ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 2, Issue 7, July 2013

A WATERSHED BASED MORPHOLOGICAL OPERATOR APPROACH FOR IMAGE SEGMENTATION

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Abstract*:* One of the primary applications of image processing is the image segmentation. The segmentation is itself an intermediate process as well as application that help other applications as its preprocessing part. The segmentation is used by many approaches to improve the effectiveness of work. To achieve the effective results from these algorithms, an effective segmentation is required. In this present work a hybrid approach is presented to perform the image segmentation. The work is about to use the basic mathematical approaches to obtain more accurate results. The approaches covered in this work are morphological operators, watershed algorithm and the adaptive thresholding approach. In this paper, the basic segmentation approaches are defined as well as a new hybrid is presented to perform the effective segmentation.

Keywords: Segmentation, Watershed, Morphological

1. INTRODUCTION

The objective of segmentation in image processing is to perform the effective recognition as well classification of images. It is basically used to extract the features from an image. The edge detection, skeletonization, feature extractions all are the parts of images segmentation.

In image processing, segmentation falls in to the category of extracting different image attributes of an original image [7]. Segmentation subdivides an image into constituent regions or objects. The level to which that subdivision carried out is a problem specific. The simplest method among all segmentation methods is threshold-based method, whose volume uses either a manually or automated generated threshold values for segmentation. In this method first the histogram of the image is computed then a particular value of threshold (intensity) is selected to segment the region. However in this method the intensity values often suffer from non-uniformly distributed contrast values inside the vessels. So, in case of small structure vessel segmentation, global threshold based methods are not useful.

A. *Edge Detection*

Edge detection [8] refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene. Classical methods of edge detection involve convolving the image with an operator (a 2-D filter), which is constructed to be sensitive to large gradients in the image while returning values of zero in uniform regions. There are an extremely large number of edge detection operators available, each designed to be sensitive to certain types of edges.

1) *Approaches to Edge detection:*

There are many methods for edge detection, but most of them can be grouped into two categories, search-based and zero-crossing based. The search-based methods detect edges by first computing a measure of edge strength, usually a first-order derivative expression such as the gradient magnitude, and then searching for local directional maxima of the gradient magnitude using a computed estimate of the local orientation of the edge, usually the gradient direction. The zero-crossing based methods search for zero crossings in a second-order derivative expression computed from the image in order to find edges, usually the zero-crossings of the Laplacian or the zero-crossings of a non-linear differential expression. As a pre-processing step to edge detection, a smoothing stage, typically Gaussian smoothing, is almost always applied.

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B. *Feature Extraction*

When the input data to an algorithm is too large to be processed and it is suspected to be redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features. Transforming the input data into the set of features is called *feature extraction*. It can be used in the area of image processing which involves using algorithms to detect and isolate various desired portions or shapes (features) of a digitized image or video stream. It is particularly important in the area of optical character recognition [10]. In this research, **Watershed Segmentation** is used as feature extraction technique. It is simple, fast and intuitive method.

- Produces a complete division of the image in separated regions even if contrast is poor.
- Accurate results.
- Yields superior performance than manual segmentation algorithms.

C. *Quantitative Measures*

Ink-bleed through removal of a document image is carried out to enhance its readability and to get a clean image by using any of ink-bleed through removal approaches so that these images can be further used for reading or for OCR. It helps in performing segmentation in OCR as it is mainly used for pre-processing of an image. The quality of ink-bleed through removal algorithm is measured by using the following quantitative measures:

1**.** Precision**:** It shows how well the system can remove the interfering strokes. It can be evaluated as:

$$\text{Precision} = \frac{\text{No.of wordscorrectlydetected}}{\text{Total no.of wordsdetected}}$$

2. Recall**:** It is a measure of the performance of the system in restoring the front page to its original state. It can be evaluated as:

$$\text{Recall} = \frac{\text{No.of wordscorrectlydetected}}{\text{Total no.of wordsin the document}}$$

3. F-Measure**:** A measure that combines precision and recall, it is the harmonic mean of precision and recall, the traditional F-measure or balanced F-score:

$$F = 2\frac{precision \times recall}{precision + recall}$$

This is also known as the F_1 measure, because recall and precision are evenly weighted. It is a special case of the general F_β measure (for non-negative real values of β):

$$F_\beta = (1+\beta^2)\frac{Precision*Recall}{\beta^2*Precision+Recall}$$

Two other commonly used F measures are the F_2 measure, which weights recall higher than precision, and the $F_{0.5}$ measure, which puts more emphasis on precision than recall.

The obvious drawback of ink-bleed is the reduction in the document's legibility. The motivation of our work is to provide a practical approach to reduce ink-bleed interference in imaged documents in order to improve legibility.

II. LITERATURE SURVEY

In Year 2011, Wudi Mu performed a work," Color-Based Image Segmentation on UAV Reconnaissance Videos with Matlab". This method can avoid the questions of poor precision to image segments with the algorithms of background subtraction, optical flows and feature matching about the complicated locomotive and shaking backgrounds [1]. In Year 2006, Sanmati S Kamath performed a work," Segmentation of Color Images for Image Data Analysis". The work described here discusses the analysis of images in port settings. As cargo containers are of specific colors, the hue information is being exploited to segment, identify and compress such video streams. A novel scheme using multiple processes has been developed. The first process is obtaining the vector angle between the RGB components which is used to segment images based on the color. The second process is the Hough transformation that is carried out on the vector angle result as well as a Laplacian of the saturation image [2]. In Year 2012, Anandarup Roy performed a work," A Finite Mixture Model Based on Pair-Copula Construction of Multivariate Distributions and its Application to Color Image Segmentation". This paper presents a finite mixture model that involves a pair-copula based construction of a multivariate distribution. The advantage of such a model is that the margins and the dependence structures are de-coupled from each other. Author further notes the existence of redundant connected components that represent the boundary of two adjacent components. Author here propose a methodology that merges such component pixels to the other two components [3]. In Year 2010, Srinivasa Perumal R. performed a work," An Efficient Color Image Segmentation Algorithm Using Hybrid Approaches". The main advantage of the proposed method is that no a priori information is required to segment the given color image and hence considered as an unsupervised approach. The proposed method is found to be reliable and works satisfactorily on different kinds of color

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International Journal of Advanced Research in Computer and Communication Engineering
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images [4]. In Year 2009, Mira Park performed a work," Microscopic Image Segmentation Based on Color Pixels Classification". In this paper, Author present clustering techniques to segment homogeneous clusters in RGB color space and then label each cluster as a different region. According to the evaluation process, 97% of nuclei pixels were correctly delineated with Presented algorithm and on average 90% of nuclei were correctly detected [5]. In Year 2010, M Sujaritha performed a work," A Three-Level Clustering Algorithm for Color Texture Segmentation". This paper presents the development of a three level unsupervised segmentation framework based on color and texture features. An important contribution of this work consists of a new formulation of three different clustering algorithms at three different levels. The proposed algorithm is applied on the Berkeley database images and complex natural images. The results are competent with the JSEG and CTex algorithms [6]. In Year 2009, ZhiYong Zeng performed a work," An Efficient and effective Image Representation for Region-Based Image Retrieval". This paper presents an efficient and effective image representation for region-based image retrieval. Author explores the issue of hybrid feature-integrated and compact region-based image retrieval for huge image database. Firstly, to describe regions of an image, Author present an image segmentation algorithm. Secondly, a compact, fixed-number and computation effective representation is designed for the color contents of each region of an image [7]. In Year 2009, Tao Xu performed a work," Texture Map: An Effective Representation for Image Segmentation". In this paper, Author present a novel algorithm that tends to generate statistical descriptors that are adaptive to the variation of texture patterns based on a simple rule of pruning and concatenating the approximately repetitive patterns. In the context of image segmentation, the color information that is used by the popular mean shift segmentation algorithm is usually not sufficient for good segmentation performance [8].

III. PROPOSED WORK

A morphological operator is therefore defined by its structuring element and the applied set operator. For the basic morphological operators the structuring element contains only foreground pixels (i.e. ones) and `don't care's'. These operators, which are all a combination of erosion and dilation, are often used to select or suppress features of a certain shape, *e.g.* removing noise from images or selecting objects with a particular direction.

In erosion, every object pixel that is touching a background pixel is changed into a background pixel. In dilation, every background pixel that is touching an object pixel is changed into an object pixel. Erosion makes the objects smaller, and can break a single object into multiple objects.

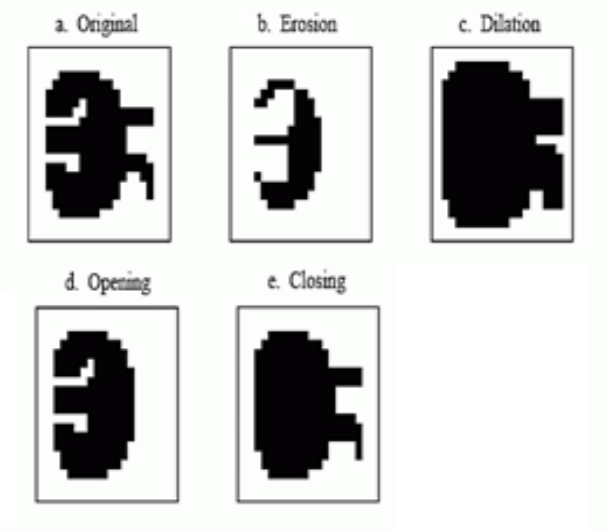

Fig: 1 Morphological operations

Four basic morphological operations are used in the processing of binary image: erosion, dilation, opening and closing. Fig (a) shows an example binary image. Fig (b) to (e) shows the result of applying these operations to the image in (a).

Dilation makes the objects larger, and can merge multiple objects into one. As shown in (d), opening is defined as erosion followed by dilation. Figure (e) shows the opposite operation of closing, defined as dilation followed by erosion. As illustrated by these examples, opening removes small islands and thin filaments of object pixels. Likewise, closing removes islands and thin filaments of background pixels.

The proposed architecture is given as

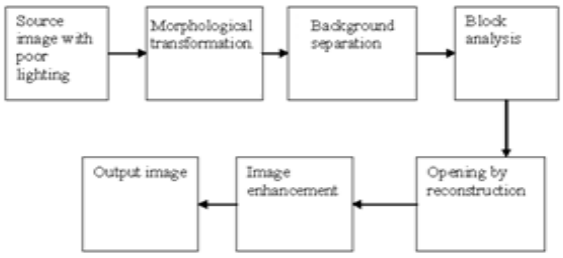

Figure 2: Proposed Architecture

This method is introduced to overcome the limitation of thresholding in Blind segmentation approach. The proposed algorithm is as follows:

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Algorithm

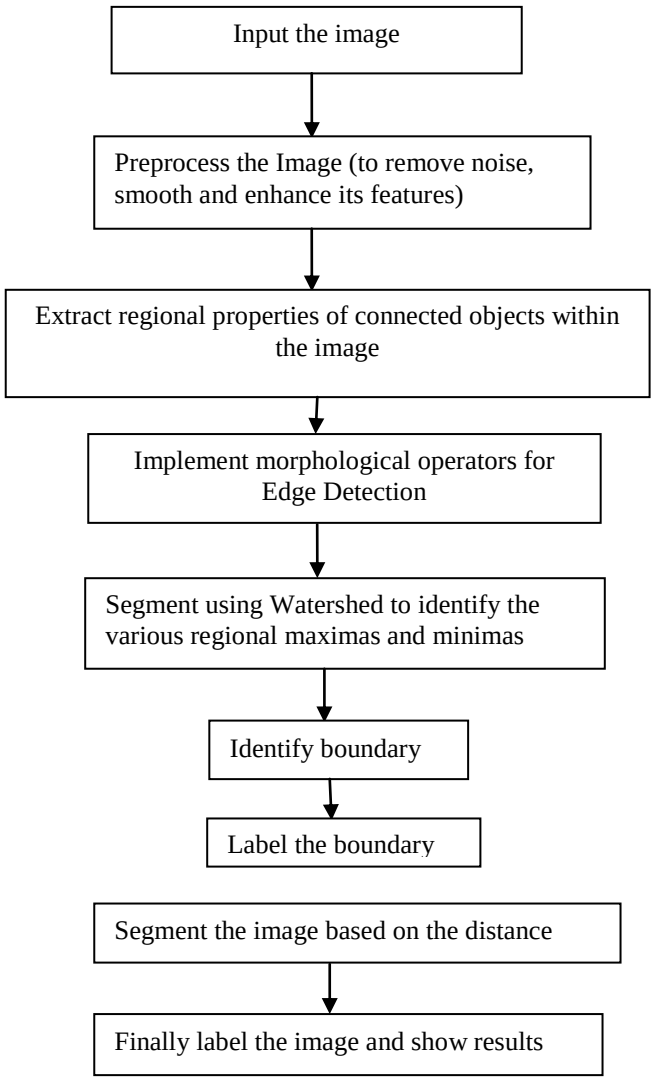

Fig 3: Flowchart

IV. RESULTS

Figure 4: Input Image

Figure 4 is here showing the input image given to the system. The given input image is in RGB color format with high resolution of 1024x768.

Figure **Ошибка! Текст указанного стиля в документе отсутствует.**:
Input Image (Grayscale)

To work with the feature extraction process, the input image is first converted to the grayscale image. The grayscale image is here shown in figure 5.

Figure 6: Median Filter Results

Once the image converted to grayscale, the next work is to smoothen the edges so that effective feature extraction will be performed. To smoothen the edges, median filtering is being used in this work.

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Figure7: Negative Image

Here figure7 is showing the negative of the actual input image. This negative image is helpful to take the distance related decisions from the image. This negative image is used by the watershed algorithm to perform the segmentation process.

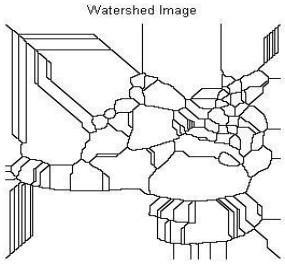

Figure 8: Watershed Image

After getting the actual image and the negative image of it, the distance analysis is being performed to identify the edges over the image. By using these distance parameters, watershed algorithm is being used. Figure 8 is showing the results obtained from respective to the watershed image.

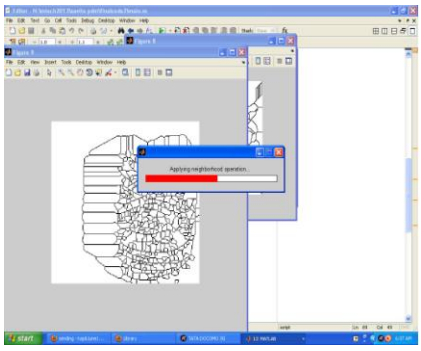

Figure 9: Neighborhood Analysis

To identify the region over the image, the neighbor pixel analysis is required. Figure 9 is showing the outcome driven from the neighborhood analysis on this input image.

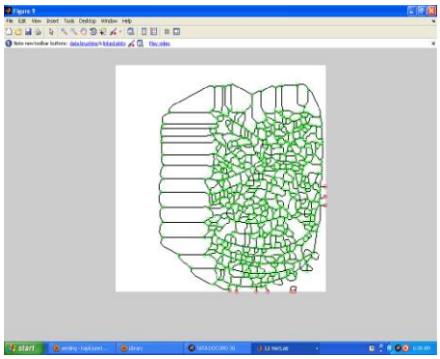

Figure 10: Region Point Extraction

Here figure 10 is showing the results driven in the form of extracted region points. The green circles are showing the region points that are main interest point to the system.

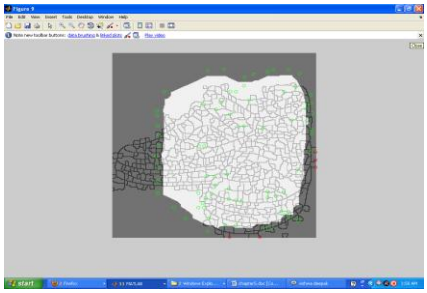

Figure 11: Feature Extraction

Here figure 11 is showing the results driven in the form of extracted figure from the system. The green circles are showing the region points that are main interest point to the system. The white area is showing the main interest area where most of image features exists.

V. CONCLUSION AND FUTURE WORK

In this present work, the focus is on one of important image feature called thinning. The thinning process is about to identify the internal image processing and the feature extraction at the lower level. It is some kind of skeletonization of image. The presented work is a hybrid model that combines basic mathematical approaches. The approaches included in this work are median filter for the preprocessing, watershed and morphological operators for the edge detection and region identification, region selection and distance measure for the feature point identification and the thresholding for the area exclusion. The obtained results show the effectiveness of the segmented area over the image

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