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Types of Segmentation – A Comparative Study

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Abstract - **Image segmentation has evolved into key areas of Image processing. This is largely due to its capability of ably assisting object identification and additionalscrutiny. The issue at hand is that there are a multitude of algorithms that venture to segment images in more sensible ways. But the bridging process to automatisation of object recognition is still at stake. So by a comparative study it would be facile to facilitate the better perception of the profound positive factors of each method. Some of the major techniques are taken for study and a profound inquiry is made on each of its intricacies. This will no doubt contribute valuable points that may impel the research further.**

Key wards — **Discontinuity, Similarity, Spatial masks, Gray levels, Topological gradient, Annealing**

I. INTRODUCTION

As an ancient proverb goes, an image is worth a thousand words. So the significance of images is well known. They are the carriers of information that needs to be ably extracted from the images. This process is indeed of high utility in a vast range of applications from medical imaging to satellite pictures. And object segmentation is the most important stage of this analysis. The following paper primarily deals with the comparison of some of the common methods that are available at present. By this work a sensible conclusion is drawn out in pertinence to the efficient and effective image segmentation.

II. IMAGE SEGMENTATION:

Image segmentation is the procedure of splitting up of the image into constituent regions. This process is done to enable better object recognition and analysis. This is the process which renders the examination of medical images efficient and ensures better interpretation. Its application is not simply restricted to medicine but it is being incorporated into a vast range of applications such as satellite imaging [1]. The image segmentation techniques that are put to study are

- Edge based segmentation
- Watershed segmentation
- Model based segmentation

III. EDGE BASED SEGMENTATION:

This is one of the common methods of segmentation of incorporating the discontinuity method. In this method, the detected edges of the image are assumed to represent object boundaries, used to identify the objects. There are various methods to perform edge detection. Edge region are traced by identifying the pixel value and compare it to neighbourpixel [6]. Edges are local change in image intensity. Edges typically occur in the bound between two regions [6]. Important techniques can be extracted from the edge from the image. Edge detection is an important feature of image analysis. This is highly applicable to higher level computer vision algorithms. Also highly applicable for object detection and image variety and application like medical image processing and biometrics [2]. Three different types of discontinuities are point, line and edge. Spatial masks are used to detect discontinuity.

IV. TYPES OF EDGE DETECTION:

- Gradient
- Log
- Canny
- Sobel
- Laplacian

V. CANNY EDGE DETECTION:

Of all the deflection, the interest of the study is restricted to Canny edge detector. It is the process of using the canny operator to find first order derivative [5]. This operator is established to the superior edge detection operator. This determines the strong and weak edge of canny edge detection. Image is first smoothened by employing bi-dimensional Gaussian's function, computing the gradient of the result and using that

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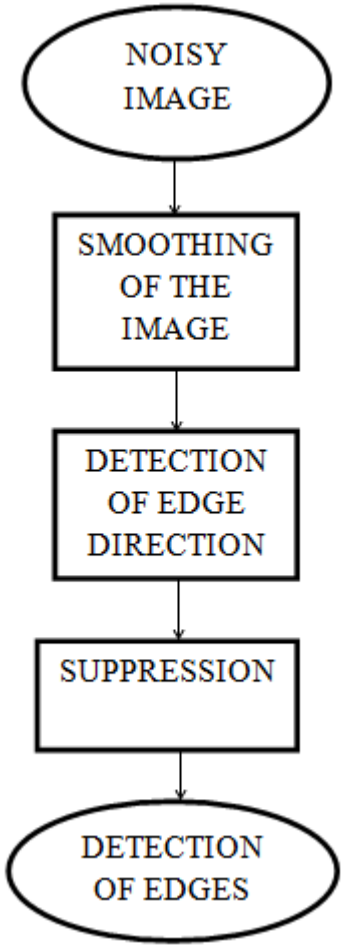
gradient magnitude and direction to get nearly equal, the value edge strength and direction at every point [4]. There the technique of double threshold is used to reduce the false segments.

Algorithm for Canny edge detector:

Step 1: Make smooth the surface of the image by using Gaussian convolution to reduce the effect of noise. [3]
Step 2: Detect the edge strength and edge direction
Step 3: Utilise the edge directions information for non-maximal suppression; to be precise, the pixels that are not related to the edges are not detected and then minimized.
Step 4: Remove the broken edges i.e. the threshold values of the image are calculated and then the pixel value is analysed by means of comparison with the threshold of the object.
Step 5: If the pixel value is higher than threshold then it is an edge [3].

FLOW CHART



Advantages:

- Used to calculate number of different objects present in a single image.

Disadvantages:

- Edges obtained are not continuous.

WATERSHED BASED SEGMENTATION:

This is rather an interesting area of region based segmentation methods. The ideology of watersheds and catchment basins is a familiar term in pertinence to Geography especially topography [6]. This concept has being productively put to practice to segment images.
The watersheds and the catchment basins are analogous to the edges and interiors of the image respectively [6] [7].

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The Altitude parameter corresponds to the gray levels of the image. The concept of watershed may be quite explicit but its implementation is quite complicated.The method that is adopted to perform watershed segmentation is watershed transformation.

***Watershed transformation*:**

This was the method successfully brought to existence by the algorithms enunciated by Luc Vincent and Pierre Soille [7].

The method takes into account the concept of immersion. According to this, each local minima is having a depression which is likely to be immersed into water. Thus proceeding from the point of lowest intensity, water fills the various catchment areas. Then a theoretical dam is built by the algorithm which separates the catchments into distinct zones. Thus merging of various zones is prevented [6].

The most common methods of implementation of watershed transformation are 1) Topological Gradient method 2) Marker controlled approach.

1) ***Topological Gradient method*:** In this method, the gray scale image is pre-processed prior to watershed transformation. The high pixel values correspond to edges and low pixel values to the regions elsewhere. This method significantly reduces the issue of unwanted contours [7] due to the noise added. The major setback of this approach is the over segmentation problem.

2) ***Marker controlled approach:*** The approach which is used to curb over segmentation is the marker controlled approach [6]. A marker is a connected region that belongs to an image. These markers are employed to alter the gradient image.

Markers may be bifurcated into internal and external.Internal markers correspond to the object and the external markers relate to boundaries. This is best suited to closed contours where the boundaries are related to ridges. [3]. After the segmentation is over the boundaries of the watershed regions are placed over the desired ridges. This act as a separation for each object from its neighbours.

Thus the problem of over segmentation is overcome by the marker controlled fashion.

Applications:

Owing to the capability to ably segment low contrast images, it is of high applicability [7].
It is used to segment high resolution images like remote sensing images.

VI. MODEL BASED SEGMENTATION:

Model based segmentation is the method of using the concept of unsupervised segmentation [8].
Unsupervised segmentation is the process of identifying and locating the interior regions of an image without the possession of any prior knowledge of the regions. Another perspective of the need for moving towards a model is that the real images are homogeneous. The neighboring pixels have similar properties. Therefore modeling becomes an essentiality to deal with such scenarios. The most dexterous model being employed is the Markov Random Field model [3].

Markov Random Field model:

It is a probabilistic model which solves the contextual constraints like intensity, colour, texture, etc…
It is widely used for restoration of images, detection of edges, stereovision etc. It forms the probabilistic model for a set of variables that interact on a lattice structure. The distribution for a single variable at a particular site is conditioned on a lattice structure.

Steps Involved in this model:

- Feature extraction The colour and texture is extracted from input image.
- MRF segment model It involves the labelling process, image process and posterior energy process.
- Parameter extraction This primarily involves Gaussian mixture identification.

MRF processes:
***Global processes*:**

- ***Step 1:*** grab the image.

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- ***Step 2***: check the stopping condition.
- ***Step 3***: save or transfer image.
- ***Step 4***: compute image statistics.
- ***Step 5***: simulate annealing process control.

Local processes:

- ***Step 1***: Compare neighbourhood labelling.
- ***Step 2:*** Calculate local energy.
- ***Step 3***: Take label decision.

COMPARISON OF THE VARIOUS METHODS:

METHOD	ORIGINAL IMAGE	PROCESSED IMAGE
CANNY EDGE DETECTION	 (256x256)	 (256x256)
WATERSHED SEGMENTA -ION	 (256x256)	 (256x256)
MARKOV RANDOM FIELDS	 (256x256)	 (256x256)

VII. CONCLUSION:

Image processing is blessed with such a promising scope and wide research on this arena is on. Technology seems to rejuvenate itself day by day. But a single generalized segmentation method which suits all types of images is still elusive. Each method renders itself apt for certain images and may prove less efficient in cases of others. Thus it would be safe to conclude that the current methods are highly context specific and the research strives forward to find a single versatile method or a conglomeration of methods which may be global in approach.

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