in comparison with other methods.
KEYWORDS: face Identification, segmentation, competitive fuzzy edge finder, color spaces

INTRODUCTION

Identification Patterns are methods by means of which, computers can make decision about different patterns. The pattern can be defined as a format which determines features of a specific group of objects.

Finding face in an image is one of the pattern identification issues. Face identification has many usage in industry, business and military. Face revelation is very important because in systems like face pursuit systems and face identification, the first and most essential action is finding face position. Various methods have been used to find face. [1]. Suggested methods of face identification in a general groping is as follow [2]:

1- Knowledge-based methods
2- Feature-based methods
3- Formal comparative methods
4- Appearance-based methods

Among feature-based methods , using skin color is the most applicable methods.

A wide range of color spaces are used to model skin color, among which we can mention to RGB , HIS , HSV , …[3][4][5]. Research about skin color show that difference between different human race skin colors is in lightness factors that pigmentation factor[6]. Thus if our purpose is finding face by using skin color feature , then color space must be selected ,so that it has enough efficiency for image tracking based on skin color , so that , even using combined color spaces can act better. But tests have shown only using different color spaces in division, determining borders between skin and skin-like regions and removing these regions from search stages is difficult, so that in most cases, using color space, sometimes is not successful in segmentation image borders.

In this paper ,we have tried to separate skinny regions from non-skinny ones by means of competitive fuzzy edge finder techniques, besides HIS and YCbCr color spaces , so that action of face identification be done with a high accuracy in different images. Nin section 2 of the paper describes the need of segmentation based on color spaces and in section 3 suggested algorithm and test results are described.

Segmentation

The need of segmentation

Segmentation is a level which divide image into smaller sections. In face identification issue , skin segmentation is effective in determining possible face regions , because the whole tracked regions of skin are not face regions, search space become less.

Among various segmentation methods, color-based segmentation is the most important one. Accurate segmentation of original images is a very important step, which results in effective identification and concentrating several image in color images with light and dark regions of skin images based on skin color region is the first step of identification and integration of face in color images. This kind of

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segmentation based on human skin color is by means of color spaces, which results identifying skin-like regions like real skin. Thus, these skin-like regions should be eliminated. Researchers work on skin color segmentation conformity to get the correct identification [7].

Segmentation skin pixels

Because color pixels of skin play an important role in face identification in color images, skin color units from different color spaces are used to divide image, effectively, which is a crucial tool for determining possible regions containing face only , attention to possible regions containing face in identification stages, decrease search space.

Human skin colors of different rates , only is different in intensity (number of skin pigments). Also people have different understanding about skin color of different regions. Stability of skin pigments makes it possible to use a simple unstable segmentation method. For face identification in color images with complicated scenes [8], using skin pixel features for segmentation, decrease search space, largely. Several researchers have used skin features to primarily face segmentation. There are other limitation in these divided joining parts, including the number of skin pores present in divided region, which is used to investigating that whether divided joining parts of a region of face skin is correct and accurate, whether based on height and width of it , the region is in accordance with golden proportion, $(1+\sqrt{5})/2$. By dividing skin color , it becomes clear if color pixel contains human skin color. By this kind of grouping , problems like different skin colors(white , pink, yellow, brown and black scene lightness and the fact that black background pixels may have the same color as that skin color , would be removed. Skin color-based face identification techniques are including 3 steps:

1- Color space-based decision making.
2- Creating skin model and dividing the image by means of this model.
3- Concentrating face in divided image

color spaces

In skin-based face identification various color spaces have been suggested and investigated. Some of the common color spaces are as follow: RGB , normalized RGB, YUV , YCbCr, and HIS (image , saturated , intensity) and many others. Vossentus et.al. have conducted many research about different color spaces[9]. By using color spaces YCbCr and HSV can face to intensity diversity more extent. Because skin color distribution different racial groups is high , a strong and material method is needed to use the amount of skin pigments of skin color by means of statistical method. Variation in light source distribution results in crucial change in emersion of face image. There is a discussion about kind of color scape , which is better fore skin segmentation. Simple transformation , clear light borders , and color parts is the reasons for using YCbCr color space more than others. The most simple model is to define skin color pixels region by using Cr, amounts by Cb , and skin color pixels sample. By choosing accurate tolerance (Cr1, Cr2), (Cb1, Cb2). A pixel has color skin if the amount of pigments(Cr, Cb) fall into an antiseptic confine , namely: Cr1<=Cr<=Cr2, Cb1<=Cb<=Cb2. This separation between skinny and non-skinny colors depends on chosen color model. Color of objects and scene will change intensively when place in different light situations. Besides YCbCr , HIS , and TSL (limited color , saturated , lightness), some other linear changes from RGB space are used to skin identification , too. Challenges , in segmentation images with different skin colors in contrast to skinless regions , made various problems. Segmentation with a single color space results in 2kind of wrong identification , that is incorrect identification in which non-skinny region is identified as skinny region , and an unknown region in which a real skinny region is not identified by the algorithm.

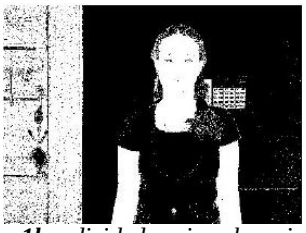

Figure 1b *– divided regions by using HIS color space*

Figure 1a *– original image*

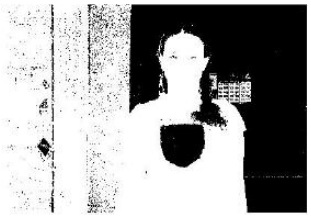

***Figure 1 c** – divided regions by using YCbCr color space*

Figure 1a , 1b , 1c, show these and sections which are divided as skinny region in HIS color space (fig. 1c) are not divided as skinny region in YCbCr color space (fig.1c) and vs.

Thus it is a better method for eliminating these problems by using color spaces combination. Most of identification algorithms suppose images as back grounds without color similar to people skins who wore cloths with the same color of skin and etc .if an image has a background similar to skin color , the whole region would be identified as skinny region.(fig.2a , 2b). to identify faces exist in divided regions, more stages of face integration is needed.

In dividing face of people who wore skin color cloths or the like , and by using segmentation technique before processing skin pixels , the whole image is identified as face region , thus we need a further step and face identification [10]. Moreover , overlapping of face regions in face segmentation , makes more limitation , because of difference in lightness , when dividing skin regions, be not identified as skin region. Face identification in this situation is more complicated than background with non-skinny , color, and steady.

***Figure 2b** – divided image by using HIS and YCbCr combination*

***Figure 2a** – original image with background similar to skin.*

Edge Identification

Nevertheless , using different color spaces while dividing determining borders between skin and skin like regions and eliminating these regions from search steps is difficult. Sometimes using color space , alone , is not successful in dividing images borders. So , for determining the exact borders of regions , combining divided image by using color spaces with original image which edge is delineated by using competitive fuzzy edge finder algorithm makes better results.

Edge identification mention to identifying discontinuity in an image. Discontinuity, is the sudden shift in pixel intensity which z scene.

Edge determine borders , thus are very important in image processing and are important tool in image segmentation.

Edge notion is very effective in processing regions , because an edge means change in grey level of a point based on its background. Edges are seen on the border between tow regions , point with high slope , that increase intensity. Thus interplay possibility of this method to noise is less and to identifying weak edges is more. Therefore using a method which can be resistant to noise and has low computational lload, can be very suitable. Among edge identification algorithms, that are used often , we can mention to Kani , LOG (Laplus of Goss) , Sobel , Priorate , and Roberts , all of which have some weakness.

We use competitive fuzzy edge finder method to explore edge , which is suggested by Lily Carl G. Looney , Rui Liang in 2003 , to classify image pixels in edge and background classes , effectively. In this method , 4 kinds of edge , including directional edge in horizontal , vertical , 45° and 135° directions are defined for wdge histogram formation. Tests results show high ability of this algorithm for determining image edges. Details about extracting edge by this algorithm are described in reference 14[12].

Then morphology actions would be done on them. As you can see in image 3b, edge finding by competitive fuzzy edge finder results in thinner and better edges in compare with Robert Cross method, which is used often for face identification.

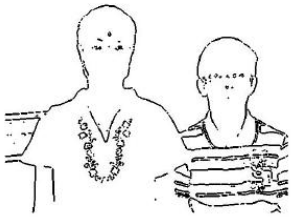

Figure 3b *– rimmed image by competitive fuzzy edge finder method*

Figure 3a *– original image*

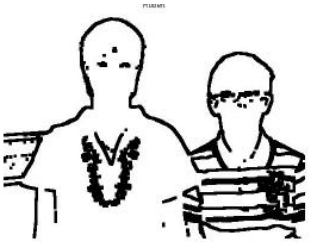

Figure 3c *– Robert Cross constructional image with surface radius 3.*

Proposed method

Algorithm

In this paper , we have suggested a combination of color space for skin pixels determination and competitive fuzzy edge finder algorithm for edge identification for suitable segmentation. Because all of the divided regions of skin , do not belong to face , each divided region passes through a face segmentation algorithm to investigate if the divided region is face or not.

Step 1 – original image will be divided by using HIS color space for skin. One these regions , gradual analysis of different morphology actions(exhaustion, erosion) and retardation is done with suitable structural image.

Step 2 – original image will be divided by using YCbCr color space. On these regions different morphology actions would be done like previous step.

Step 3 – divided images from steps 1 and 2 are combined as a single divided image. In this image , joined parts will be analyzed , to achieve a divided combined image. Regions bigger than tolerance region (in this case , more than 600 pixels) bare selected which are compatible with next specific proportions and have pores.

Step 4 – the original color space transmuted to a simple white image. Determined edges of this image are got by using competitive fuzzy edge finder algorithm, separately. Determined edge images from the two methods , would be combined to determine borders of regions ,exactly.

Step 5 – borders from previous step will be combined with divided image from step 3. After completing morphology actions , as steo 3 , we will achieve final divided image regions with pores are which are possible regions of face because of existence of eyes and mouth , and other regions would be removed. Selected face regions like paper [13] are analyzed by dividing and integrating algorithm. Just as non-facial regions which place in position similar to face , because of having pores.

Results of suggested method:

Resulted image border by using competitive fuzzy edge finder in compare with Robert Cross algorithm with surface radius 3 , suggested thinner and capillary border edges.

Dividing by using combination of color spaces and edge determined by competitive fuzzy edge finder method, determines borders better than combination of YCbCr and Robert Cross edge. If the original image contains several faces with different sizes , and faces have overlap , the proposed segmentation method Is better. Like figure 4a in which face images have different size.

As you can see in figure 4c face in the aforesaid image is identified well by using proposed method.In figure 5b face of people who have glasses , are divided to two parts in Robert Cross edge segmentation , because after R.C edge identification morphological action like retardation , an analysis

was done about it , and edges would become thicker , while face identification was done well by proposed method.

Figure 5a *– original image*

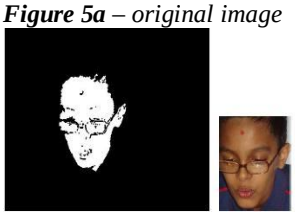

Figure 5b *- divided by proposed method*

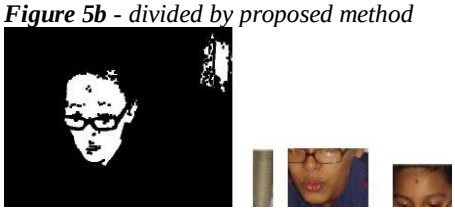

Figure 5c *- divided by YCbCr and Robert Cross edge method*

Figure 4a *– original image*

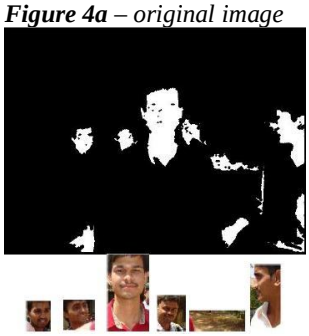

Figure 4b *- divided by proposed method*

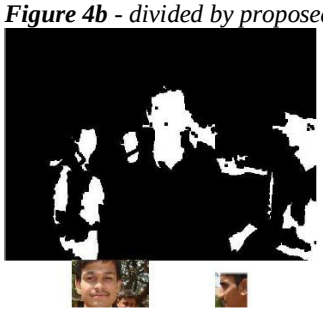

Figure 4c *– divided by YCbCr and Robert Cross edge method*

Conclusion

In this paper a segmentation algorithm for face identification in color images and skin regions is suggested. Identifying edge by dividing skin based on amount of skin color and combining several color spaces , results in a better segmentation. Especially combining HIS and YCbCr color spaces with edge identification algorithm , competitive fuzzy edge finder , divide original image better than previous endeavor in which a color space and Robert Cross edge technique were used. This segmentation method decrease searching space in identification stage. This is obvious from divided images 4b , 5b , which are the final images of 4a , 5a ,accordingly.

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