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IMAGE SEGMENTATION OPTIMIZATION USING ANT WEIGHT LIFTING ALGORITHM

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ABSTRACT
Image segmentation is an excellent concept in the field of image processing and is one of most popular platform of research. To properly segment an image in to well-defined classes watershed segmentation, k-means clustering and quad tree segmentation have been researched. Segmentation techniques can be broadly classified such as thresholding techniques, clustering techniques, region based and merging, edge detection techniques. Optimization in Image segmentation results in good quality reproduction. In many cases it becomes essential to get an segmented image accurately but it may not possible with the existing techniques because of certain limitations. In this paper the proposed segmentation technique is bio-inspired from the behavior of ants nature and is called the Ant Weight Lifting segmentation algorithm. This algorithm generates optimum image segmentation data for reproduction on a wide range conditions and the results show a high correlation factor between the segmented and original images and also yields minimum standard deviation.

KEY WORDS— Image segmentation, thresholding, watershed segmentation, edge-based segmentation, quad tree segmentation, (AWL)Ant weight lifting algorithm.

I. INTRODUCTION

Segmentation mainly subdivides any image into its constituent regions or objects. The result of image segmentation is a set of segments that collectively cover the entire image. Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity. Segmentation continues till the threshold levels are reached for each of the parameters considered.

Image segmentation[1] forms a crucial role in image processing. Image is considered to be a matrix with *m* rows and *n* columns in image processing. Every matrix element is called pixel or picture element denoting the intensity of the image at that point. Image segmentation means partitioning [$m \times n$] matrix of the image in to multiple classes such that every pixel in the image belongs to a particular segment and pixels in one segment share some common feature or behavior.

Image segmentation is extremely important to analyze an image and is often used as a penultimate step for classification and helps in object searching. The basic operation involved during segmentation is analyzing each pixel and group pixels according to some common feature into segments.

A multitude of [2][3] segmentation techniques like thresholding are already prevalent. Techniques like watershed segmentation and quad tree segmentation are in much use but the fact remains that the before mentioned techniques have certain disadvantages that generate the need for a technique with the requirements. A discussion of the before mentioned techniques and their drawbacks would further highlight the need for an efficient segmentation technique.

Thresholding is a widely used technique to segment an image and is also the simplest approach available. At first, a threshold value is selected based on application. Pixels with strength greater than the threshold are assigned a value of 1 and all other pixels assigned 0.This process divides an image into two zones and thus creates a binary image. Basically, it divides the darker and the lighter regions. Many parameters such as intensity characters and size of objects are taken into consideration while selecting the threshold value. Several types of thresholding like multilevel, hysteresis and optimal but the concept remains same. Disadvantages in selecting thresholding becomes quite difficult to determine the optimum threshold value and also does not give satisfactory results in case of a large number of objects, its primary usage being in cases where we need to separate objects from the background.

Another segmentation is edge-based segmentation in which the edges of the objects are determined and only closed boundaries are taken in to consideration. The objects which are in closed boundaries are then filled and thus segmented image is formed. The detection of closed boundaries is a main problem caused due to noise hampering the image quality. [5] Watershed segmentation mainly performs the segmentation by flooding the areas that are determined as watersheds by using a local minima function and then linking them together by creating watersheds. It comes along with a major drawback in form of over-segmentation which requires a lot of pre and post-processing to be implemented on the image to give optimum results.

Another segmentation technique [6] is the Quadtree segmentation which implements an image to be subdivided into four equal squares if it does not meet a pre-selected homogeneity criterion. Edges usually do not meet the requirement of a homogeneity criterion and thus quadtree segmentation often results in a lot of segmented squares at the edges giving improper results.

Region based segmentation techniques are also widely used involving two major steps: region splitting and merging. Merging is performed by initially over segmenting the image and then combining the identical segments using some similarity measure until no segments can be merged any further. Splitting is done by analyzing each pixel and splitting them if they do not match the homogeneity criterion. Region growing takes an initial set of pixels and continues to attach neighboring pixels to each of the initially selected pixels accordingly based on an identical feature. Segmentation using the above-mentioned techniques proves to involve pre-processing and post processing since they either lead to under-segmentation or over-segmentation. Therefore the need remains to develop a novel approach to segment the image in an convenient manner. To solve these issues the Ant Weight Lifting algorithm is proposed.

II. ANT BEHAVIOUR

Ants belong with the family Formicidae alongside animals like wasps and honey bees. Ants are as far as omnipresent having an aggregate population of millions and having possessed practically the whole circle of Earth right from mountains to levels to fields. They are generally social in nature framing settlements and wanting to live respectively while some want to lead a nomadic life. Colonies of ants are enormous with the biggest yet recording to 6000 km. Ants are extraordinary foragers of food and courageous warriors also. Groups of ants are going by a ruler or rulers and likewise incorporate laborer ants who are wingless females having no conceptive framework with their goal of life being tending to the ruler and her descendants, scrounging for food, looking after the home, protecting the group.

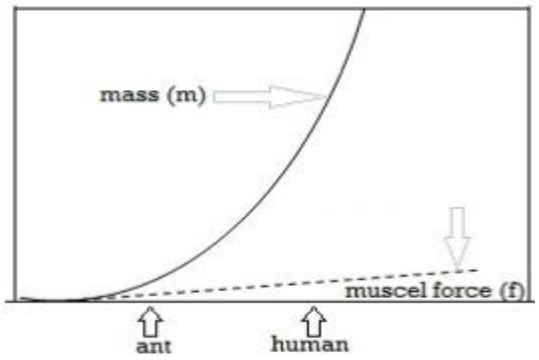
The one reason that has fascinated and keeps on astonishing the world is the weight carrying capacity of ant. As of late a weaver ant was in news for lifting a weight 50 times as itself. Several reasons make conceivable this heavenly accomplishment of a ant. Nature has supplied an ant with hairs on its feet

that can stick to smooth surfaces, incline bodies also, huge heads which are the key components to its quality empowering them to lift various times their own particular weight. Too helping this is their capacity to change the shape and size of the cushions on their feet relying upon the article that they need to convey what's more, the sticky substance on their feet that is a to a great degree powerful cement.

An ant walk either right or left and also up or down to collect food from different regions. Because an ant can collect food by roaming from one region to another region. Experimentally, the weight lifting capability of ants is a game of physics. Three essential ideas of size, mass and quality plays an important role. Exploration says the littler a living being is more is its strength.

- The strength of a muscle is directly proportional to the surface area of its cross-section. This implies, the strength of a life form increments as the square of the scale factor.
- A living being's quality is likewise identified with surface area, which increments in extent to the square of its length.
- Volume is a three-dimensional estimation, and is corresponding to the cube of its length.

A creature's weight is identified with volume, which increments in extent to the cube of its length weight to strength comparison between ant and human.



As showed in Fig.1.1, it can be seen that the quality to weight proportion of an ant is very high when compared with a human.

This is on the grounds that huge creatures while lifting weights are discouraged by their own particular body weight whereas an ant modest in size has negligible weight. Laborer ants are further profited by the absence of reproductive systems which makes their strength to weight ratios nearly higher than their fellow beings.

III. PROPOSED METHOD

Adopting behavior of ants, the algorithm for effective image segmentation have been done by using three parameters.

- The whole input image is considered as a food source where every pixel means a particular calorific estimation of a sustenance grain.
- The heaviness of all ants and the heaviness of grains are same (one unit).
- An ant can only collect a specific range of food.

Algorithm for Image Segmentation using Ant Weight Lifting Algorithm

Step 1: N quantities of random ranges of calorific values are chosen from the food space, within range of greatest and least calorific qualities.

Step 2: An arrangement of N number of ants are situated positioned randomly on the pixels.

Step 3: Ants begin strolling randomly in the food space and begin gathering grains having calorific value.

Step 4: If all the food grains comparing to a specific calorific value have already been gathered, the calorific value is set to NULL.

Step 5: In this random walk, ants can move in both the left and right directions to collect calorific value in its assigned range present in the food space.

Step 6: In every move, the ant walk counter is expanded by one.

Step 7: The procedure of gathering grains will proceed until the all the ants finish a walk of length that each ant collects food grains in its range.

Step 8: If the ant collects all the food grains appointed to be gathered by him have been gathered, there will be no further risk of getting food from the food space.

Step 9: An ant can carry 50 times more weight than its own weight. The ant can re-enter the food space in future in the event that it has more grains to gather. Along these lines, it will again take an interest in the opposition for going into the food space.

Step 10: Mean of the aggregate gathered calorific value is computed for each ant and the resultant

value is appointed to the respective range results segmented image.

Step 11: Mean standard deviation is computed for all the calorific values gathered by the arrangement of ants.

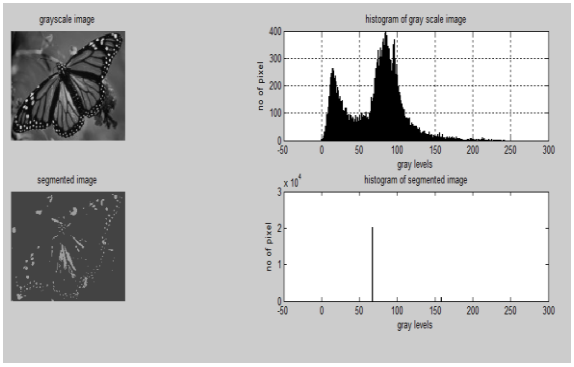
Step 12: The arrangement of ants having least mean standard deviation, i.e. comparing to the best degree to the wanted result is the most effective.

Step 13:The number of ants are increased until a predefined correlation coefficient value is reached.

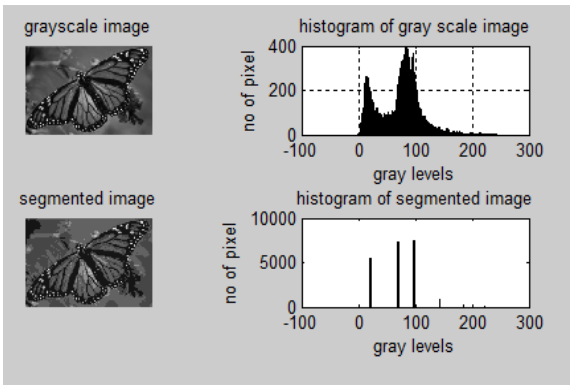
IV. EXPLANATION OF THE PROPOSED METHOD

The Ant Weight Lifting Algorithm has proved to be very efficient in image segmentation. The entire image is considered as the food source. An image is basically in a matrix form where each matrix element is called a pixel or picture element. Each pixel has its own intensity value. In this algorithm each pixel value is thought of as a calorific value. Each ant is assigned its unique as well as random range of calorific or pixel values, say ant 1 is assigned values from 30-45, the next ant being assigned values 46-60 and so on till N number of ants are assigned their respective range of values.we select N numbers of quantum of pixels, values lying between the maximum and minimum pixel values of the image. Each specific quantum range has been assigned to a particular ant, having assumed that there are N ants. These ants start by randomly moving in any direction across the image and on finding a pixel value lying in its range, and it collects it up. If there is no pixel value within its range it leaves the search assigning the range a value of NULL. An ant can walk or search for a maximum number of times which equals the number of pixel values lying in that range. The next step is to find the mean of the pixel values collected by each ant and replacing the entire quantum with that value creating segments in the process. We complete this process for all the N number of ants. After this we calculate the standard deviation of all the pixels collected by the N number of ants to determine to what extent has the result deviated from our desired or expected result. The ideal case is that each ant should collect the calorific value assigned to him. This would give the least value of standard deviation which would be the best fit solution. Correlation of the segmented image to the original image is used to determine which N set of ants give the optimum result. If the correlation value is high that is the original image and the segmented image are highly comparable then it presents the optimum result. A correlation value of greater than 0.99 is used as a stopping condition and we thus obtain the desired segmented image. The time required determines primarily on the number of ants involved, a larger the number of ants lowers the standard deviation and the test sets used to show that a lower deviation and the higher correlation factor for accuracy in image.

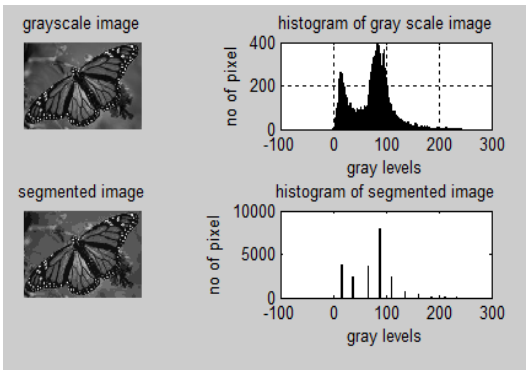
V. RESULTS AND DISCUSSION



Number of ANTS = 2
Mean of Standard deviation = 29.5507
Correlation = 0.5321

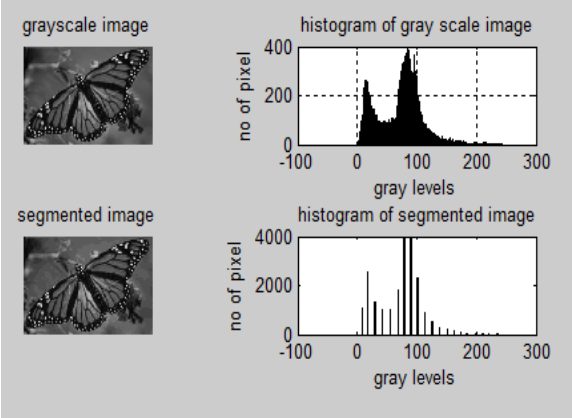


Number of ANTS = 6
Mean of Standard deviation = 10.7896
Correlation = 0.9606

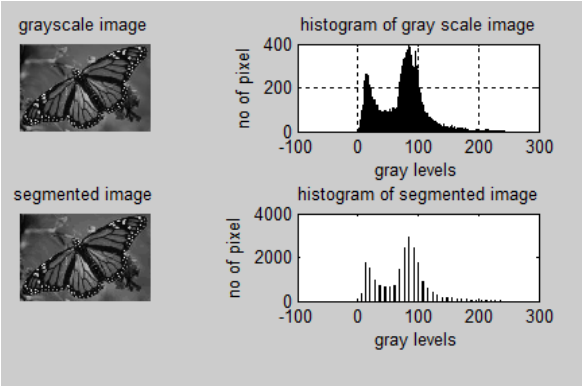


Number of ANTS = 10

Mean of Standard deviation = 6.7189
Correlation = 0.9838



Number of ANTS = 20
Mean of Standard deviation = 3.4214
Correlation = 0.9960



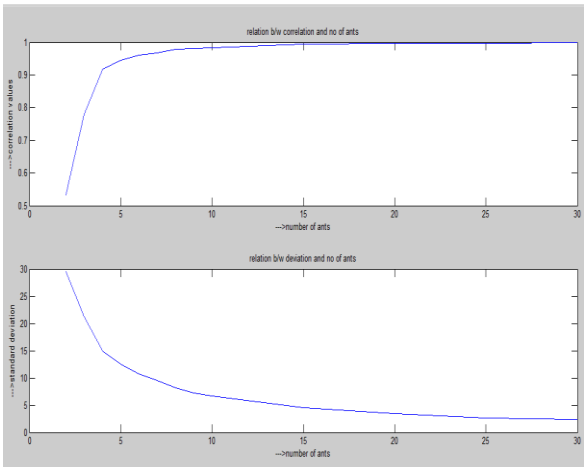
Number of ANTS = 30
Mean of Standard deviation = 2.3005
Correlation = 0.9982

As the results portray, by considering the number of ants we get the segmented image with higher accuracy. A comparison of the histogram of the original and segmented image can be done to better understand the result.

We stopped testing on getting a correlation value of greater than 0.99. Correlation is a similarity measure that determines the percentage of similarity between the original and the segmented image.

The above figures gives a detailed result enough to understand and determine the efficiency of the algorithm. As can be seen the value of the number of ants directly influences the result obtained which is measured by calculating the mean standard deviation between the original image and the segmented image. As proposed in the algorithm the correlation function has been used to determine the accuracy of the proposed algorithm.

VI. Analysis of standard deviation and correlation



Analysis of standard deviation and correlation

VII. CONCLUSION

In these Ant Weight Lifting (AWL) algorithm shows exceptional results in the event of image segmentation. It has a higher accuracy rate as compared to the previous segmentation techniques since it does not have drawbacks like over segmentation or under-segmentation contrary to the previous techniques like Watershed and Quad tree Segmentation and also solves issues that come along with the earlier segmentation techniques. From the results obtained this algorithm greatly depends on the number of ants used and efficiency increases with the increases in number of ants. Adopting this algorithm also solves issues like time complexity to a great extent. The correlation coefficient can be tuned according to the requirements and to obtain the desired result. This proves to be a novel approach and may prove to be a great breakthrough in the field of image segmentation.

VIII. REFERENCES

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