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Object Shape Recognition in 2-D images with various approaches.

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ABSTRACT

All the edges in the images are characterized by its boundries and its basically a big hurdle in the case of fundamental importance in image processing.The concept of edge detection is completely used for the reduction in the size of the data and to remove the unwanted information and also protecting the vital structural aspects in that image.Edge detection is a very crucial part as it is used in the process of recognition of objects during analysis of an image.Edge detection has been used with the algorithm propose by John canny i.e Canny Edge Detection method which has used the Robert,LOG(laplacian of Guassian).Prewith that ultimately improves the performance of the system.This has been reviewed that Laplacian of Guassian and others like Robert's operator,prewitt,sobel etc are cheaper than the Canny edge Detection Technique.

Index Terms- Canny Edge Detection.Image Processing, Morphological algorithm, Object Shape Recognition.

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I. INTRODUCTION

Object recognition is a process for identifying a specific object in a digital image or video. Object recognition algorithms are based on learning,matching or pattern recognition algorithms using appearance-based or feature-based techniques. Common techniques include edges, gradients, Histogram of Oriented Gradients (HOG), Haar wavelets, and linear binary patterns. Object recognition is useful in applications such as video stabilization, automated vehicle parking systems.

The objects will be recognized using a variety of models, including Extracted features and boosted learning algorithms, Bag-of-words models with features such as SURF and MSER, Gradient-based and derivative-based matching approaches, Viola-Jones algorithm, Template

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matching, Image segmentation and blob analysis.After recognizing the objects, there shapes are being matched with the reference images.

Shape matching is a central problem in visual information systems,computer vision, pattern recognition and robotics. Applications of shape matching include industrial inspection, medical sciences, finger print matching and content based image retrieval.Matching deals with transforming a pattern, and measuring the resemblance with another pattern using some dissimilarity measure. Pattern matching and shape matching are commonly used interchangeably. However, more formally, the shape of a pattern is the pattern under all transformations in a transformation group. The matching problem is studied in various forms: 1.Computation problem: compute dissimilarity between the two patterns. 2.Decision Problem: Decide whether the dissimilarity between two patterns is smaller then the threshold and also decide whether there exists a transformation such that the dissimilarity between the transformed pattern and the other pattern is smaller than the threshold. 3.Optimization Problem: Find the transformation that minimizes the dissimilarity between the transformed pattern and the other pattern[1]. A theory of edge detection is presented. The analysis proceeds in two parts. (1) Intensity changes, which occur in a natural image over a wide range of scales, are detected separately at different scales. (2) Intensity changes in images arise from surface discontinuities or from reflectance or illumination boundaries, and these all have the property that they are spatially localized[2].The purpose of edge detection in general is to significantly reduce the amount of data in an image, while preserving the structural properties to be used for further image processing. Several algorithms exists, and this research paper focuses on a particular one developed by John F. Canny (JFC) in 1986.Even though it is quite old, it has become one of the standard edge detection methods and it is still used in research.

Mathematical Morphology edge detection methods use single and symmetrical structure elements. But they are difficult to detect complex edge feature, because they are only sensitive to image edge which has the same direction of structure elements. Mathematical Morphology is a powerful tool for dealing with various problems in image processing and computer vision. It was introduced as a technique for analyzing geometric structure of metallic and geologic samples. It was extended to image analysis.Mathematical morphology is a very important theory, whose operation must be defined by set arithmetic. Therefore, the image which will be processed by mathematical morphology theory must been changed into set. Mathematical morphology is composed by a series of morphological algebraic arithmetic operators. The basic morphological operations, namely erosion, dilation, opening, closing etc. are used for detecting, modifying, [3]

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To overcome all the problems encounter in morphological edge Detection,the Canny Edge Detection Technique for 2-D geometric shape recognition is adopted.

This paper is described as follows: First, a review on the work done already in this area is mentioned. Then, the methodology is explained.After that a clear description of all the techniques used in the proposed approach are mentioned.Then, there comes to the future work which is yet to be done.

II. LITERATURE REVIEW

In this section,the various research conducted in this field is discussed

Michael S.Lew[1], the author proposed that texture is the term used to categorize the surface of a given object or phenemona and it is undoubtedly one of the main feature used in image processing and pattern recognition.In an image,texture is one of the visual charactersitics that identies the segment as belonging to a certain class.There many parts of objects by texture rather than by shape.If the texture belongs to a class that has a particular interpretation than it may be regarded as a natural texture.On the other hand a texture may belong to class identified by artificial visual characteristics that have a consice mathematical interpretation.

D.Marr et al[2], the authors proposed that A theory of edge detection is presented. The analysis proceeds in two parts. (1) Intensity changes, which occur in a natural image over a wide range of scales, are detected separately at different scales. An appropriate filter for this purpose at a given scale is found to be the second derivative of a Gaussian, and it is shown that, provided some simple conditions are satisfied, these primary filters need not be orientation-dependent. Thus, intensity changes at a given scale are best detected by finding the zero values of $\nabla ^{2}$G(x, y)* I(x, y) for image I, where G(x, y) is a two-dimensional Gaussian distribution and $\nabla ^{2}$ is the Laplacian. The intensity changes thus discovered in each of the channels are then represented by oriented primitives called zero-crossing segments, and evidence is given that this representation is complete. (2) Intensity changes in images arise from surface discontinuities or from reflectance or illumination boundaries, and these all have the property that they are spatially localized. Because of this, the zero-crossing segments from the different channels are not independent, and rules are deduced for combining them into a description of the image. This description is called the raw primal sketch.

C.Naga Rajuet al[3],the author proposed that Edge detection is one of the important pre-processing steps in image analysis. Edges characterize boundaries and edge detection is one of the most difficult tasks in image processing hence it is a problem of fundamental importance in image processing. Edges in images are areas with strong intensity contrasts and a jump in intensity from

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one pixel to the next can create major variation in the picture quality. Edge detection of an image significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. Conventionally, mathematical morphology edge detection methods use single and symmetrical structure elements. But they are difficult to detect complex edge feature, because they are only sensitive to image edge which has the same direction of structure elements. This paper proposed a novel edge detection algorithm based on multi-structure elements morphology of eight different directions. The eight different edge detection results are obtained by using morphological gradient algorithm respectively, and final edge results are obtained by using synthetic weighted method. The experimental results showed that the proposed algorithm is more efficient for edge detection than conventional mathematical morphological edge detection algorithms and differential edge detection operators.

Sanket Reige et al[4],the authors described that approach involving digital image processing and geometric logic for recognition of two dimensional shapes of objects such as squares, circles, rectangles and triangles as well as the color of the object. This approach can be extended to applications like robotic vision and computer intelligence. The methods involved are three dimensional RGB image to two dimensional black and white image conversion, color pixel classification for object-background separation, area based filtering and use of bounding box and its properties for calculating object metrics. The object metrics are compared with predetermined values that are characteristic of a particular object's shape. The recognition of the shape of the objects is made invariant to their rotation. Further, the colors of the objects are recognized by analyzing RGB information of all pixels within each object. The algorithm was developed and simulated using MATLAB. A set of 180 images of the four basic 2D geometric shapes and the three primary colors (red, green and blue) were used for analysis and the results were 99% accurate.

Bao.P et al[5], the author proposed that the technique of scale multiplication is analyzed in the framework of Canny edge detection. A scale multiplication function is defined as the product of the responses of the detection filter at two scales. Edge maps are constructed as the local maxima by thresholding the scale multiplication results. The detection and localization criteria of the scale multiplication are derived. At a small loss in the detection criterion, the localization criterion can be much improved by scale multiplication. The product of the two criteria for scale multiplication is greater than that for a single scale, which leads to better edge detection performance. Experimental results are presented.

Shalinee Patil et al[6], the author proposed that the Basic 2D Object Detection refers to identify a location that identify and register components of a particular object class at various levels of

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detail Image Processing Algorithms are the basis for Image Computer Analysis and Machine Vision The goal of Basic 2D Object Detection system is to identify the basic geometric shape of objects present in image. It uses some Image Processing algorithms and techniques to detect objects from the image and compare it with the properties of basic geometric shapes to classify that which object is similar to which particular geometric shape like circle, triangle, square and rectangle. The detection of edges of objects from an image is done by using Edge Detection technique After detecting edges of objects it recognizes the objects, having basic geometric shape. The Edge Detection of object is done by using Canny Edge Detection technique. After that detected objects are labeled as a region. And then, region properties are applied to each region to identify and recognize the shape of that region.

III. Basic Theory

A. Pre-Processing

The image before it is actually processed needs pre-processing.

- The image taken from a camera includes noise which introduces some distortions in the image which is needed to be eliminated; so we use some filtering techniques like low-pass filtering for Gaussian noise, median filtering for salt-pepper noise, notch filtering for periodic noise etc.
- The next step is to convert the RGB image to gray scale image; after that the gray scale image is converted to binary image by use of thresholding technique.

The process of converting of gray scale to binary image is also important as it depends upon the application i.e. which type of image is being converted to binary; whether it only a certain amount of pixels which are higher gray level to be segmented or a significant amount of pixels which are high gray levels but with variable intensity in different areas of the image.

B. Edge Detection

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. The same problem of finding discontinuities in 1D signals is known as step detection and the problem of finding signal discontinuities over time is known as change detection. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction.

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C. Canny Edge Detection

Canny Edge Detection Technique was named after a scientist name'JOHN CANNY'.John Canny considered the mathematical problem of deriving an optimal smoothing filter given the criteria of detection, localization and minimizing multiple responses to a single edge. He showed that the optimal filter given these assumptions is a sum of four exponential terms. He also showed that this filter can be well approximated by first-order derivatives of Gaussians. Canny also introduced the notion of non-maximum suppression, which means that given the presmoothing filters, edge points are defined as points where the gradient magnitude assumes a local maximum in the gradient direction. Looking for the zero crossing of the 2nd derivative along the gradient direction was first proposed by Haralick It took less than two decades to find a modern geometric variational meaning for that operator that links it to the Marr–Hildreth (zero crossing of the Laplacian) edge detector.

Canny edge detection algorithm is also known as the optimal edge detector. Canny's intentions were to enhance the many edge detectors in the image. 1. The first criterion should have low error rate and filter out unwanted information while the useful information preserve. 2. The second criterion is to keep the lower variation as possible between the original image and the processed image. 3. Third criterion removes multiple responses to an edge.

Based on these criteria, the canny edge detector first smoothes the image to eliminate noise. It then finds the image gradient to highlight regions with high spatial derivatives. The algorithm then tracks along these regions and suppresses any pixel that is not at the maximum using non-maximum suppression. The gradient array is now further reduced by hysteresis to remove streaking and thinning the edges.

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IV. FUTURE SCOPE

In this paper, an approach for recognizing the shapes of objects with the help of canny edge detection technique. The identification of objects within an image can be a very difficult task. One way to simplify the problem is to change the grayscale image into abinaryimage, in which each pixel is restricted to a value of either 0 or 1. The techniques used on these binary images go by such names as: blob analysis, connectivity analysis, and morphological image processing(from the Greek word morphē, meaning shape or form). The foundation of morphological processing is in the mathematically rigorous field of set theory; however, this level of sophistication is seldom needed. Most morphological algorithms are simple logic operations and very ad hoc.

In future**,** the surveyed techniques can be utilized for efficient image edge detection and shape recognition process that will enhance the efficiency and accuracy of the work.

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