HISTOGRAM BASED AUTOMATIC IMAGE SEGMENTATION USING WAVELETS FOR IMAGE ANALYSIS

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ABSTRACT

Model-Based image segmentation plays a dominant role in image analysis and image retrieval. To analyze the features of the image, model based segmentation algorithm will be more efficient compared to non-parametric methods. In this project, we proposed Automatic Image Segmentation using Wavelets (AISWT) to make segmentation fast and simpler. The approximation band of image Discrete Wavelet Transform is considered for segmentation which contains significant information of the input image. The Histogram based algorithm is used to obtain the number of regions and the initial parameters like mean, variance and mixing factor. The final parameters are obtained by using the Expectation and Maximization algorithm. The segmentation of the approximation coefficients is determined by Maximum Likelihood function. It is observed that the proposed method is computationally efficient allowing the segmentation of large images and performs much superior to the earlier image segmentation methods.

Keywords: Discrete Wavelets, Image Segmentation, Histogram, Generalized Gaussian distribution, EM Algorithm, ML Estimation.

I. INTRODUCTION

Digital image processing, the manipulation of images by computer, is relatively recent development in terms of man's ancient fascination with visual stimuli. In its short history, it has been applied to practically every type of images with varying degree of success. The inherent subjective appeal of pictorial displays attracts perhaps a disproportionate amount of attention from the scientists and also from the layman. Digital image processing like other glamour fields, suffers from myths, mis-connect ions, mis-understandings and mis-information. It is vast umbrella under which fall diverse aspect of optics, electronics, mathematics, photography graphics and computer technology. It is truly multidisciplinary endeavor ploughed with imprecise jargon.

Several factor combine to indicate a lively future for digital image processing. A major factor is the declining cost of computer equipment. Several new technological trends promise to further promote digital image processing. These include parallel processing mode practical by low cost microprocessors, and the use of charge coupled devices (CCDs) for digitizing, storage during processing and display and large low cost of image storage arrays.

An image is a two-dimensional picture, which has a similar appearance to some subject usually a physical object or a person. Image is a two-dimensional, such as a photograph, screen display, and as well as a three-

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dimensional, such as a statue. They may be captured by optical devices—such as cameras, mirrors, lenses, telescopes, microscopes, etc. and natural objects and phenomena, such as the human eye or water surfaces.

The word image is also used in the broader sense of any two-dimensional figure such as a map, a graph, a pie chart, or an abstract painting. In this wider sense, images can also be rendered manually, such as by drawing, painting, carving, rendered automatically by printing or computer graphics technology, or developed by a combination of methods, especially in a pseudo-photograph.

II. FUNDAMENTAL STEPS IN DIGITAL IMAGE PROCESSING

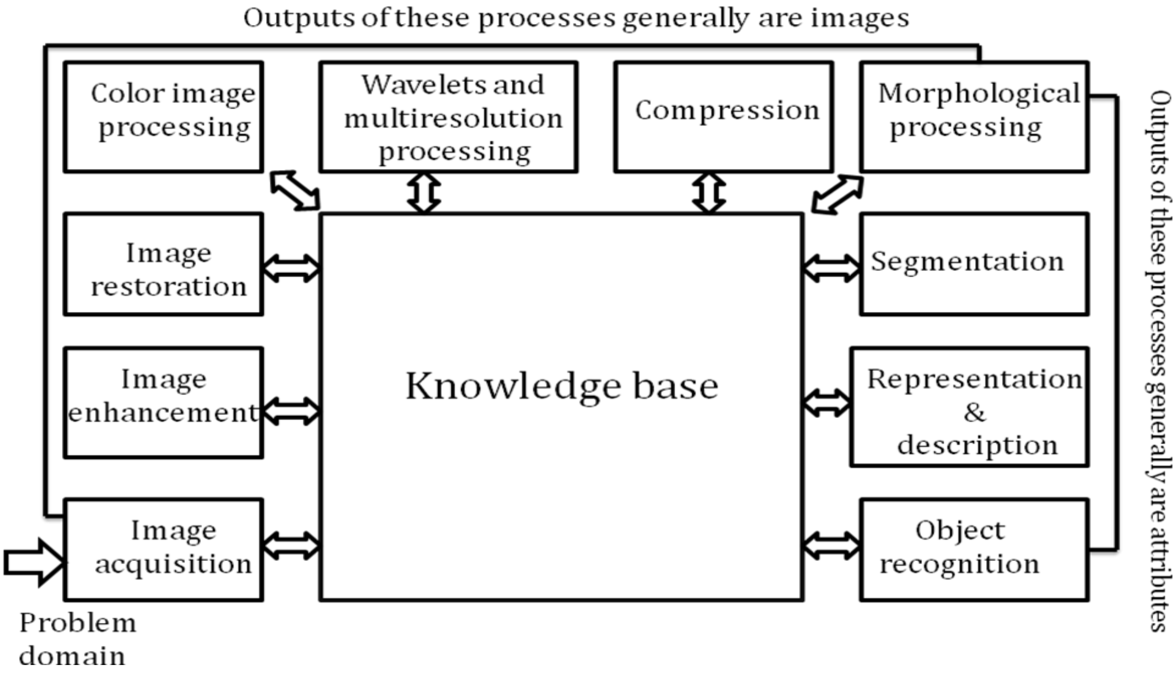

Fig: 1 Fundamental Steps in Digital Image Processing

2.1 Image Acquisition

Image Acquisition is to acquire a digital image. To do so requires an image sensor and the capability to digitize the signal produced by the sensor. The sensor could be monochrome or color TV camera that produces an entire image of the problem domain every 1/30 sec. the image sensor could also be line scan camera that produces a single image line at a time. In this case, the objects motion past the line.

Scanner produces a two-dimensional image. If the output of the camera or other imaging sensor is not in digital form, an analog to digital converter digitizes it. The nature of the sensor and the image it produces are determined by the application.

2.2 Image Enhancement

Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interesting an image. A familiar example of enhancement is when we increase the contrast of an image because "it looks better." It is important to keep in mind that enhancement is a very subjective area of image processing.

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Fig: 2 Image Enhancement

2.3 Image Restoration

Image restoration is an area that also deals with improving the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to be based on mathematical or probabilistic models of image degradation.

Fig: 3 Image Enhancements

Enhancement, on the other hand, is based on human subjective preferences regarding what constitutes a “good” enhancement result. For example, contrast stretching is considered an enhancement technique because it is based primarily on the pleasing aspects it might present to the viewer, where as removal of image blur by applying a deblurring function is considered a restoration technique.

III. WAVELETS AND MULTI-RESOLUTION PROCESSING

Wavelets are the formation for representing images in various degrees of resolution. Although the Fourier transform has been the mainstay of transform based image processing since the late1950’s, a more recent transformation, called the wavelet transform, and is now making it even easier to compress, transmit, and analyze many images. Unlike the Fourier transform, whose basis functions are sinusoids, wavelet transforms are based on small values, called Wavelets, of varying frequency and limited duration.

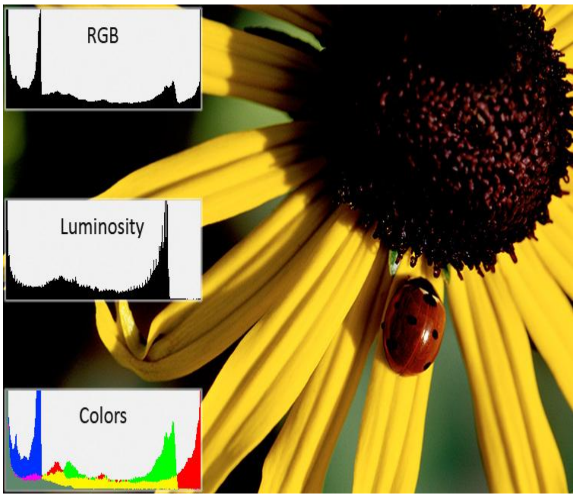

Fig: 4 Multi Resolution Image

Wavelets were first shown to be the foundation of a powerful new approach to signal processing and analysis called **Multi-resolution** theory. Multiresolution theory incorporates and unifies techniques from a variety of disciplines, including sub band coding from signal processing, quadrature mirror filtering from digital speech recognition, and pyramidal image processing. We proposed Automatic Image Segmentation using Wavelets (AISWT) to make segmentation fast and simpler.

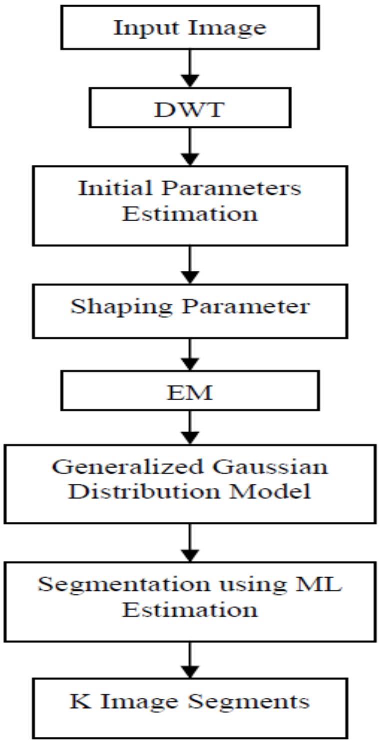

Fig: 5 Block Diagram of AISWT

3.1 Segmentation

Segmentation procedures partition an image into its constituent parts or objects. In general, autonomous segmentation is one of the most difficult tasks in digital image processing. A rugged segmentation procedure brings the process a long way toward successful solution of imaging problems that require objects to be identified individually.

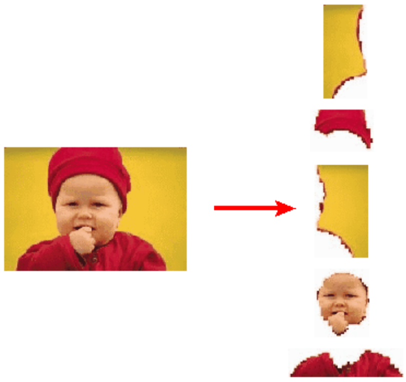

Fig: 6 Image Segmentation

On the other hand, weak or erratic segmentation algorithms almost always guarantee eventual failure. In general, the more accurate the segmentation, the more likely recognition is to succeed.

3.2 Representation and Description

Representation and description almost always follow the output of a segmentation stage, which usually is raw pixel data, constituting either the boundary of a region (i.e., the set of pixels separating one image region from another) or all the points in the region itself. In either case, converting the data to a form suitable for computer processing is necessary. The first decision that must be made is whether the data should be represented as a boundary or as a complete region. Boundary representation is appropriate when the focus is on external shape characteristics, such as corners and inflections.

Regional representation is appropriate when the focus is on internal properties, such as texture or skeletal shape. In some applications, these representations complement each other. Choosing a representation is only part of the solution for transforming raw data into a form suitable for subsequent computer processing. A method must also be specified for describing the data so that features of interest are highlighted. Description, also called feature selection, deals with extracting attributes that result in some quantitative information of interest or are basic for differentiating one class of objects from another.

IV. RESULT

In this mainly we used Expectation and Maximization Algorithm, The EM algorithm is an efficient iterative procedure to compute the ML estimate in the presence of missing or hidden data. For obtaining the EM algorithm a sample of the coefficients *z1, z2... zn*, are drawn with PDF $f(z, \theta)$ given in Equation (1) where θ is set of initial parameters

$$i.e., \theta = (\alpha, \mu, \sigma^2, P). \quad \text{.....................} \quad (1)$$

4.1 Steps of AISWT Algorithm

- Input: Image of variable Size
- Output : Segmented Regions

1. DWT is applied on an image and approximation band is considered.
2. Histogram Based method is applied to obtain initial parameters like mean, variance, and maximization

Parameter.

3. Shaping parameter P is determined

4. Expectation and Maximization algorithm is used to get updated final parameters

5. PDF of Generalized Gaussian Distribution is Determined.

6. Segmentation is obtained Using Maximum-Likelihood Estimation.

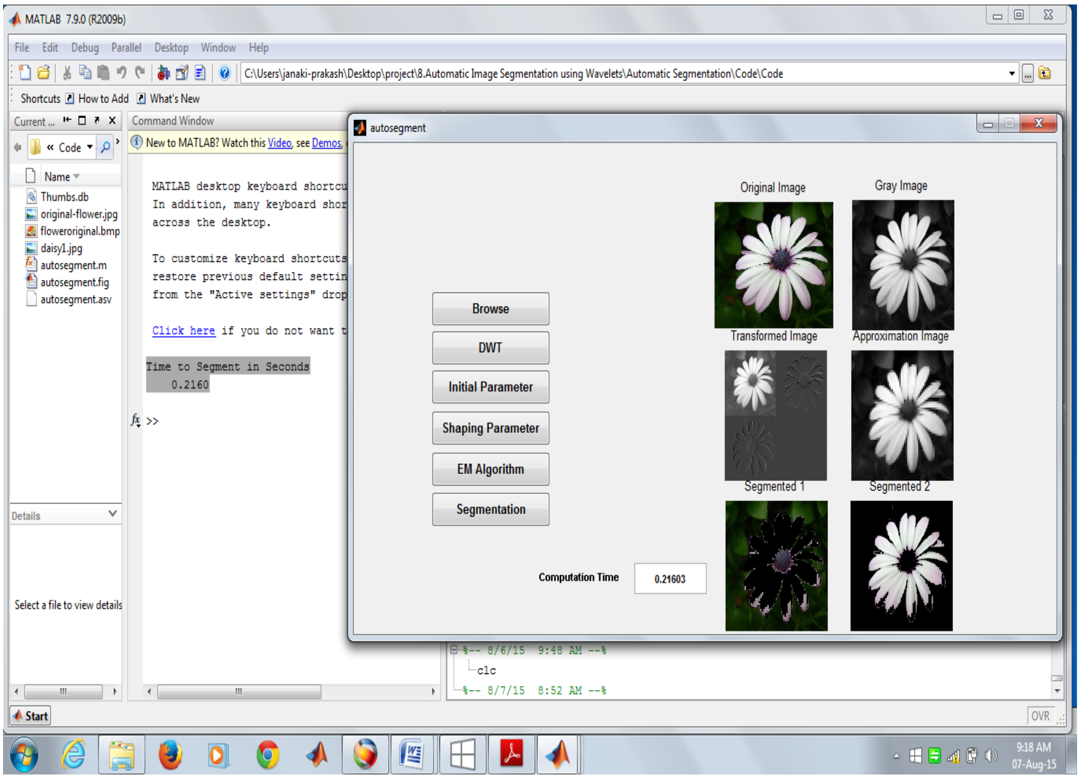

Fig: 7 Result of Image Segmentation Computed time is 0.2160 Sec

V. CONCLUSION

In this paper, we proposed fast segmentation algorithm AISWT. The approximation band of an image DWT is considered as a mixture of K-Component GGD. The initial parameters are estimated using Histogram based method. Through EM algorithm, the final parameters are obtained. The segmentation is done by ML estimation. The AISWT algorithm is computationally efficient for segmentation of large images and performs much superior to the earlier image segmentation methods FGM and FGGD in terms of computation time and image quality index.

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