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A Survey of Image Segmentation based on Artificial Intelligence and Evolutionary Approach

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Abstract : *In image analysis, segmentation is the partitioning of a digital image into multiple regions (sets of pixels), according to some homogeneity criterion. The problem of segmentation is a well-studied one in literature and there are a wide variety of approaches that are used. Different approaches are suited to different types of images and the quality of output of a particular algorithm is difficult to measure quantitatively due to the fact that there may be much correct segmentation for a single image. Image segmentation denotes a process by which a raw input image is partitioned into nonoverlapping regions such that each region is homogeneous and the union of any two adjacent regions is heterogeneous. A segmented image is considered to be the highest domain-independent abstraction of an input image. Image segmentation is an important processing step in many image, video and computer vision applications. Extensive research has been done in creating many different approaches and algorithms for image segmentation, but it is still difficult to assess whether one algorithm produces more accurate segmentations than another, whether it be for a particular image or set of images, or more generally, for a whole class of images.*

In this paper, The Survey of Image Segmentation using Artificial Intelligence and Evolutionary Approach methods that have been proposed in the literature. The rest of the paper is organized as follows. 1. Introduction, 2.Literature review, 3.Noteworthy contributions in the field of proposed work, 4.Proposed Methodology, 5.Expected outcome of the proposed research work, 6.Conclusion.

Keywords: *Image Segmentation, Segmentation Algorithm, Artificial Intelligence, Evolutionary Algorithm, Neural Network, Fuzzy Set, Clustering.*

I. Introduction

Digital image processing is one of most important area of research and has opened new research prospects in this field. Digital image processing refers to processing digital image by means of digital computer. Image processing [23] is a very profound key that can change the outlook of many designs and proposals. Fundamental steps in digital image processing are image acquisition, image enhancement, image restoration, color image processing, compression, image segmentation and recognition. Image segmentation [9] has become a very important task in today's scenario. An importance of segmentation is, segmentation is generally the first stage in any attempt to analyze or interpret an image automatically. Segmentation provides bridges the gap between low-level image processing and high-level image processing. The any application involving the detection, recognition, and measurement of objects in images make use of segmentation techniques like. Application area of Segmentation is include, Industrial inspection, Optical character recognition (OCR), Tracking of objects in a sequence of images, Classification of terrains visible in satellite image, Detection and measurement of bone, tissue, etc., in medical images.

Image segmentation is part of image processing. The task of Image segmentation [1 4] is to group pixels in homogeneous regions by using common feature approach. Features can be represented by the space of colour, texture and gray levels, each exploring similarities between pixels of a region. Segmentation [5] refers to the process of partitioning a digital image into multiple regions. The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. In the present day world computer vision has become an interdisciplinary field and its applications can be found many like area be it medical, remote sensing, electronics and so on. Recently image segmentation based on [31][32] rough set and fuzzy set and genetic algorithm have gained increasing attention. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture.

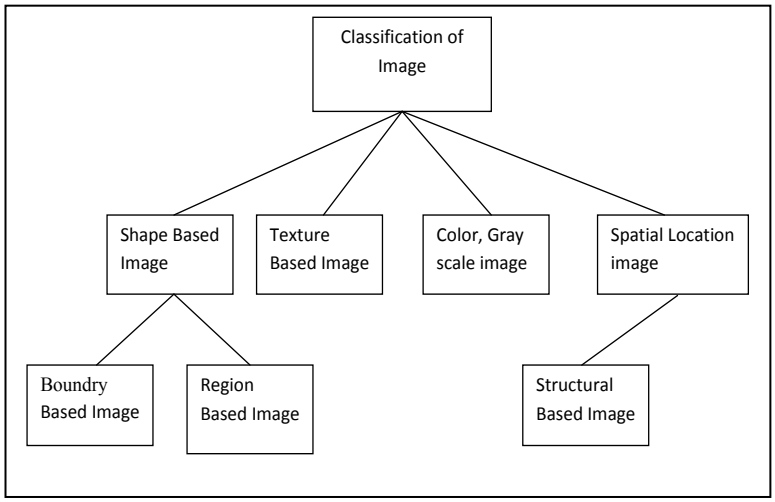

Fig. 1 Classification of image

Segmentation is based on the measurements taken from the image based on the attributes like grey level, colour, texture, depth or motion. Image segmentation techniques are categorized into three classes: Clustering, edge detection and region growing. Edge [2 26] detection is an essential pre-processing step for image segmentation which is used to transform the input image to a binary image, which indicates either the presence or the absence of an edge. Edges are sets of pixels and are an important contour features where distinct intensity changes or discontinuities in the corresponding image occur. In Digital image [3] brightness characteristics of a pixel has an influence of background noise hence imaged pre-processing become necessary. Most noise in the image is discrete noise. Median filter can eliminate the discrete noise, inhibition of salt and pepper noise and overcome the image blur. The aim of noise [4] reduction is to suppress the noise while preserving the important fine details and edges which are the boundary tow different regions. Image segmentation has been done based on the Artificial Intelligent (neural network, fuzzy set, and rough set) [40] and Evolutional approach (ant colony optimization, PSO) as a filter on both noisy and noise free images.

II. Literature Review

Image segmentation has been a topic of interest for the research as it can be associated with different research areas like data mining, soft computing etc. Many researchers have published research papers related to the above mentioned image segmentation related fields. Jan-Marco Bremer, Michael Gertz, [7] where the image segmentation has been done based on the relative differential box-counting algorithm and the gliding-box algorithm, which is a novel method for estimating the lacunarity features of greyscale digital images. The authors have used four nature texture images to test the performance of the novel lacunarity measure. Wang Lian, David Wai-lok cheung, Nikos Mamoulis, Siu-Ming Yiu, [8] present a novel method to detect plural kinds of shapes such as lines, circles, ellipses, and parabolas have been proposed. It is based on improved Genetic Algorithm (GA). .Rahm,Philip A Bernstein, [9] in which author talk about image segmentation result in a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. Due to the importance of image segmentation a number of algorithms have been proposed but based on the image that is inputted the algorithm should be chosen to get the best results. The paper [9] the author gives a study of the various algorithms that are available for color images, text and gray scale images.

They [9] have been put forward different types of segmentations which are, Point-based or pixel-based segmentation, pixel based segmentation results in a bias of the size of segmented objects when the objects show variations in their gray values. Darker objects will become too small, brighter objects too large. Edge-Based Segmentation, Edge-based segmentation is based on the fact that the position of an edge is given by an extreme of the first-order derivative or a zero crossing in the second-order derivative. Region-based methods focus attention on an important aspect of the segmentation process missed with point-based techniques. There a pixel is classified as an object pixel judging solely on its gray value independently of the context. This meant that isolated points or small areas could be classified as object pixels, disregarding the fact that an important characteristic of an object is its connectivity. Model-Based Segmentation all segmentation techniques discussed so far utilizes only local information. The human vision system has the ability to recognize objects even if they

are not completely represented. It is obvious that the information that can be gathered from local neighbourhood operators is not sufficient to perform this task.

The [10][23] proposed Ant Colony Optimization (ACO) is proposed which is a group of algorithms inspired by the foraging behaviour of ant colonies in nature. Like their biological counterparts, a colony of artificial ants is able to adapt to the changes in their environment, such as exhaustion of a food source and discovery of a new one. In this paper, one of the basic ACO algorithms, the Ant System algorithm, was applied for edge detection where the edge pixels represent food for the ants. A set of gray scale images obtained by a nonlinear contrast enhancement technique called Multiscale Adaptive Gain is used to create a variable environment. As the images change, the ant colony adapts to those changes leaving pheromone trails where the new edges appear while the pheromone trails that are not reinforced evaporate over time. Although the images were used to create an environmental setup in which the ants move, the colony's adaptive behaviour could be demonstrated on any type of digital habitat.

Hong-Hai Do, Sergey Melnik, Erhard Rahm , [11] paper presented a new approach for image segmentation by applying k-means algorithm. In image segmentation, clustering algorithms are very popular as they are intuitive and are also easy to implement. The [22][27] K-means clustering algorithm is one of the most widely used algorithm in the literature, and many authors successfully compare their new proposal with the results achieved by the k-Means. Amarintrarak N, R. Sailkean K., Tongsima S. Wiwatwattana N, [12] proposed a method for automatic detection of root crowns in root images, are designed, implemented and quantitatively compared. The approach is based on the theory of statistical learning. The root images are preprocessed with algorithms for intensity normalization, segmentation, edge detection and scale space corner detection. Survey paper [13 14] proposes a method for automatic 3D segmentation of human brain CT scans using data mining techniques. The brain scans are processed in 2D and 3D.

III. Noteworthy Contributions In The Field Of Proposed Work

A lot of research work is going on in the field of image segmentation and it has found considerable interest in both research and practice Many researchers have put forward many aspects of image segmentation. Radim Burget, Vaclav Uher, Jan Masek [15] presents an innovative algorithm combining theory of artificial intelligence and knowledge of human eye anatomy. Ping Chen , Zhisheng Zhang, Yanxiang Han , Fang Chen ,Bei Tang [16] proposed based on separating the coke microstructures from coke microscopic image is a crucial task for automatic recognition by using digital image analysis technology. The author Yang Gui, Xiang Bai, Zheng Li, Yun Yuan, [17] proposed novel approach is presented for color image segmentation. By incorporating the advantages of mean shift (MS) segmentation and spectral clustering (SC) method, the proposed approach provides effective and robust segmentation. Yanan Fu, Wei Zhang, Mrinal Mandal, and Max Q.-H. Meng, Fellow [18], talk about on Wireless capsule endoscopy (WCE) can directly take digital images in gastrointestinal (GI) tract of a patient. It has opened a new chapter in small intestine examination. Jamshid Sourati, Dana H. Brooks, Jennifer G. Dy, Deniz Erdogmus , [19] published by have disuses about Constrained spectral clustering with affinity propagation in its original form is not practical for large scale problems like image segmentation. The paper [19] author has employed novelty selection sub-sampling strategy, besides using efficient numerical Eigen decomposition methods to make this algorithm work efficiently for images. In addition, entropy-based active learning is also employed to select the queries posed to the user more wisely in an interactive image segmentation framework. Gajanan K. Choudhary and Sayan Dey, their paper [20] presents fuzzy logic and artificial neural network based models for accurate crack detection on concrete. Features are extracted from digital images of concrete surfaces using image processing which incorporates the edge detection technique. The properties of extracted features are fed into the models for detecting cracks. G.Subha Vennila, L.Padma Suresh, their paper [21] used image segmentation and classification on dermoscopy which is the method of examining the skin lesions. It is especially used for Diagnosing melanoma, a type of skin cancer. Image segmentation and classification are important tools to provide the information about the Dermoscopic images clinically in terms of its size and shape. Chaloemchai Lowongtrakool and Nualsawat Hiransakolwong [22], their paper proposes AUCCI, the Design of Image Segmentation Using Automatic Unsupervised Clustering Computation Intelligence, a novel automatic image clustering algorithm based on Computation Intelligence. V. Senthil, R. Bhaskaran, [24] talk about analyzes the robustness of watermarking method in still images using Haar, Daubecheies and Biorthogonal wavelets. The embedding process uses a canny edge detection method and hides the watermark with the perceptual considerations on different modalities of images. Rubén Salvador, Andrés Otero, Javier Mora, Eduardo de la Torre, Teresa Riesgo and Lukas Sekanina,, [25] presents an evolvable hardware system, fully contained in an FPGA, which is capable of autonomously generating digital processing circuits, implemented on an array of Processing Elements (PE). R. Harinarayan,R. Pannerselvam,M. Mubarak Ali,Dhirendra Kumar Tripathi, [26] their paper present a FPGA-based architecture for edge detection algorithms has been proposed. Mei Yeen Choong, Wei Leong Khong, Wei Yeang Kow, Lorita Angeline, Kenneth Tze Kin Teo, [27] represents a graph-based image segmentation method. Vaishnavi

Ganesh, Sandhya Vaidyanathan, Eswer K, [28] talk about digital image segmentation with sensor.-With the help of sensors and image processing technique giving artificial intelligence another limb to work with. The applications of such a combined mechanism are limitless and this can be further brought to practical usage if given the right resources. Ms.K.Kavi Niranjana, Ms.M.Kalpana Devi and Ms.L.Mary Marshaline ,[29] paper presents a new approach for image segmentation by applying Marker Controlled Watershed Algorithm (MCWS). The proposed approach [29] for image segmentation by comparing with Pillar - K means algorithm [30] [33] [35] and involving RGB color space. Amiya Halder , Avijit Dasgupta, their paper [30] describes a rough set approach for gray scale image segmentation that can automatically segment an image to its constituents parts. The method mainly consists of spatial segmentation; the spatial segmentation divides each image into different regions with similar properties. T. J. Ram´irez-Rozo, J.C.Garc´ia,Alvarez,C. G. Castellanos-Dom´inguez,[33] where the Expectation Maximization Clustering (EM-Clustering) segmentation is evaluated for IR images, using as reference watershed transform-based segmentation. A major challenge in segmentation [35] evaluation comes from the fundamental conflict between generality and objectivity. As there is a glut of image segmentation techniques available today, customer who is the real user of these techniques may get obfuscated. Wenbin Zou, Kidiyo Kpalma and Joseph Ronsin ,[36] where the used new concept image segmentation by using region bank. Images are hierarchically segmented leading to region banks. Local features and high-level descriptors are extracted on each region of the bank. Vasiliy N Vasyukov, Nikolay and Sysoev, [37] introduce a new image texture segmentation algorithm, based on wavelets and the hidden Markov tree model Hidden Markov tree model provides a good classifier for distinguishing between textures. Mei Wang, Hsiung-Cheng Lin, Xiao-Wei Wu, Jian-Ping Wang, [39] proposed a new image segmentation approach using the proportion of foreground to background method.

IV. Segmentation Algorithm

Segmentation algorithms are based on one of two basic properties of color, gray values, or texture: discontinuity and similarity. First category is to partition an image based on abrupt changes in intensity, such as edges in an image. Second category are based on partitioning an image into regions that are similar according to a predefined criteria. Histogram thresholding approach falls under this category.

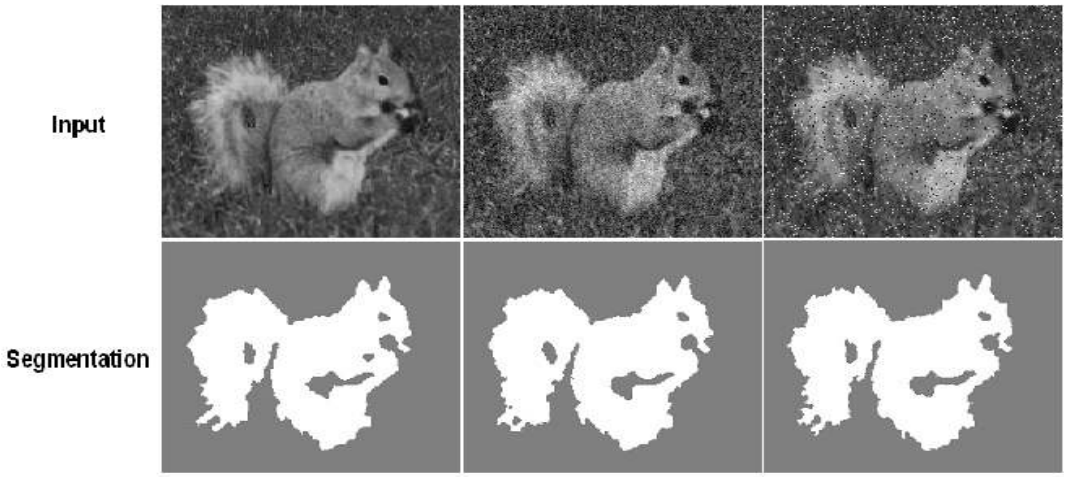

Fig. 2 Segmentation

4.1 Thresholding

The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image. The key of this method is to select the threshold value (or values when multiple-levels are selected).Finding histogram of gray level intensity.

- Basic Global Thresholding
- Otsu's Method
- Multiple Threshold
- Variable Thresholding

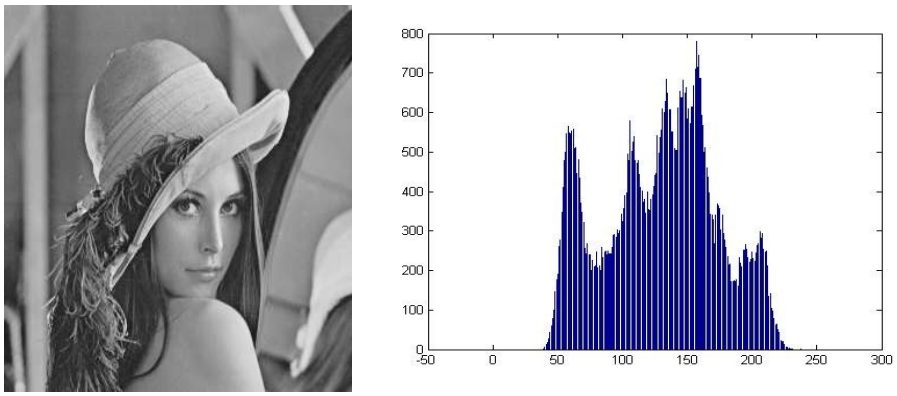

Fig. 3 Original image with thresolding

4.2 Edge-based segmentation

Using mask to detect edge in image by convolution.

- Basic Edge Detection
- The Marr-Hildreth edge detector(LoG)
- Short response Hilbert transform(SRHLT)
- Watersheds

Fig. 4 original image with Edge Based Segmentation

4.3 Region-based segmentation

Finding region, but not finding edge.

- Region Growing
- Data Clustering (Hierarchical clustering)
- Partitional clustering
- Cheng-Jin Kuo`s method

Fig. 7 original image with Region Based Segmentation

V. Proposed Methodology

The propose work will Develop and implement of A Novel algorithm for image segmentation which used concepts of Data mining techniques. A investigate the applications and improvements in the field of image segmentation. The following proposals can be taken forward during the tenure of the research work.

- The paper [34] given by author proposed a new method for neural network training patterns using fuzzy concepts which cannot be applied directly to medical image because medical image as it does not distort the objects shape and is able to retain the important features. So it is required develop improved matching algorithm that can be applied directly on the medical images.
- The paper [35] compares the performance of a few clustering based image segmentation methods. Fuzzy c-Means clustering algorithm, particle swarm optimization and Darwinian PSO are discussed. It is required proposed to work on the performance analysis will be based on some newer optimization techniques as well as the algorithms and comparison will be extended to wide range of applications.
- In paper [9] author has explained and suggested a few application specific segmentation algorithms which also take into consideration the type of image inputted like color, gray scale and text. So it is required to calculate performance of new optimization techniques on different types of inputted image.
- The propose algorithms criteria are, First of all, we need to be aware of the target image which we would like to segment out. Second, the background image has to be blurred and the colour of the target image should be different to that of background image as much as possible. They expect the appendages of the target image to cross over each other as least as possible. The approach work is to obtain segment of the target image and boundary extraction separately and simultaneously. The proposed methodology used concepts artificial intelligence [34 4] (Neural network, fuzzy logic and rough set theory) and evolutionary approach [2 23] of the pixels of the target image. The propose work use Matlab to extract the segment of image. Then they will perform final modification and remove the noise. Then these processes applied for different types of image and calculate the performance of algorithm.

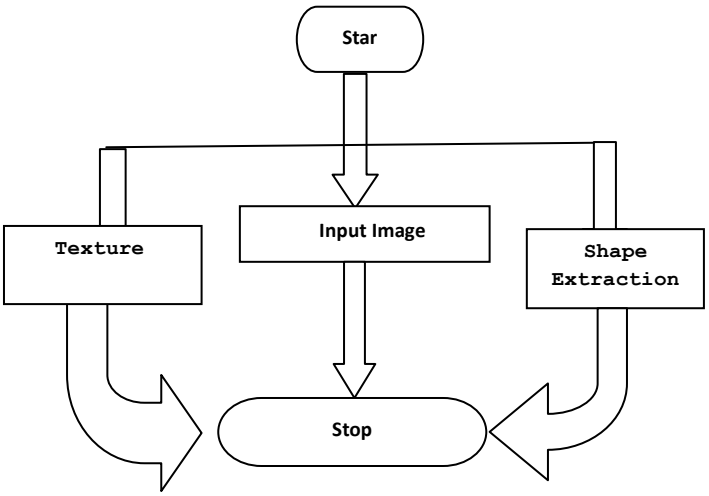

Fig. 8 Flowchart of the proposed algorithm

VI. Expected Outcome Of The Proposed Research Work

Using the proposed methodology following outcomes is expected in due course of research work. They include after picking a numbers different types of images which fit the criteria from the website, some images are selected and partially segmented from the original image. The processed images are posted as follows:

- Images are blurred can be segmented with nice quality.
- Images with clear boundary would be extracted.
- Only clear foreground images would be left.
- The information of the pixels which reside in the extracted boundaries.

VII. Conclusion

In image analysis, Segmentation is an important pre-processing step in the areas of image analysis and image compression. It is a critical and essential component of image recognition system and usually determines the quality of the final result. Segmentation is the partitioning of a digital image into multiple regions (sets of pixels), according to some homogeneity criterion. The problem of segmentation is a well-studied one in literature and there are a wide variety of approaches that are used. Different approaches are suited to different

types of images and the quality of output of a particular algorithm is difficult to measure quantitatively due to the fact that there may be much "correct" segmentation for a single image. From the analysis, there has been done in creating many different approaches and algorithms for image segmentation, but it is still difficult to assess whether one algorithm produces more accurate segmentations than another, whether it be for a particular image or set of images, or more generally, for a whole class of images.

The performance of the segmentation algorithm is measured by their Speed, Shape Connectivity, and System reliability.The second major problem became readily apparent from the literature, which is that most of the method based on neural network training patterns using fuzzy concepts which cannot be applied directly to medical image because medical image as it does not distort the objects shape and is able to retain the important features. So it is required develop improved matching algorithm that can be applied directly on the medical images.

Another important problem, specific segmentation algorithms which also take into consideration the type of image inputted like color, gray scale and text. So it is required to calculate performance of new optimization techniques on different types of inputted image.

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