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A Hybrid Approach of Ant Colony Optimization Technique to Detect Edges of an Image

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ABSTRACT

An edge is a collection of linked pixels lying between boundaries of two regions. It is a local concept but the boundary of an edge is a universal concept. An ideal edge is a group of pixels located at an orthogonal step transition in gray level. Blurry edges are also acquired by the factors like problems or imperfections happened at the time of optics, sampling and image acquisition systems etc. So, edges can be closely seen as having a profile as that of ramp-like profile. Ant colony optimization is an algorithm which is inspired by the natural foraging behavior and activities of ants. ACO is mainly introduced here to tackle the image edge detection problem. The proposed approach generates a matrix, called as pheromone matrix that represents the edge information which is stored at each pixel according to the movement of ants. The movements of these ants can be determined by local changes in the intensity value of pixel.

Keywords : Hybrid Approach, Image, ACO, Edge Detection

I. INTRODUCTION

Image Edge detection is principal digital image processing technique that deals with finding the edges that show unexpected changes in image intensities [5]. It has wide range of applications in analysis of images and machine visualization techniques. It is beneficial in recovering information of shape, structure & other important characteristics of image [7]. In this process mainly aims to classify pixels in image where discontinuities occur in image intensities. These pixels are called edges. Edges can be defined as the pixels connected together in between two boundaries. Edges are defined in binary images as black pixels with regard to white [2]. Edge is confined concept but boundary is overall approach. Edge is group of pixels situated in quadrate step progress in gray level. Edges can be classified into blurry edge and sharp edge.

Existing Technologies for Edge Detection

Edge detection mainly deals with identifying the places where intensities are changing rapidly.

These places can be detected using either

1. search-based
2. zero-crossing based

Search-based methods deal with locating places 1st derivative of intensity is greater than described threshold & Zero Crossing Methods deals with locating places where 2nd derivative of intensity has zero crossing. Based on these methods various techniques & algorithm like Sobel, Canny, Laplacian, Gaussian & more are developed [4].

Problems in Existing Techniques

In spite of simplicity, low computational cost & basic few quality parameters, they have following problems [6]

- They require high-quality data as their specification for better extraction.
- Performance of these techniques is dependent on lightening condition &noise. In absence of these dependencies causes failure of methods.
- They are sensitive to lightening conditions, noise etc. Increase noise to image degrades magnitude of edges.
- Gradient magnitude of edges is decreases; decrease the chances of correct image edge detection.

Researchers have also applied optimization and nature inspired algorithms for better results in image edge detection. ACO is a nature-inspired algorithm, one of nature-inspired algorithm that applied in image edge detection [3].

PROPOSED ALGORITHM

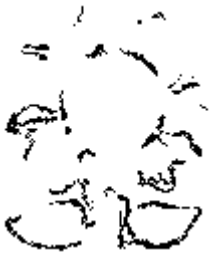
The Edge Detection process has been implemented by using the following steps:

1. Select an image and take it as input.
2. Save the image as a 256 colored bitmap format.
3. Find pixel values and generate the edges of image.
4. Generate the results with improved quality of edges.

In our proposed hybrid approach, ants move on a 2D image from one pixel to another to construct a pheromone matrix. By the help of this matrix, edge information is determined to extract the edges of the image. The movement of the ants is steered by the local deviation of the image's pixel intensity values [9].

II. RESULTS

Table 1: Image Edge Detection using Jing Tian's & Proposed Hybrid Approach

Source Image	Jing Tian's Approach	Proposed Hybrid Approach
		
		

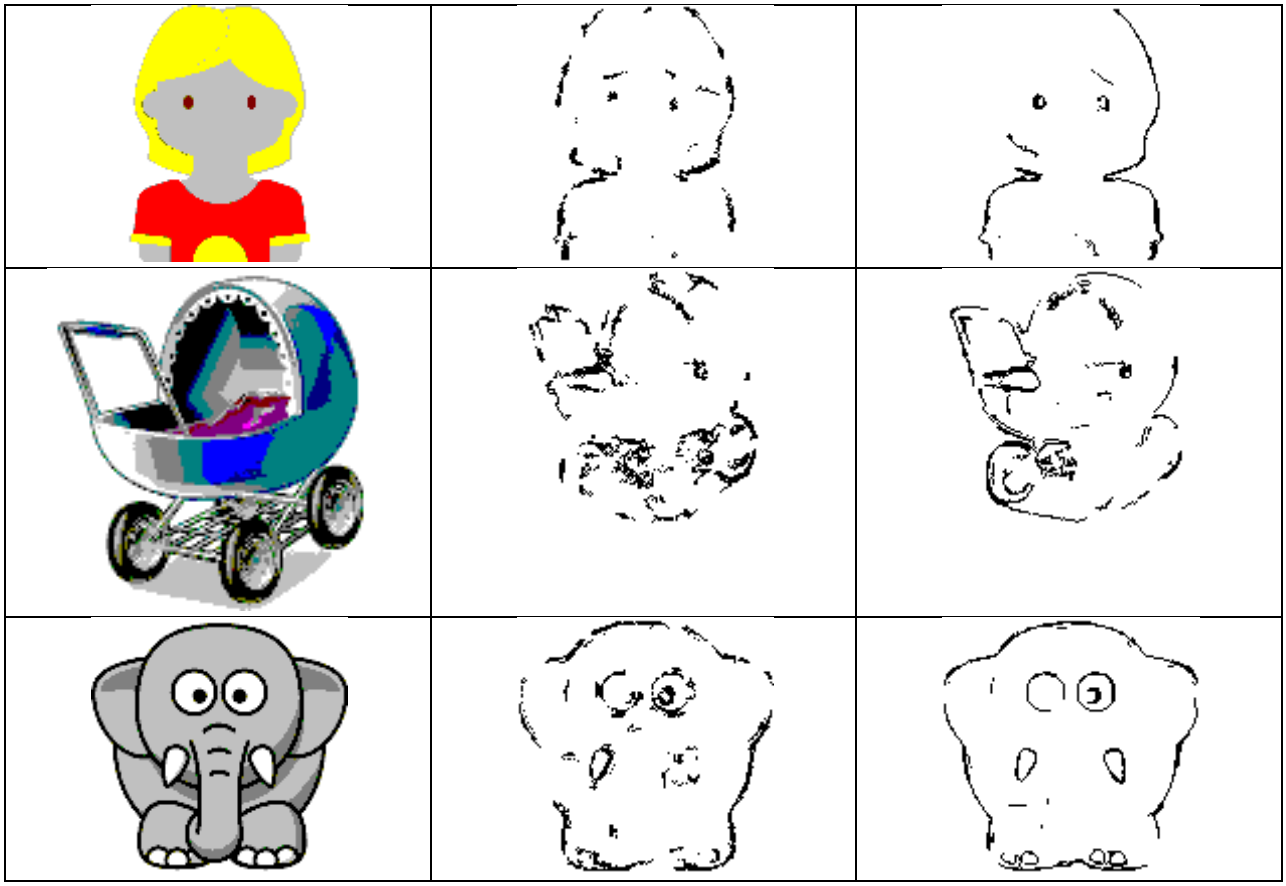
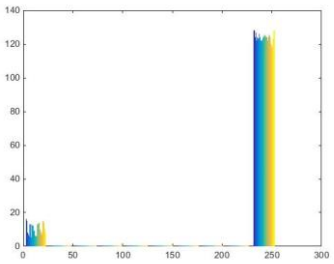
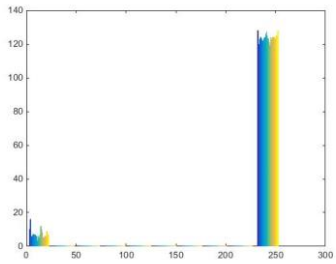
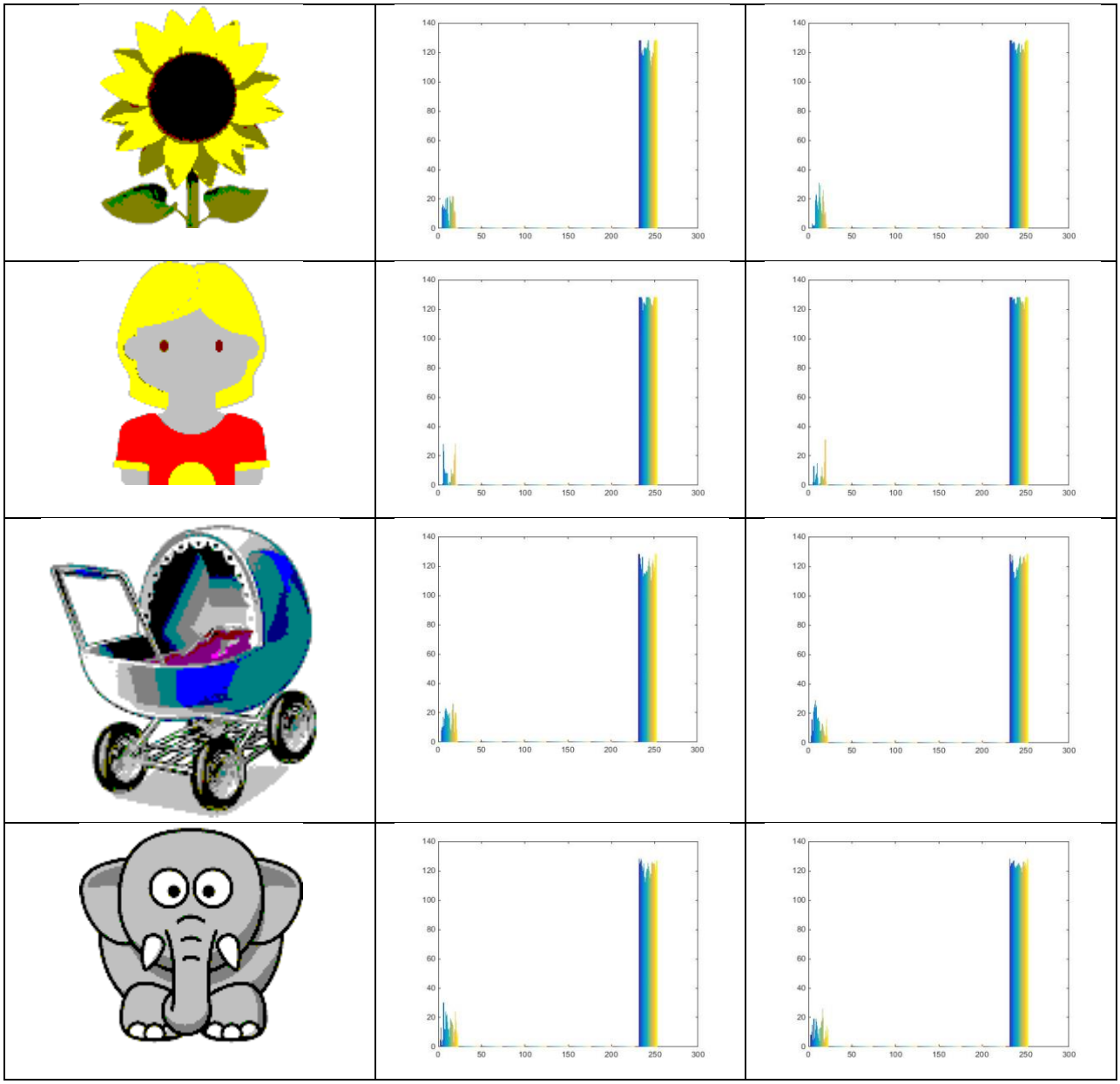


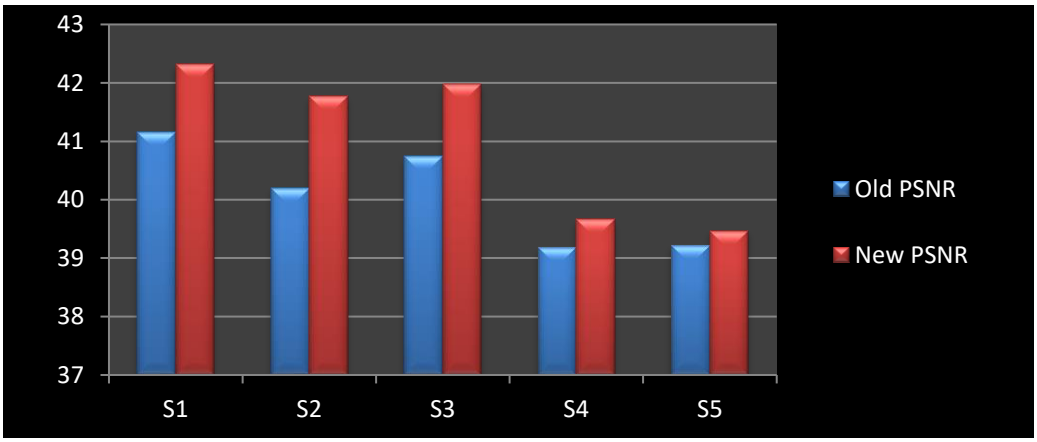
Table 2: PSNR & RMSE Values for Jing Tian's & Proposed Hybrid Approach

Source Image	Old PSNR	New PSNR	Old RMSE	New RMSE
S1	41.1591712	42.3078105	2.24	1.96
S2	40.2015058	41.7650880	2.50	2.09
S3	40.7357997	41.9816110	2.35	2.04
S4	39.1815415	39.6635952	2.81	2.66
S5	39.2152046	39.4671696	2.80	2.72

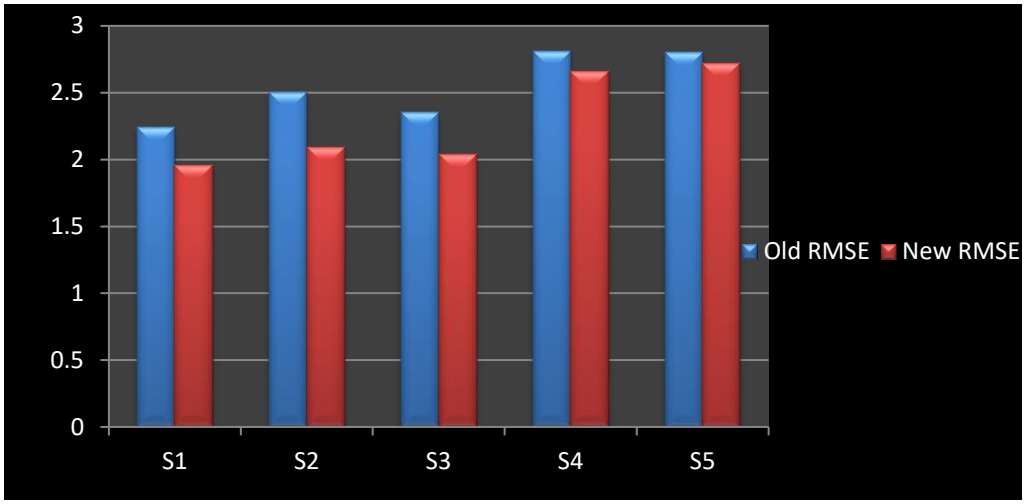
Table 3: Output Image Histogram for Jing Tian's & Proposed Hybrid Approach

Source Image	Output Image Histogram for Jing Tian's Approach	Output Image Histogram for Proposed Hybrid Approach
		





Graph 1: Comparison of PSNR Values for Jing Tian's & Proposed Hybrid Approach



Graph 2: Comparison of RMSE Values for Jing Tian's & Proposed Hybrid Approach

III. CONCLUSION & FUTURE SCOPE

Edge detection is a very important area in image processing, mainly in the areas of feature detection and extraction, which mainly aims at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. An edge can be defined as a group of connected pixels lying between boundaries of two regions. Edge can also be defined as in binary images as the black pixels with one nearest white neighbor. An Edge is a local concept but the boundary is a global concept. An ideal edge is a group of pixels located at an orthogonal step transition in gray level.

In present research work an improved edge detection algorithm is design for detection of edges in a grayscale image which has proven to be a useful. Blurry edges are also acquired by the factors like problems or imperfections happened at the time during of optics, sampling and image acquisition systems. So, edges can be closely seen as having a profile as that of ramp-like profile. ACO is mainly introduced here to tackle the image edge detection problem. Experiments show that this Ant Colony Optimization technique improves the accuracy of edge detection and the final image contains a relatively complete edge profile. In practice, choosing a suitable method for image edge extraction is based on specific conditions.

The proposed algorithm generates complete edge profile which is not generated in traditional methods. It also leaves some of the true edges with low (dim) intensity. So, the future scope is to study the reasons for this anomaly and further improve the proposed method. Also in future, we can improve our proposed algorithm for images with inter mixed edges, multi color edges, dotted or misprinted edges. This edge detection algorithm can also be interlinked with shortest path algorithms to find out the shortest path from a map. Also it can be used to improve air traffic management system, real time traffic management with live satellite images. Our proposed algorithm can also be merged with various pattern matching algorithms, various industrial applications, and medical diagnostic applications to identify pixel of the various edges.

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