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L*A*B Based Canny Used For Edge Detection

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Abstract: Image edge is the most basic feature of image. The edge is the set of pixels which has step change in pixel gray value. Image edge reflects most of the image information. Therefore, edge detection is an important part of image processing. The review has shown that the still much improvements can be done in the edge detection. Most of the classical edge detection methods take operation on the neighbor region pixels, and obtain the gradient with templates approximation, such as Robert, Sobel, and Prewitt, which are relatively simple and easy to implement, and have good real-time performance, but these operators are sensitive to noise, poor anti-interference performance. In order to overcome the limitations of the earlier work a new approach has been proposed for color images using L*A*B color model, color gradients, particle swarm optimization based improved canny edge detector i.e. L*A*B based Canny. The L*A*B color space has ability to efficiently reflect the difference in human eye and color sensation. Color based edge detection has 10 % more potential edges than the gray one. The particle swarm optimization based edge detection can successfully reduce the poor speed issue with ant colony optimization. The color based gradients has the ability to remove the effect of the false edges while preserving the potential edges.

Keywords: Pixels; Detection; Particle swarm optimization; canny edge detector; Gradient.

I. INTRODUCTION

An Image is a photo that has been made or replicated and put away in electronic structure. A picture can be portrayed regarding vector representation or raster illustrations. A picture put away in raster structure is some of the time called a bitmap.[1] The utilization of advanced PCs are made to prepare the picture. A digitizer scanner is utilized to change over a picture into advanced structure.

It is characterized as directing arithmetical depiction of articles to a progression of uses keeping in mind the end goal to get a fancied result. It begins with one picture and process changed adaptation of the same. The stage computerized picture preparing comprehensively alludes to refinement of a two - dimensional picture by an advanced PC. An advanced picture is depicted as a variety of genuine of genuine numbers by limited quantities of bits. The ethic preferred standpoint of advanced picture handling technique is its flexibility, respectable and the first safeguarding of information exactness.

The varying picture preparing procedures are:-

- Image representation
- Image analysis
- Image per-processing
- Image enhancement
- Image restoration
- Image reconstruction
- Image data compression[2]

A. Applications of Digital Image Processing

The human brain interpret, process and perceive the visual information most widely. One third of the human cortical area of brain is dedicated to visual information processing. Digital image processing, is a computer supported technology that performs various operations like automatic processing, interpretation and manipulation of visual information. Also in our daily life it plays an increasingly important role as well as in a wide variety of discipline and fields in science and technology, with its applications such as photography, television, robotics, medical field, remote sensing and industrial inspection.

• Medical field

One of the major application of digital processing techniques is in the medical area. As in CT scan images of brain are formed by using the CT scan machines. The processed images help to determine the location of the tumor. Another example of medical field comes under mammogram image which helps to detect the presence of cancerous tissues. Therefore image processing techniques in the medical field is helpful to detect the formation of cancers.

• Remote sensing

The remote sensing application makes it is easy to find the information which are present in the image. Different color codings are used for the indicating different regions, in remote sensing image and aerial image which is taken from satellite. Another application of remote sensing is it is used for terrain mapping .Terrain mapping of a hilly region is not accessible easily. These images are processed to locate 3D terrain maps.

• Weather forecasting

Image processing technique is used in weather forecasting. In TV news the weather forecasting is given where on a map some images are overlapped that indicates that where

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is the cloud formation taking place and many more information.

• Astronomy
Astronomy uses the process of digital image processing for focusing on particular cases such as star formation process, capturing various images of galaxy etc.

II. IMAGE SEGMENTATION

Picture division is a basic step in picture examination. Division separates a photo into its fragment parts or inquiries. The level to which the segment is passed on depends on upon the issue being understood. Right when the objects of eagerness for an application have been hard to achieve the division must stop. Division counts for pictures all around in perspective of the irregularity and closeness of picture force values. Discontinuity procedure is to allocate picture in light of unforeseen changes in force and likeness relies on upon allotting a photo into areas that are relative according to a game plan of predefined criteria. In this way the choice of picture division framework is depends on upon the issue being considered. Edge disclosure is a bit of picture division. The reasonability of various picture taking care of furthermore PC vision errands depends on upon the faultlessness of perceiving vital edges. It is one of the procedures for recognizing power discontinuities in a propelled picture.

A. Edge detection techniques
The edge presentation of an image somewhat reduces the quantity of data to be processed. In a scene it helps to retain essential information regarding the shapes of objects. This simplification of an image is easy to integrate into large amount of object recognition algorithms used over computer vision. The important feature of edge detection technique is its competence to extract the exact edge line with good orientation as well as more information about edge detection has been available in the past three decades.
The rudimentary instrument of picture division is edge location. The advantages of edge recognition techniques is it changes the first pictures into edge pictures to roll out improvements in dark tones of the pictures. It is a fundamental procedure , distinguishes and layouts of an item and limits among articles and the foundation in the picture. Edge identification is a standout amongst the most widely recognized methodology for identifying critical discontinuities inside different force values.

Picture force changes with neighbor hood changes in the edges. Edges essentially happens on the more extensive inside two areas. Picture investigation is likewise one of the essential component of edge discovery. Propelled PC vision utilizes these components as a part of calculations. Edge identification is a dynamic range of investigation as it encourages more prominent level picture examination. The discontinuities are arranged into three classes in dark level like point, line and edges...++++++++++

There are many edge detection methods in the information for image segmentation. Some commonly used discontinuity based edge detection techniques are reviewed below such as Roberts edge detection, Sobel edge detection, Prewitt edge detection, and many more.

III. RELATED WORK

Y Zhao, et al (2006) [5] Edge detection is an important pre-processing step in image analysis. Conventionally, mathematical morphology edge detection ways use single and symmetrical structure parts. however they're difficult to find complicated edge feature, as a result of they're solely sensitive to image edge that has an equivalent direction of structure parts. This paper projected a completely unique edge detection rule supported multi-structure parts morphology of eight totally different directions. we tend to got eight totally different edge detection results by using morphological gradient rule severally, and final edge result was got by using artificial weighted technique.
W Gao, et al. (2010) [6] This paper proposes a technique which mixes Sobel edge detection operator and soft-threshold ripple de-noising to do edge detection on pictures that embody White Gaussian noises. In recent years, lots of edge detection ways are projected. The usually used ways that combine mean de-noising and Sobel operator or median filtering and Sobel operator can't take away salt and pepper noise alright. during this paper, we tend to first use soft-threshold wavelet to get rid of noise, then use Sobel edge detection operator to try to to edge detection on the image. This technique is especially used on the pictures which has White Gaussian noises.
JF Canny (1983) [4] The problem of detection intensity changes in pictures is canonical in vision. Edge detection operators are usually designed to optimally estimate initial or second by-product over some (usually small) support. alternative criteria like signaling to noise ratio or bandwidth have additionallys been argued for. This is a trial to formulate a collection of edge detection criteria that capture as directly as attainable the desirable properties of an edge operator. Variational techniques are used to realize an answer over the area of all linear shift invariant operators. the primary criterion is that the detector have low chance of error i.e. failing to mark edges or incorrectly marking non-edges. The second is that the marked points ought to b The third criterion is that there should be low chance of quite one response to one edge. The technique is employed to search out optimum operators for step edges and for extended impulse profiles (ridges or valleys in 2 dimensions). The extension of the one dimensional operators to 2 dimensions is then mentioned.
V Torre, (1986) [7] Edge detection is the method that tries to characterize the intensity changes within the image in terms of the physical processes that have originated them. A critical, intermediate goal of edge detection is that the detection and characterization of great intensity changes. This paper discusses this a part of the sting detection drawback. To characterize the intensity changes

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derivatives of various types, and probably completely different scales, are needed. Thus, we tend to take into account this a part of edge detection as a problem in numerical differentiation.

Muthukrishnan.R1 et al. (2011) [8] Translation of picture substance is one of the targets in PC vision particularly in picture handling. In this period it has gotten much consciousness of specialists. In picture elucidation the allotment of the picture into article and foundation is a serious stride. Division isolates a picture into its part areas or items. Picture division t needs to fragment the article from the foundation to peruse the picture legitimately and recognize the substance of the picture painstakingly.

IV. PROPOSED ALGORITHM

A. Design Considerations:

A new approach using ant colony optimization and color gradients for color image edge detection is proposed. The methodology is shown in Fig.8. In my methodology input image is checked firstly whether it is color or not?

If Colored: If the image is colored then three operations will be performed on that RGB image. Firstly RGB image is simultaneously converted to HSV image, PCA image and Gray image. We will acquire potential information from these transformations, that is hue (denoted as H in Fig.2), first principal component (denoted as PC in Fig.2) and gray values. Then on these values Image gradients are applied simultaneously to locate sharp variations in intensity or color elements. Subsequent to that Process A is applied on these gradient images. Where process A represents the ant colony optimization algorithm. Then edges of all these three components are fused to form Final Edge Detected Image.

If Not Colored: On this gray image, Image gradient is applied .After that Process A (Ant colony system algorithm) is applied to get edges from the image. Finally we get the Final Edge Detected Image.

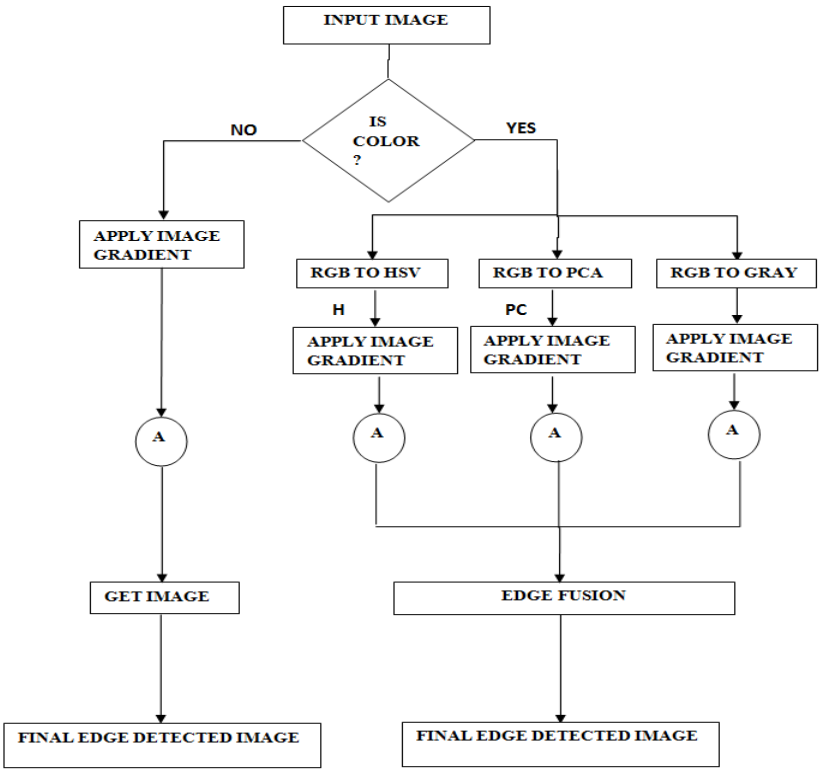

Fig 1: Flow chart of proposed methodology

B. Description of the Proposed Algorithm:

Table.1: Nomenclature for Main Algorithm

S.no.	Symbols	Description
1.	Image	Input Image
2.	RGB2HSV	Converts RGB image to HSV image
3.	RGB2PCA	Converts RGB image to PCA image
4.	RGB2GRAY	Converts RGB image to GRAY image
5.	H	Hue edge detected image
6.	P	PCA edge detected image
7.	G	Gray edge detected image

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Main(image)
Step1.Check whether image is color, if color move to step 5, otherwise move to step 2
Step2. Apply image gradients
Step3.Apply ACO based edge detection algorithm (2)
Step4.Return final image
Step5.Apply RGB2HSV

$$H = \cos^{-1} \frac{(0.5*(R-G)+(R-B))}{\{((R-G)^2+(R-B)(G-B))^{0.5}\}} \quad \text{Eq.1}$$

Step6. Apply image gradients
Step7.Apply ACO based edge detection algorithm (2)
Step8.Return H
Step9.Apply RGB2PCA
A. To change RGB image to PCA image, prime every element of an RGB image should be converted into vector. Then concatenation of all these vectors is done through using following equation

$$v = \text{cat}(2, R, G, B) \quad \text{Eq.2}$$

Where IIV corresponds to the Input Image Vector and cat corresponds for the concatenate function.
B. Then Eigen values are calculated by using principal component function which is specified by following equation

$$ev = \text{princomp}(v) \quad \text{Eq.3}$$

Where VV corresponds to the vector values and princomp is inbuilt function in MATLAB.
C. PCA vector is attained from vector values through using following equation

$$\text{pca\_vector} = ev/(\Sigma(ev) \quad \text{Eq.4}$$

D. At last PCA image is attained from vector representation by using following function

$$\text{pca\_image} = v * \text{pca\_vector} \quad \text{Eq.5}$$

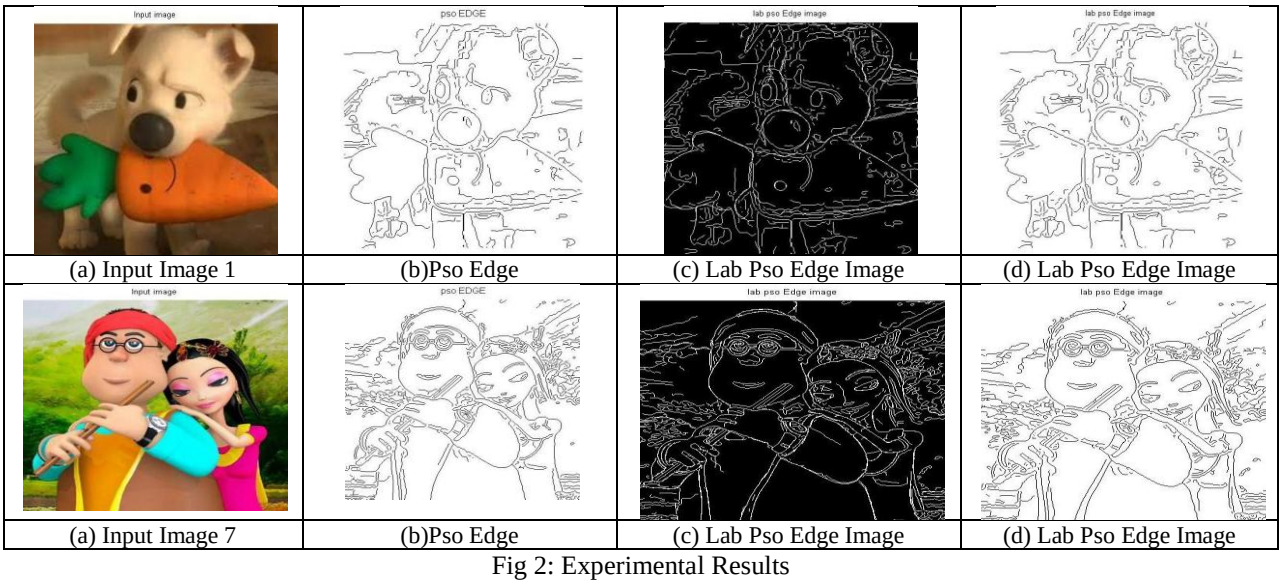
Where pca_image corresponds to the output vector image and v corresponds to the Input Image Vector.
Step10. Apply image gradients
Step11.Apply ACO based edge detection algorithm (2)
Step12.Return P
Step13.Apply RGB2GRAY

$$\text{Gray} = (\max(R, G, B) + \min(R, G, B)) / 2. \quad \text{Eq.6}$$

Step14. Apply image gradients algorithm (3)
Step15.Apply ACO based edge detection algorithm (2)
Step16.Return G
Step 17.Return (H+P+G)
ACO based edge detection algorithm 2:-
Step 1. Initializing the positions of all ant as well as pheromone matrix (the same size as input image).
Step 2. Secondly the construction step comes in which, move the ant K for L steps appropriate to the probability transition matrix.
Step 3. Next comes Updation of the pheromone matrix.
Step 4. Take the binary decision to select, whether there is present an edge or not based on final pheromone matrix.

V. SIMULATION RESULTS

This section shows the experimental results of base technique and proposed technique. In order to overcome the limitations of the earlier work a new approach has been proposed for color images using L*A*B color model, color gradients, particle swarm optimization based improved canny edge detector i.e. L*A*B based Canny. The L*A*B color space has ability to efficiently reflect the difference in human eye and color sensation. Color based edge detection has 10 % more potential edges than the gray one. The particle swarm optimization based edge detection can successfully reduce the poor speed issue with ant colony optimization. The color based gradients has the ability to remove the effect of the false edges while preserving the potential edges.



(a) Input Image 1	(b)Pso Edge	(c) Lab Pso Edge Image	(d) Lab Pso Edge Image
(a) Input Image 7	(b)Pso Edge	(c) Lab Pso Edge Image	(d) Lab Pso Edge Image

Fig 2: Experimental Results

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VI. PERFORMANCE ANALYSIS

A. Mean Square Error

In an image the average different between the pixels is represented as the mean square error (MSE) of image. The greater difference between original and processed images indicates higher MSE.

Therefore, it is essential to be very careful with the edges. Following is the formula for calculating the MSE.

$$Mean\ Sqaure\ Error = \frac{1}{z}\sum_{i}\sum_{j}(A-B)^2$$

Where z is the size of the image, A is the processed image and B is the orignal image.

Table 2: MSE Comparison Table

Input	Existing	Proposed
1	0.0795	0.0478
2	0.0532	0.0265
3	0.0928	0.0435
4	0.0637	0.0329
5	0.0954	0.0389
6	0.1142	0.0688
7	0.0842	0.0654
8	0.0782	0.0781
9	0.0729	0.0679
10	0.0705	0.0885

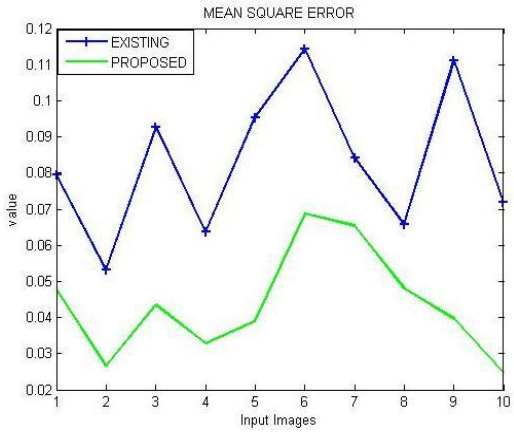

Fig 3: Mean Square Error Graph 1

B. Peak Signal To Noise Ratio

For quantitative comparison we use PSNR. The term peak signal to noise ratio is an benchmark basically used for evaluating performance improvements of new objectives perceptual video quality matrices.

$$PSNR = 10.\log_{10}\frac{MAXE^2}{MSE}$$

Here, Maxe represents to the maximum pixel value of an image. When the pixels uses eight bits per sample, this is 255. Basically when samples are presented using linear PCM with B bits per sample, Maxi is 2B-1.

Table 3: PSNR Comparison Table

Input	Existing	Proposed
1	59.1282	61.3320
2	60.8702	63.8942
3	58.4536	61.7447
4	60.0915	62.9588
5	58.3333	62.2285
6	57.5541	59.7553
7	58.8803	59.9725
8	59.1984	59.2033
9	59.5054	59.8129
10	59.6512	58.6638

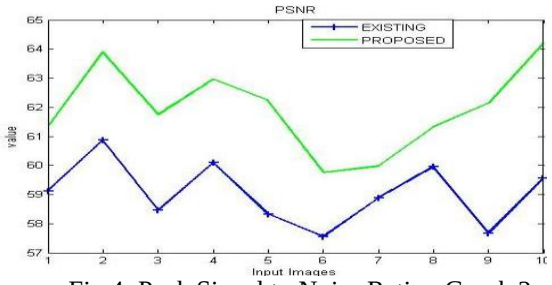

Fig 4: Peak Signal to Noise Ration Graph 2

VII. CONCLUSION

In this paper, we have evaluated the performance of the Color edge detection based on the ant colony optimization. So we propose a new approach for color images using L*A*B color model, color gradients and particle swarm optimization based canny edge detector. Then we evaluate the significant improvement of L*A*B based particle swarm optimization over the existing edge detectors; based upon the following parameters :-Pratt's figure of merit (FOM), Accuracy, F-measure, Peak signal to noise ratio, Mean square error etc.

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