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Colour Image Segmentation using Background Subtraction with Global and Local Threshold

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Abstract: ***Image segmentation is one of the fundamental and essential steps in all the major applications of digital image processing. In this process the digital image is divided into various regions which are also known as segments. These segmented parts of the digital image could be used for further processing like detection of types of objects present in the segmented region, various tumors present in the digital images or the scene understanding process. Usually segmentation is classified as local segmentation and the global segmentation. Image segmentation is also classified on the basis of digital image properties also. In this case it is of two types. First one is non continuity detection and second one is the continuous detection. Various image segmentation techniques are proposed by researchers which have various limitations. Some techniques do not split the region uniformly and other techniques take enough time and memory for the processing of digital image. In this research work both the local and global thresholding concept is used to get the segmented regions of the image. The proposed technique will be able to extract the segmented objects from the digital image. To check the authenticity and efficiency of the proposed technique, it will be compared with other well known techniques of image segmentation using background subtraction of colored digital images. Time of computation, sensitivity and accuracy are used as objective parameters for the performance evaluation of the techniques. For the subjective evaluation visual quality of the digital image is used for performance evaluation.***

Keywords: Image segmentation, image processing, object, thresholding, global, local

I. INTRODUCTION

Digital image processing has numerous applications in the field of artificial intelligence like in crowd monitoring, counting persons in queue, number plate detection and many more. All this type of stuff requires understanding of object detection, pattern recognition which is very deep area of study. It is possible by one of the pre-processing step of image processing which is known as segmentation and it becomes essential in each application area where segmentation is necessary to extract or detect region of interest. Image segmentation is one of the prime as well as challenging fundamental tasks in digital image processing. Actually this is the process of segmenting the various region of digital images based on some important criteria. Usually thresholding is used as criteria for segmenting foreground object from the background. In the thresholding concept a single value is considered above which all the pixels are white and below that value all pixels of image are black. Image segmentation has numerous applications in various fields like object detection, pattern recognition, medical image processing for tumor segmentation and many more.

Various research studies have tried to get the object detection with segmentation theory. Some techniques are able to get the good results while some techniques have not well performed. Some segmentation algorithms are fast and some are very slow due to their complex nature. Sometimes background color is similar to the foreground object so in that case it becomes very difficult to extract the objects reliably. Also if the illumination condition like brightness as well as contrast is not proper then even in that condition it becomes very difficult to segment objects.

A deep and comprehensive literature is reviewed so that various research gaps can be identified and can be improved in the proposed research.

II. LITERATURE REVIEW

P. Devisivasankari et al. [1] in 2020 proposed a novel method for the medical image segmentation with the help of parallel Watershed method. Authors had used the GPU computational power to speed up the process of computation and idea behind it was taht the algorithm was implemented in parallel way. Authors used 24 cores GPU and implemented in CUDA. Authors compared thesholding, region growing, watershed and Altas based method based on six various parameters. Authors divided the Watershed computation into three stages. From the results it was cleared that GPU had very much fast computation efficiency in comparison to CPU machines.

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A. Tarafdar et al. [2] in 2019 proposed a colored digital image background subtraction method. Authors first converted the image into three channels. It had made easy to extract both the background and foreground from the input digital image. After it authors tried to get the dominant color in the each 3 channels and compared it with the threshold value. If the value satisfied the condition then it was denoted as white otherwise black. Further authors used morphological operation of dilation to fill the holes present in the output segmented image. The results of the proposed segmentation were marginally accurate.

T. Let et al. [3] in 2018 proposed a clustering algorithm for image segmentation. This algorithm was based on the C-Means clustering and had used morphological as well as filtering method to get good results. Authors found that the maximum segmentation algorithms were complex due to iteratively computation of distance amid the image pixels. First authors performed morphological construction operation and then used membership partition to modify the pixels. The main benefit of this algorithm was that it was simpler than other complex image segmentation algorithms. Also it had shown results in faster way and even algorithm was able to segment the noisy images also.

M. Agarwal et al. [4] in 2017 proposed a medical image enhancement by performing the segmentation on the digital images. Authors had used the range limited weighted histogram equalization method to improve the quality of image. Authors first used the gamma correction method to improve the quality of image. After it authors had used the Homomorphic filtering so that overall quality of the image got improved. Then image segmentation was done with the help of Otsu method. From the results of the experiment it was clear that the proposed algorithm was able to improve the contrast enhancement and was able to preserve the maximum entropy.

S. Kumar et al. [6] in 2016 proposed a method to segment various moving objects based on the background subtraction. Authors tried to improve the future pixel values of the object so that their color did not loss in the next frame. Algorithm was divided into two stages. In the first stage authors provided a background model with the updating scheme. Second stage was the improving the neighbouring pixel values of the region in which object is moving with the help of recursive filter. Authors compared the proposed with other various methods. Proposed algorithm was able to beat the Gaussian Mixture Model method in computation time.

III.PROBLEM FORMULATION AND METHODOLOGY

In various application of artificial intelligence digital image processing has numerous effect. For counting of objects or for tracking objects and as well as extraction of objects the image processing is one of the essential steps. Thresholding is the main concept in the segmentation process. Local threshold is used for smaller regions of an image while global thresholding is used to segment the objects present in the complete image. Main problem arises when the algorithm is not able to segment the objects with specified boundaries and it can be due to various reasons.

After performing a deep literature study, some of the research gaps were found and are listed below

1) Segmentation algorithms are not able to work properly on every type of image like nature, human, animals and static or moving objects
2) Some of the algorithms are so complex that the execution takes too much time
3) Few algorithms do over segmentation and some under segmentation
4) Usually some algorithms segment one region of image properly while remaining regions not accurately segmented

A. *Objectives*

This research work will focus on achieving the below mentioned objectives

1) To study, design and implement an optimized segmentation algorithm
2) Proposed algorithm should be reliable and able to segment properly
3) Algorithm should have fast computation time
4) Learn the design process, recognize and solve various hurdles in object segmentation so that overall detection quality increases

B. *Methodology*

The steps which are followed in segmentation of objects in digital images are given below

1) The first step is to pre-process the captured digital images to remove any kind of noise in it
2) In the second step image is sharpened so that all objects have clear boundaries
3) Check for the distance between the abrupt color changes so that different objects can be detected with global segmentation
4) Check whether region segmented is of same object or of different object using local segmentation
5) Color objects with different colors which are neighbour of each other

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C. Proposed Algorithm

The proposed algorithm includes specific steps which are as follows

1) Apply the Gaussian filter to remove blurring and other effects
2) Apply the Homomorphic filter to enhance the brightness in the image
3) Apply the sharpening filter so that objects with clear boundaries are visible
4) Identify the regions of different objects by apply region based segmentation approach
5) Create a seed point in region to check objects are of same region or not. If of same region match the color of neighbouring regions so that each object has only one color

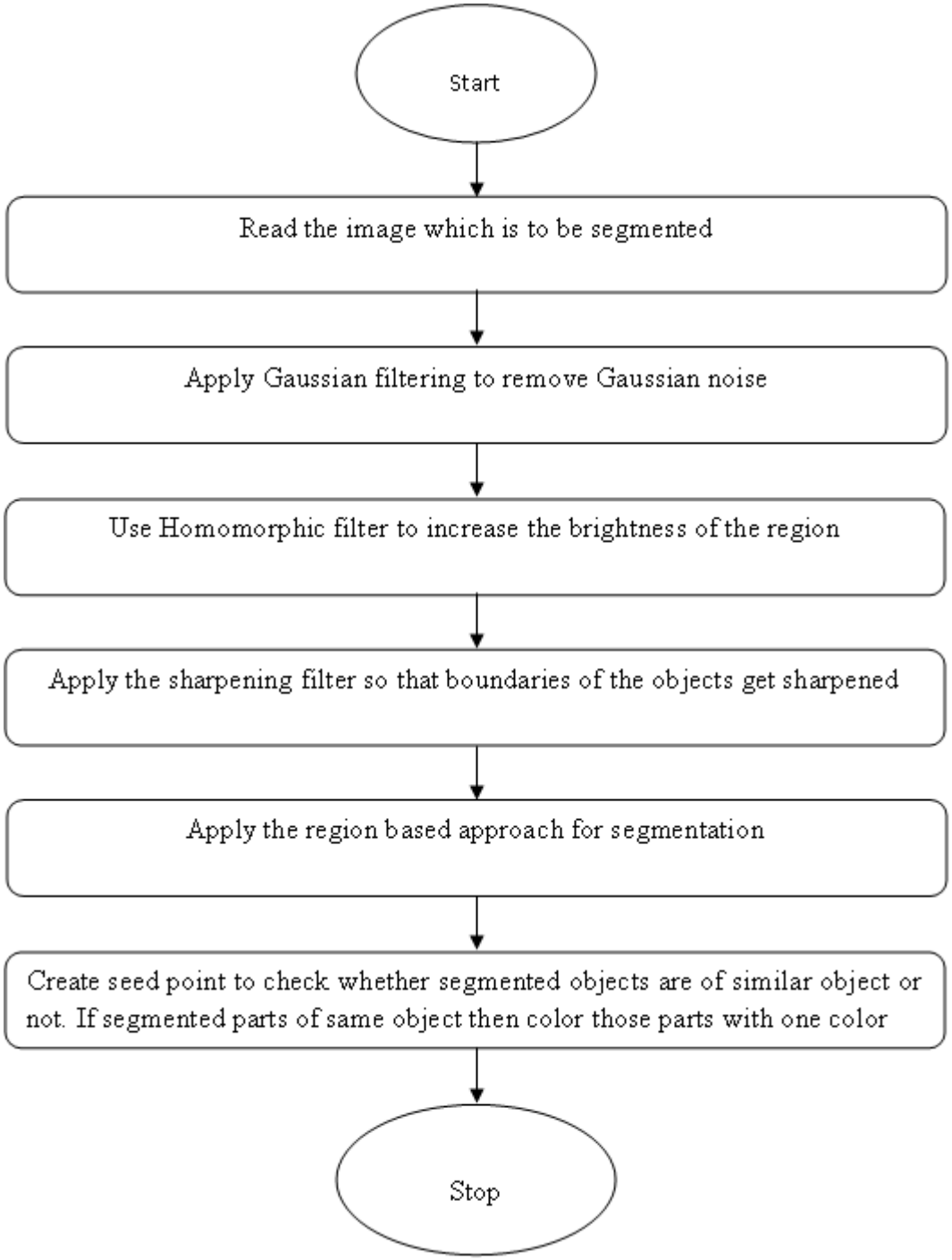

Fig. 1 Flowchart of proposed algorithm

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IV. RESULTS

Proposed algorithm is compared with the Hill Climbing segmentation approach and some of the results are shown below.

Fig. 2 (a, b, c) Original image, Hill Climbing segmentation and proposed algorithm segmentation

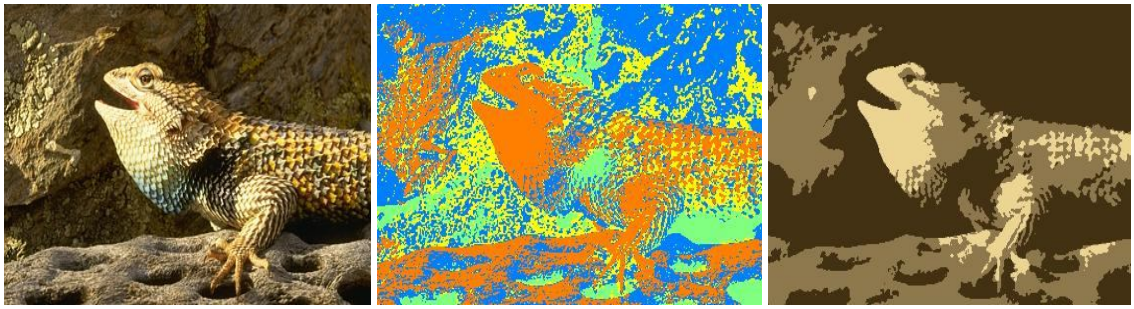

Fig. 3 (a, b, c) Original image, Hill Climbing segmentation and proposed algorithm segmentation

Fig. 4 (a, b, c) Original image, Hill Climbing segmentation and proposed algorithm segmentation

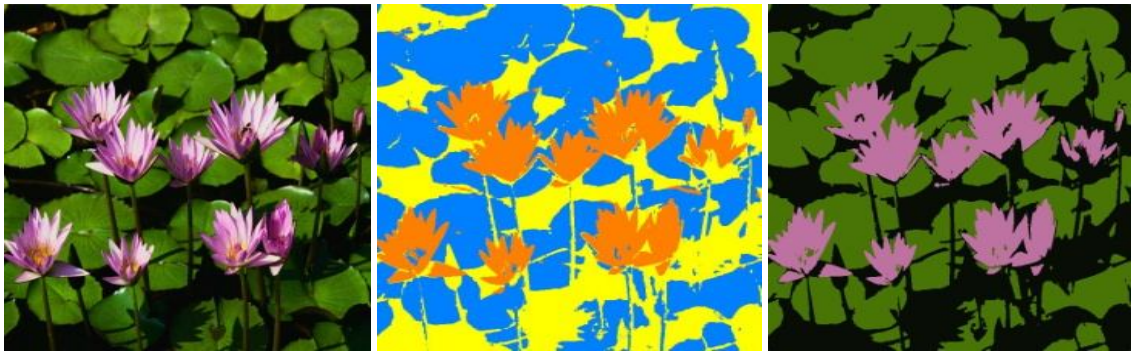

Fig. 5 (a, b, c) Original image, Hill Climbing segmentation and proposed algorithm segmentation

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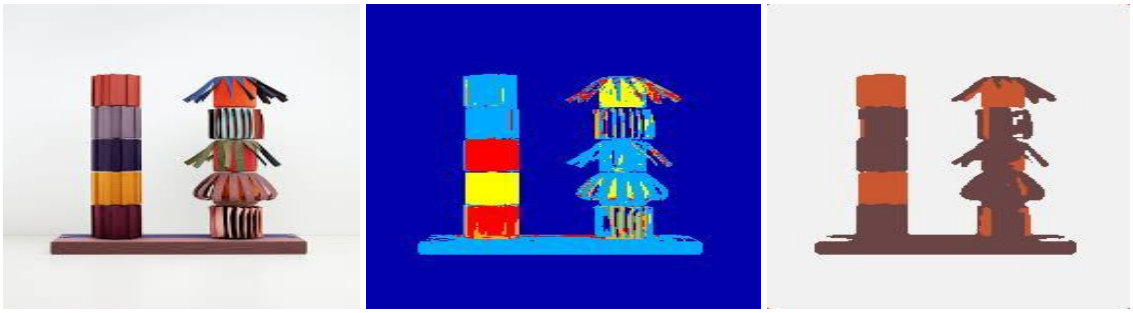

Fig. 6 (a, b, c) Original image, Hill Climbing segmentation and proposed algorithm segmentation

Fig. 7 (a, b, c) Original image, Hill Climbing segmentation and proposed algorithm segmentation

Table I: Total Execution Time Consumed By Algorithms In Seconds

Image No.	Hill Climbing Method	Proposed Method
Fig 2	10.256931	7.2274
Fig 3	9.951675	5.401
Fig 4	9.502838	5.8853
Fig 5	18.03400	18.632
Fig 6	9.675400	3.5867
Fig 7	9.527070	2.8055

Table II: Result Obtained On The Test Set

S. No.	Technique	Percentage Sensitivity	Percentage Accuracy
1	Hill Climbing Method	85 .6	88.2
2	Proposed Method	92.8	93.8

Finally after performing operations on various images overall sensitivity and accuracy of proposed algorithm is found to be nearly 93 and 94 percent respectively while Hill climbing has got nearly 85 and 88 values respectively.

V. CONCLUSIONS

The experiment is performed on more than 200 colored images which include all kind of images like human, animal, nature, other objects. From the outcomes of the research it is found that the proposed algorithm has superior results in comparison to Hill Climbing segmentation method. Proposed algorithm is able to clearly identify the various objects which are in different colors. Proposed algorithm is fast in execution of segmenting objects while the Hill Climbing algorithm is slow. Also the sensitivity and accuracy of the proposed method is more that other compared algorithm.

In the future work the proposed algorithm can be compared with other known algorithms and authenticity of the proposed algorithm can be checked. Also proposed algorithm can be improved further by improving the algorithm.

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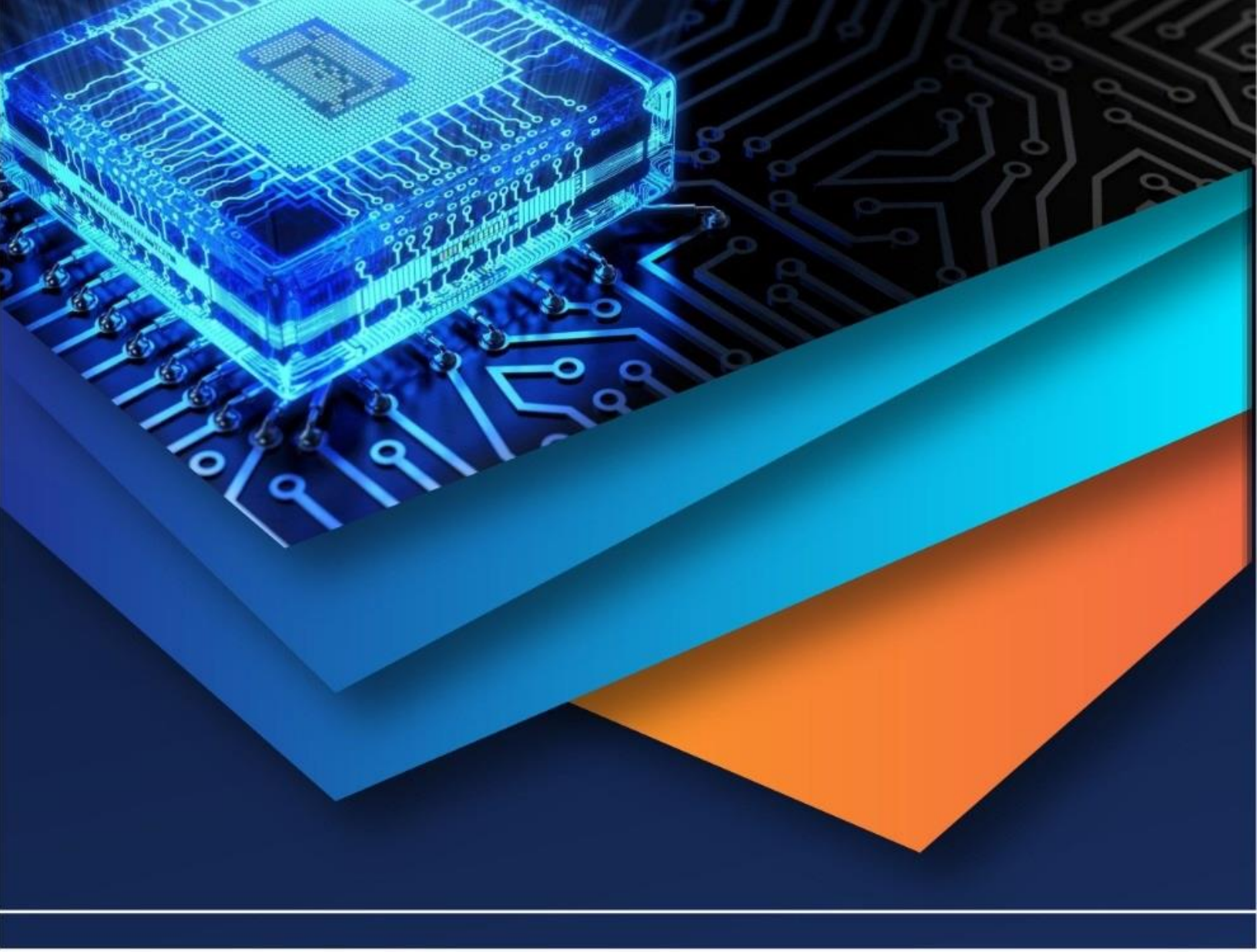

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