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An Improved Mathematical Model Based Approach for Shadow Detection

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Abstract— Image Segmentation is the basic and the Most useful Image processing operation used to extract the features or the objects from an image. One of such image processing application is the detection of shadow over the images. Shadow Detection can be an individual application or the filtration stage of any image processing application to remove the chances of illusion. In this paper, a morphological operators based mathematical model is presented to detect the shadow area over the image. In this paper, the review of the existing segmentation approaches is defined as well as a new color model improved mathematical model is suggested to perform the shadow area extraction over the image.

Keywords— Shadow Detection, Color Model, Segmentation, Morphological Operators

I. INTRODUCTION

Image segmentation is one rich image processing application as well as the methodology to work as the baseline in the area of images. Image segmentation basically includes the detection of the object or the extraction of the features from the image. To detect the object or the image features, the image is divided to the several sub areas and by performing the statistical or the pixel based analysis under the different criterias, the detection of the object will be performed. There are number of approaches that are directly or indirectly associated with image segmentation. One of such approach is the Clustering. Clustering is basically to divide the image in smaller regions under some pixel based classification. The clustering is the structural process that divides the pixel in different homogeneous groups so that similar data or the pixel area will be maintained in one group. Based on this feature based analysis the classes over the image will be defined along with the cluster boundaries. These all classes basically form the partitions over the image. These partitions divide the images in certain groups and define the data distribution over the image. Image segmentation is the foremost step of image analysis and the pattern recognition. It is one of the critical image processing tasks to define the image separation respective to the application. In most general view the image segmentation separates the foreground from the background. There are number of image segmentation approaches and some of them are listed as under.

A) Histogram Thresholding

According to this approach the image is represented by the image histogram and by performing a peak and average weight analysis some pixel range is kept in the image and some is discarding. This range specification actually defines the threshold value

B) Edge Based Approaches

The kind of image segmentation is the edge detection. There are number of such edge detection operators such as Sobel, Laplacian for example. Resulting regions may not be connected; hence edges need to be joined

C) Region Based Approaches

This kind of analysis includes the similarity based check over the image regions to identify the relative areas or the similar areas over the image. Such kind of approach further include some methodology like region growing approach, threshold based analysis etc. The watershed algorithm also defined under the same approach

II. LITERATURE REVIEW

Chin-Ya Huang, Mon-Ju Wu proposed the image segmentation with the help of gray and color images. He introduces a basic idea about color information and edge extraction to achieve the image segmentation. The color information helps obtain the texture information of the target image while the edge extraction detects the boundary of the target image. By combining these, the target image can be correctly segmented and represent[1]. Ullrich Kothe proposed general algorithmic framework based on priority queues that allows for the integration of a variety of different segmentation algorithms. A seeded region growing approach, along with a number of improved seed selection methods of critical areas, is chosen to realize this framework. Experimental evaluation shows very good performance of these algorithms on a relatively large number of outdoor photographs without the need to adjust parameters[2].

Nassir Salman proposed combination of K-means, watershed segmentation method, and Difference In Strength (DIS) map was used to perform image segmentation and edge detection tasks. We obtained an initial segmentation based on K-

means clustering technique. Starting from this, we used two techniques; the first is watershed technique with new merging procedures based on mean intensity value to segment the image regions and to detect their boundaries. The second is edge strength technique to obtain an accurate edge maps of our images without using watershed method. In this paper: We solved the problem of undesirable over segmentation results produced by the watershed algorithm, when used directly with raw data images[3]. An improved Ostu method based on the GGM function is proposed in this paper. It makes use of not only the gray level information of the image, but also the gradient information, so it can segment the image efficiently. The simulation shows that the binary image after segmentation by the GGM algorithm has less noise and clearer edge than other algorithms[4].

This paper demonstrates how a modification of the Rand index, the Normalized Probabilistic Rand (NPR) index, meets the requirements of largescale performance evaluation of image segmentation. We show that the measure has a clear probabilistic interpretation as the maximum likelihood estimator of an underlying Gibbs model, can be correctly normalized to account for the inherent similarity in a set of ground truth images, and can be computed efficiently for large datasets. Results are presented on images from the publicly available Berkeley Segmentation dataset[5]. This paper presents an evaluation of two popular segmentation algorithms, the mean shift-based segmentation algorithm and a graph-based segmentation scheme. We also consider a hybrid method which combines the other two methods. This quantitative evaluation is made possible by the recently proposed measure of segmentation correctness, the Normalized Probabilistic Rand (NPR) index, which allows a principled comparison between segmentations created by different algorithms, as well as segmentations on different images[6].

This paper had a comparison of the following two-dimensional Ostu thresholding method. One-dimensional Ostu method considered only grayscale information of the pixel, 2D Ostu algorithm considered both the gray value of a pixel and the average gray value of its neighborhood, thus is more robust to noise[7]. Lamia present a new method for image segmentation using mathematical morphology. The approach used is based on the watershed transformation. In order to avoid an oversegmentation, it propose to adapt the topological gradient method[8]. In Year 2008, Tetsuya Kakuta at el performed a work," Detection of Moving Objects and Cast Shadows Using a Spherical Vision Camera for Outdoor Mixed Reality". This paper presents a method to detect moving objects and remove their shadows for superimposing them on Mixed Reality (MR) systems. Author cut out the foreground from a real image using a probability-based segmentation method. Author superimpose virtual objects using the stencil buffer, which is used to limit the area of rendering for each pixel. Synthesized images of an outdoor scene show the efficiency of the proposed method[9]. In Year 2001, Byong Mok Oh at el performed a work," Image-Based Modeling and Photo Editing". Author present an image-based modeling and editing system that takes a single photo as input. Author represent a scene as a layered collection of depth images, where each pixel encodes both color and depth. Starting from an input image, Author employ a suite of user-assisted techniques, based on a painting metaphor, to assign depths and extract layers. Presented system enables editing from different viewpoints, extracting and grouping of image-based objects, and modifying the shape, color, and illumination of these objects[10].

In Year 2012, Cesar Isaza at el performed a work," Synthetic Ground Truth Dataset to Detect Shadows Cast by Static Objects in Outdoors". In this paper, Author propose a precise synthetic ground truth dataset to study the problem of detection of the shadows cast by static objects in outdoor environments during extended periods of time (days). For Presented dataset, Author have created a virtual scenario using a rendering software. To increase the realism of the simulated environment, Author have defined the scenario in a precise geographical location[11]. In Year 2010, Girisha R at el performed a work," Self Shadow Elimination Algorithm for Surveillance Videos using ANOVA F test". Author propose an algorithm based on inferential statistical one way ANalysis Of VAriance (ANOVA) F test. This statistical model can deal scenes with complex and time varying illuminations without restrictions on the number of light sources and surface orientations[12]. In Year 2009, M.H. Khan at el performed a work," A Robust Background Subtraction Algorithm for Motion based Video Scene Segmentation in Embedded Platforms". The paper presents robust background subtraction algorithm to segment motion based video scene in embedded platforms. Presented algorithms used bandpass video scene filtering with wavelets for extracting illumination invariant scene features and then combine them efficiently into the background reference frame. Performance of algorithms was evaluated on the basis of number of frames in which the moving target was detected for each video sequence[13]. In Year 2009, Syed Sohaib Ali performed a work," Moving Human Detection and Recognition in Videos using Adaptive Method and Support Vector Machine". This paper presents a robust adaptive moving human detection and recognition method in videos. The adaptive threshold method is used to simultaneously update the system to environment changes. The modified human model consists of five parts with robust features to facilitate human recognition process. For recognition purpose Support Vector Machine has been used as classifier[14]..

III. RESEARCH METHODOLOGY

We are purposing an approach to perform the shadow area segmentation over the raster images by using a combined approach of water shed algorithm and the morphological operators. Watershed algorithm is basically defined to perform the boundary detection of shadow area. Proposed watershed algorithm is improved by using the median filter at the processing stage. The median filter will improve the smoothness over the image so that the sharp edges will be identified. In the second phase, the morphological operators will be used as the region growing approach to detect the ROI over the image. Finally, the adaptive thresholding will be applied so that the well defined object segmentation will be performed. The design of the proposed work is given as under

- The first step is a preprocessing to obtain the normalize image over the image

- In the second step, the watershed algorithm will be defined along with median filtration so that the smooth edges over the image will be identified.
- In third stage, the morphological operator will be used to perform the ROI detection by using the region growing approach.
- Adaptive thresholding will be used as the final stage to obtain the exact object mapping to cover up the object in the boundaries.
- Analysis of the work under different parameters

A) Median Filtering

The median filter since it preserves edges and rejects uncorrelated noise effectively. Median filtering is done in two steps: first, sorting pixel values covered by the mask and then putting this computed median value into the center pixel of the mask.

B) Watershed Model

Morphological enhancement of the gradient image is accomplished by simulation of a natural watershed process after rainfall. To extract area having large magnitudes such as water reservoir, we use an inverted gradient magnitude image), Watershed after rainfall induces water that is collected in concave regions in lower altitude around the current pixel at which raindrop is to be added. By iterative rainfall, the concave regions can be merged into a lower concave region. Water filled valleys at equilibrium correspond to potential areas having large magnitudes. To track down the final water filled regions, a labelling process is necessary for each local concave region or local minimum. The depth of a water filled region is the average over the region under water. It is calculated using weighting factors that decrease as the distance from the mask center increases.

C) Morphological Algorithm

Mathematical morphology (MM) is a theory and technique for the analysis and processing of geometrical structures, based on set theory, lattice theory, topology, and random functions. MM is most commonly applied to digital images, but it can be employed as well on graphs, surface meshes, solids, and many other spatial structures. Topological and geometrical continuous-space concepts such as size, shape, convexity, connectivity, and geodesic distance, can be characterized by MM on both continuous and discrete spaces. MM is also the foundation of morphological image processing, which consists of a set of operators that transform images according to the above characterizations.

D) Adaptive Thresholding

Thresholding is applied to the waterfilled regions in which edge detection is based on the amount and depth of water. Since the total amount of rainfall or water used in the WaterShed process can change the regional characteristics, thresholding results vary depending on the amount of water poured on the inverted gradient magnitude image.

IV. CONCLUSIONS

In this paper, a mathematical model is presented to identify the shadow area in raster images. The work is defined by a hybrid image segmentation approach for the detection of shadow areas. The color model based initial extraction will be refined by the morphological operators, median filter and the thresholding approach.

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