A Novel Skin Segmentation Based on Watershed Algorithm

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Abstract: This paper presents the skin segmentation using watershed algorithm which separates the skin and non-skin regions using two color levels i.e, two different colors one represents the skin region and the other represents the non-skin region. The watershed segmentation algorithm is proposed to segment the skin region of the RGB (Red, Blue, Green) color images based on the chrominance component of the YCbCr color space. As the watershed algorithm is not suitable for segmenting the color images directly. So firstly in the pre-processing stage the input RGB image is converted to YCbCr and then the RGB is converted to the gray image (Cb component). After, the pre-processing stage the edges of the images are detected using different edge operators like sobel, canny, prewitt and Roberts etc. and the gradient magnitude is computed which also detects the edges. watershed transform is applied to the image for segmentation and multi threshold is used to segment the skin region and non-skin regions using two different color levels.

Keywords- *Segmentation, skin region, watershed, YCbCr, multi threshold.*

I.INTRODUCTION

Image segmentation is the method of partitioning a digital image into number of segments. The goal of the segmentation is to simplify and change the representation of an image into something that makes easy to extract and easier to analyze. Image segmentation is used to locate objects and also boundaries in the images. Image segmentation is a process to allocate the label to every pixel in an image such that pixels with the same label share certain characteristics. The result of the image segmentation is a set of segments that cover the entire image .Each of the pixels in a region are almost same with respect to some of the characteristic , such as color, intensity, or texture. Adjacent regions are significantly different with respect to the characteristics.

The image segmentation algorithms area unit typically supported the 2 basic characteristics of the luminance: separation and similarity. Edge detection algorithms area unit supported the separation. Similarly, the brink process, region growing, regional separation and chemical action area unit supported similarity. Watershed algorithmic rule that could be a arithmetic morphological methodology for image segmentation supported region process, has several benefits. The results of watershed algorithmic rule is word segmentation, border closure and high accuracy, it can do one-pixel wide, connected, closed and actual location of define. The essential conception of watershed relies on visualizing a grey level image into its geographics illustration, which incorporates 3 basic notions: minima, construction basins and watershed lines.

Watershed segmentation of the gray scale image has been seen as a topographic relief. In that case, the gray level of the pixel is interpreted like a altitude in a relief. A few number of researches has proposed watershed segmentation method to segment human skin from the color images. Watershed algorithm segments the skin region in some stages, in the pre-processing stage the input RGB image is converted into YCbCr and also into gray image. By using the edge operators on the gray image the edges of the image can be detected. The gradient magnitude uses the sobel and prewitt edge operators to detect the edges. Watershed transform is applied to the image for segmentation and multi threshold is used to segment the skin and non-skin regions using two color levels.

This paper is organized as follows: Section 2 describes the Literature survey. Section 3 Watershed algorithm. Section 4. Result and discussion. Section 5 gives the conclusion.

II. LITERATURE SURVEY

In this section, detailed literature review is done that aims to review the critical points of current works. Here the information collected about researches and innovations carried out on the related technologies have been done. This section will highlight the recent trends and innovations in the concerned technology.

There are various types of image segmentation like region based segmentation, edge based segmentation, threshold based segmentation, model based segmentation and the watershed segmentation algorithm comes under region based segmentation. watershed region is defined as the region overall point of flows 'downhill' to common point. In geography, a watershed is the ridge that divides area drained by different river systems. The watershed transform applies these ideas to gray scale image in a way that it can be used to solve a variety of segmentation problems in images. The watershed is applied to the document image gradient and the watershed lines separate homogenous regions and giving the desired segmentation results. The gradient document image for the transform is often found using the morphological gradient. Over segmentation is the significant problem for most watershed algorithm, which was addressed in many literatures. watershed transform is mostly designed for the objective of document image segmentation.

Beucher (1991) proposed a method for segmenting the image based on the mathematical morphology. The process of image segmentation divides into two ways , boundary based and region based. Watershed segmentation is a region based method and uses to detect the pixel and region similarities. watershed transformation is applied on the gray images by using flooding process. The problem of over segmentation is reduced by using marker controlled watershed segmentation. Another method , called hierarchial segmentation is proposed. This method is explicitly efficient for defining the levels of segmentation starting from the graph representation of the images based on the mosaic image transform.

Anthony et al [1] implements a variation of the traditional watershed segmentation method by applying a multiresolution implementation of the watershed segmentation algorithm. This method uses a watershed pyramid to form a scale space representation to reduce the computational cost and to avoid the over segmentation problem present in traditional watershed algorithm. These pyramids are used to produce high accuracy edges . The aim of this method is edge detection in an image, not necessarily a face and it is used to obtain all the edges present in the image.

Malik et al [16], proposes use of the conventional watershed transform, but this procedure is applied only after preprocessing to standardize the contrast of the image and ensure no over segmentation or under segmentation. As a pre processing step, an algorithm named random walk is applied on the image which is based on probability. To provide a beginning point to the random walk algorithm a seed is generated by using the threshold of the image. The aim of the algorithm is to improve image quality so that watershed algorithm can be applied.

Erikson (2005) proposes two totally different techniques of performing preprocessing of an image to enhance segmentation results. The strategies use the gray level thickness of the objects, so as to search out the ensuing image. The primary methodology projected by the author is RW, uses the stochastic process of a particle to a random position, the position is outlined within the in the neighborhood of the particle. The ensuing image through this methodology holds the quantity of times the particle visits a pixel. The second methodology is repetitious Procedure (IP) scans the image iteratively and calculates the mean of constant variety, rather than randomization to search out the quantity of visits. The strategies projected in this paper are independent of the segmentation

methodology and may so be used as a preprocessing step for alternative segmentation strategies in addition.

In Sobottka et al [2], the standard watershed rule is applied to an individual's face with pre process. This application of watershed rule is one among the solutions to section the face.intially the inside pixels of the subject face area unit sorted consistent with gray levels values.After this step, beginning with the initial regions that area unit determined by employing a threshold, the regions are flooded by applying an alternate methodology. This enables regions to grow and if the distinction between 2 adjacent regions is below a threshold, they are incorporate. This procedure continues till the varied basins units are obtained. The result segments a part of the hair and eyes.

III. PROPOSED WORK

Watershed algorithm:

A watershed is a transformation defined on a gray tone image. The name refers to a geological *watershed*, or drainage divide, which separates by the side of the drainage basins. The watershed transformation use the image it operates like a topographic map, with the brightness of each point representing its height, and finds the lines that run along the tops of ridges. There are different definitions of a watershed. In graphs, watershed lines are defined on the nodes or on the edges. There are many different algorithms used to find watersheds. Watershed algorithm is used in image processing for the segmentation purposes.

There are mainly 3 ways to implement the watershed:

1. Distance transform approach
2. Gradient method
3. Marker controlled approach

We are going to use the gradient method in this skin segmentation

Gradient method:

The gradient magnitude is used to pre-process a RGB image into a gray-scale image prior to using the watershed transform for segmentation. The gradient magnitude image has high pixel values along object edges and low pixel values in the remaining part. watershed ridge lines are formed along the object edges by applying watershed transform[2]. In this method there exists a problem called over segmentation. The topological gradient provides a global analysis of the image then the almost unwanted contours due to the noise added to a given image can be significantly reduced by our approach. The experimental results show that the over segmentation problem, which usually appears with the watershed technique, can be attenuated, and the segmentation results can be performed using the topological gradient approach. Another advantage of this gradient technique is that it splits the process of segmentation into two separate steps: first we will detect the main edges of the image being processed, and then the watershed of the gradient is computed.

Features of watershed algorithm:

The various Features of watershed algorithms is:

1. Watershed Segmentation is basically simple and intitutive method.
2. It is fast and can be parallelized with almost linear speedup.
3. It produces the complete division of the image even if the contrast is poor.
4. Avoids the need of contour joining.
5. The resulting boundaries of a given object forms closed and connected regions where as other edge-based techniques forms disconnected boundaries.

6. The boundaries of the resulting regions always corresponds to contours which appear in the image as obvious contours of objects.
7. This is in contrast to split and merge methods where the first splitting is often a simple.
8. Regular sectioning of the image of the image loading, sometimes results to unstable results.
9. The union of all regions forms the entire image region.

The block diagram of skin segmentation based on watershed algorithm is as shown in below figure.

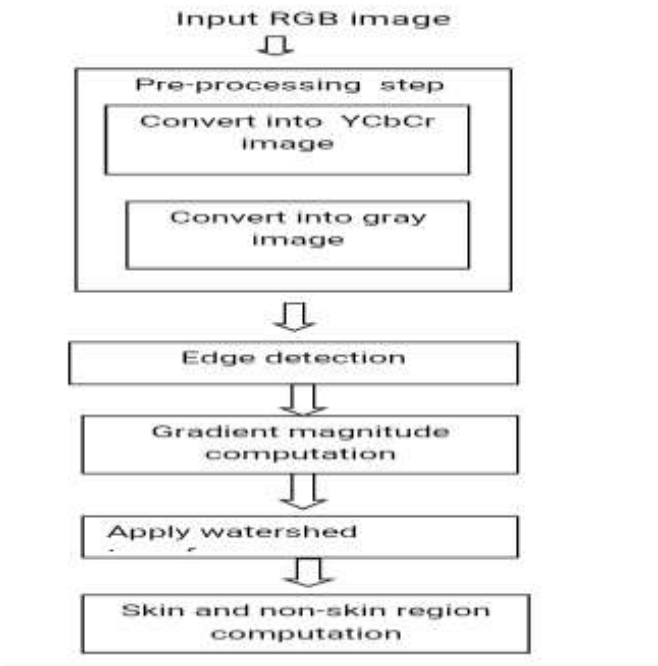

Fig 1: Block Diagram of watershed algorithm

Pre- processing :

Pre-processing is the first step of segmentation and in this step the input RGB image is converted into YCbCr image and also the RGB image is converted into gray image, because the watershed transform cannot be applied directly on the RGB image.

Edge detection:

Edge detection is a technique used for detecting the boundaries of objects within images. It works by detecting discontinuities in brightness. The edges of an image are detected by using various edge operators like sobel, prewitt, canny and Roberts.

Gradient magnitude computation:

Partial derivative with respect to x-axis and partial derivative with respect to y-axis is required to compute the gradient of the image.

Watershed transform:

The watershed transform is a way of choice for image segmentation. The skin and non-skin regions are computed using the multi-threshold Method.

The input RGB color input image is taken from the database and is converted into the YCbCr color image consisting of the components such as luminance, blue-difference (Cb) and red-difference (Cr). After converting into YCbCr color image again the RGB image is converted into gray image. This is what occurs in the preprocessing step. The edges of the images are detected using different edge operators like sobel, prewitt, Roberts, canny. The gradient magnitude detects the edges using some of the basic edge operators like sobel and prewitt. After detecting the edges watershed transform is

applied on the image and the segmentation occurs and by using the multi threshold we can segment the skin and non skin region region using two color levels, i.e skin region is represented by one color and non-skin region is represented by another color. And finally the skin segmentation has occured using the watershed algorithm.

IV. RESULTS AND DISCUSSIONS

The following are the outputs of the proposed work and are shown in below figures.

The pre-processing stage outputs are shown in fig 2,3&4

Fig 2: input image

Fig 3: YCbCr image

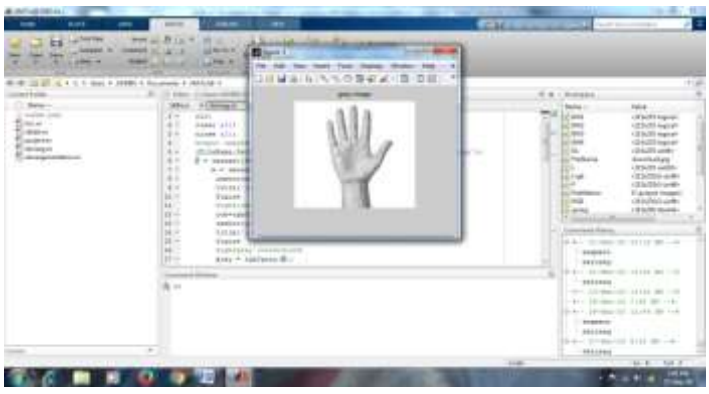

Fig 4: Gray image

The edges are detected using various edge operators like sobel, canny, prewitt and Roberts. The output obtained using the prewitt operator is shown in below fig 5.

Fig 5: Prewitt output

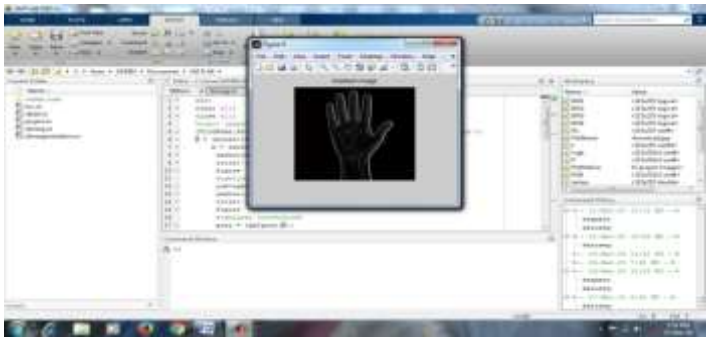

Fig 6: Gradient image

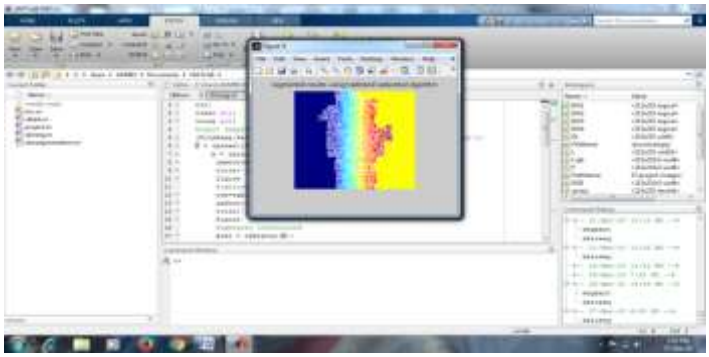

Fig 7: segmented result

Fig 8: skin and non-skin region computation

V. CONCLUSION

In this paper we developed an efficient method of watershed algorithm that is presented for the segmentation of the human skin region in the color images. In the pre-processing stage, the suitable gray image has been generated from RGB color input image through YCbCr image. Then gradient image of Cb component image is computed to segment with the help of watershed algorithm.To distinguish the skin and non skin regions, multi thresholding is applied where two regions are segmented using two different color levels. It is concluded that the proposed method that is watershed algorithm used to segment the skin and non-skin regions on gradient image.

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