A MODIFIED IMAGE EDGE DETECTION WITH UNIQUE MIXING OF CANNY AND SOBEL (UMCS)

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***Abstract*: a modified Image edge detection method is been proposed in the work where a unique mixing of Canny edge detection and Sobel edge detection is been used for finding required edges of any image. DWT cum median filter is proposed for the restoration of images that are highly corrupted by white noise or salt & pepper noise. In this filter at first the noisy pixel is identified and then it is replaced by a suitable value. Here the size of the DWT window automatically increases until it gets its suitable median value to replace the noisy pixel. This proposed algorithm shows better results than the switching mean median filter (SMMF). The proposed algorithm is tested against different images and it gives better Peak Signal-to-Noise Ratio (PSNR), Mean Square Error (MSE) and Structural Similarity Index (SSIM).The work is been done with the help of MATLAB 2013b and the results of proposed filter is found better then available work. The work is been done with the help of MATLAB 2013b and the results of proposed filter is found better then available work.**

***Keywords*: QSP, ASL, DWT, PSNR, MSE, MATLAB, UMCS**

I-INTRODUCTION

Edge detection is one of the main steps in image processing, image recognition, computer vision techniques and also very important in the image analysis domain. This types of algorithms are composed by a set of mathematical methods that have the objective to identifying points in a proposed image at which the image brightness changes rapidly or has discontinuities behavior. The main objective of this algorithm is to reduce or simplify the amount of informations provided by image and step up to a further process depending on the intended purpose. The importance of effective and reliable edge detector in most vision systems has been widely accepted [1]. It can be said that nowadays, this algorithm directly influences a number of processes such as face recognition, industrial techniques, searching systems, military systems and a lot of another different domains. It is obvious that nowadays there are a lot of strategies that try to influence the parameters of this algorithms, according to the processing time(the speed-up improved), the size of the images and to offer to the system the best possibility to work in real time.

II-DESIGN METHODOLOGY

The Canny algorithm has widely used in image edge detection. However, it is still remaining three defects. The first one is that Gaussian filtering is sensitive to noise, and it is easy to produce isolated edge points. This leads to the generation of pseudo edge points. The second defect is that the values of the double thresholds are set fixed, so it cannot satisfy the algorithm's adaptability. The last one is that it only find whether there are edge points around them, when judging candidate edge points, this method will increase the number of pseudo edge points. For example, if there is a non edge point in the neighbourhood of the candidate edge point, and it has the same gray scale value with edge point, it will misjudge the candidate edge points as edge points. This leads to an increasing number of false edges, and it causes the prospecting of the target to be submerged in the background image. In this paper, the median filter is used to replace the Gaussian filtering method, when smoothing image. Check candidate edge points through two adaptive thresholds, then connect them to form generalized chains. After that, we select generalized chains by rules to delete pseudo-edge points.
Use Gauss function to smooth image.
Obtains the amplitude gradient and direction by differential operators.
Choose non-maximal value suppression method to get candidate edge points.
Check these candidate edge points by double thresholds.
Connect the rest candidate edge points, which are connected with edge points, and get the edge detection results of image.
In this paper, median filter algorithm is used to replace Gaussian filtering method. The pixel value of a certain point in image is substituted by the median value in its neighbourhood; this method not only reduces the influence of noise, but also can eliminate the isolated point. The adaptive real-time dual-threshold algorithm is implemented by making a differential operation on the amplitude histogram of the image. First, we need to find the maximum value of the central pixel in the same gradient direction by the non-maximum value suppression method, then the maximum value is processed by double threshold, if it is not a maximum value.

III-ALGORITHM

Step 1: Histogram of the given image, by employing a histogram for digital values in order to an image and redistributing stretching value over image variation for maximum range for possible values [14]. Furthermore linear stretching from ‘S’ value may provide stronger values to each range by looking at less output values. Here a percentage for saturating image may be controlled in order to perform better visual displays.
Consider ‘a’ is a discrete and let n_i be the number of occurrences of gray level i. The probability of an occurrence of a pixel of level i in the image is

$$P_a(i) = p(a == i) = \frac{n_i}{n}, \quad 0 \le i \le L$$

L being the total number of gray levels in the image (typically 256), n being the total number of pixels in the image, and $P_a(i)$being in fact the image's histogram for pixel value i, normalized to [0,1].

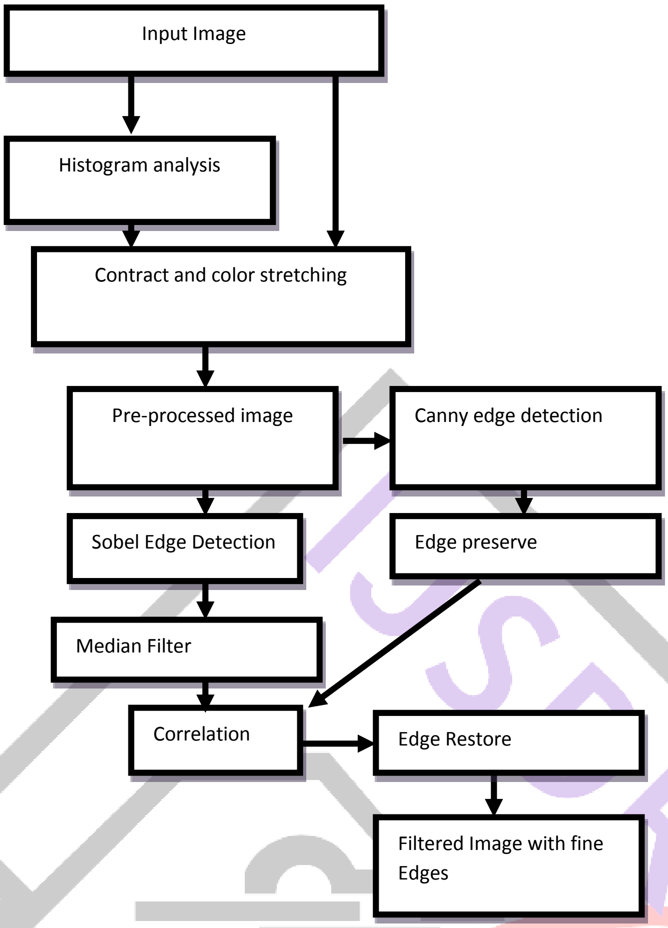

Figure 1 flow and block diagram of the work

Step 2: The contrast/colour stretching algorithm is used to enhance contrast for image. This is carried out by stretching range for colour values to make use for all possible values using the information provided by histogram analysis. Contrast/ colour stretching procedure use linear scaling function in order to pixel values. Every pixel is scaled using following function below:-

$a_o = \{(a_i\text{-}c) \times (b\text{-}c) / (d\text{-}c)\} + a$

Where

a_o is normalized pixel value;

a_i is considered pixel value taken

a is minimum value for desire range;

b is maximum value for desired range

c is lowest pixel value present in image;

d is highest pixel value present in image

The values of a, b, c and d computed from histogram values $P_a(i)$

Step 3: The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. An edge in an image may point in a variety of directions, so the Canny algorithm uses four filters to detect horizontal, vertical and diagonal edges in the blurred image. The edge detection operator (such as Roberts, Prewitt, or Sobel) returns a value for the first derivative in the horizontal direction (G_x) and the vertical direction (G_y). From this the edge gradient and direction can be determined:

$$\mathbf{G} = \sqrt{\mathbf{a}_x^2 + \mathbf{a}_y^2}$$

$$\emptyset = \mathbf{arctan2}(\mathbf{a}_x, \mathbf{a}_y)$$

where G can be computed using the hypot function and atan2 is the arctangent function with two arguments. The edge direction angle is rounded to one of four angles representing vertical, horizontal and the two diagonals (0°, 45°, 90° and 135°). An edge direction falling in each color region will be set to a specific angle values, for instance θ in [0°, 22.5°] or [157.5°, 180°] maps to 0°. The edges (G, ∅) will be preserve and at the time of image reconstruction it will be used and all the preserve pixels will replace the obtain pixels.

Step 4: 'a' is the image obtain after pre-processing (histogram and contrast stretching), DWT applied on 'a', Proposed work use 'sym4' type wavelet for decomposition of image

$$a(n)_L = \sum_{k=-\infty}^{\infty} a(k)g(2n-k)$$

$$a(n)_H = \sum_{k=-\infty}^{\infty} a(k)h(2n-k)$$

Where g and h coefficients of symlet. DWT2 is use for Images for two dimension DWT, hence $a(n)_L$ and $a(n)_H$ further need to filtered as below

$$a(n)_{LL} = \sum_{k=-\infty}^{\infty} a(n)_L g(2n-k)$$

$$a(n)_{LH} = \sum_{k=-\infty}^{\infty} a(n)_L h(2n-k)$$

$$a(n)_{HL} = \sum_{k=-\infty}^{\infty} a(n)_H g(2n-k)$$

$$a(n)_{HH} = \sum_{k=-\infty}^{\infty} a(n)_H h(2n-k)$$

DWT decomposing is require because after DWT decomposing, frequencies of image separates and with the help of that frequencies we can separate the LL, LH , HL and HH component and in proposed method different frequencies will be filtered differently.

Step 5: DWT based Median filter , The median filter is a nonlinear digital filtering technique, often used to remove noise from an image, The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns).

To demonstrate, using a window size of three with one entry immediately preceding and following each entry, a median filter will be applied to the following simple 1D signal:

x = [2 80 6 3]

So, the median filtered output signal y will be:

y[1] = Median[2 2 80] = 2

y[2] = Median[2 80 6] = Median[2 6 80] = 6

y[3] = Median[80 6 3] = Median[3 6 80] = 6

y[4] = Median[6 3 3] = Median[3 3 6] = 3

i.e. y = [2 6 6 3].

Note that, in the example above, because there is no entry preceding the first value, the first value is repeated, as with the last value, to obtain enough entries to fill the window. This is one way of handling missing window entries at the boundaries of the signal, but there are other schemes that have different properties that might be preferred in particular circumstances:

Avoid processing the boundaries, with or without cropping the signal or image boundary afterwards, Fetching entries from other places in the signal. With images for example, entries from the far horizontal or vertical boundary might be selected, shrinking the window near the boundaries, so that every window is full. Hence proposed use boundary/edge perseverance along with median filter.

IV-RESULT

Parameters for the valuation of the work are), Gradient (Grad), Entropy (Ent), Execution time and Speed Up ratio.

Gradient (Grad): An image gradient is a directional change in the intensity or color in an image. The gradient of the image is one of the fundamental building blocks in image processing.

$$\text{grad} = \frac{1}{rc}\sum_{i=1}^{RW}\sum_{j=1}^{CL} x_{ij} - x_{i(j-1)}$$

Entropy (Ent): Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image

$$\text{Ent} = \sum_{i=1}^{RW}\sum_{j=1}^{CL} p_{ij}\log_2 p_{ij}$$

Where p_{ij} is the histogram of the image x_{ij}

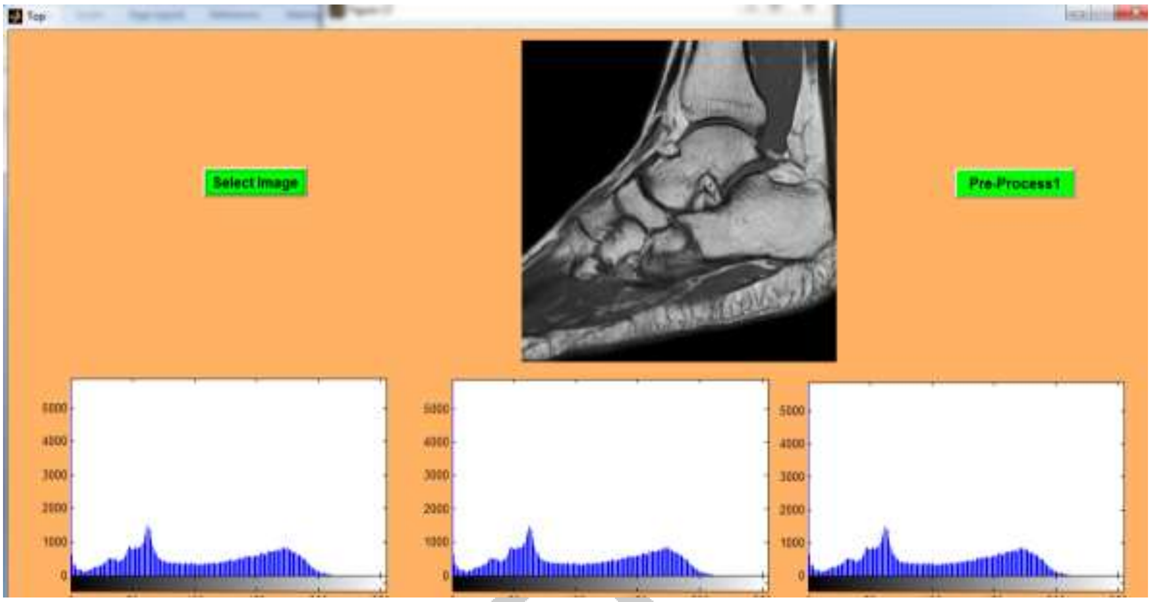

Figure 2 GIU for input image and Histogram Of MRI-1

Execution time: it is the time for execution of the function or time from taking plane input image to develop output image with edge detected.
Speed up ratio: The speed-up factor measures how much a parallel algorithm is faster than a corresponding sequential algorithm.

$$\text{Speedup} = \frac{\text{Sequential Time}}{\text{Parrallel Time}}$$

The simulation results re been performed on the MATLAB standard images of Lena and Baboon also the Simulation is been carried out for the Medical test images of [1]

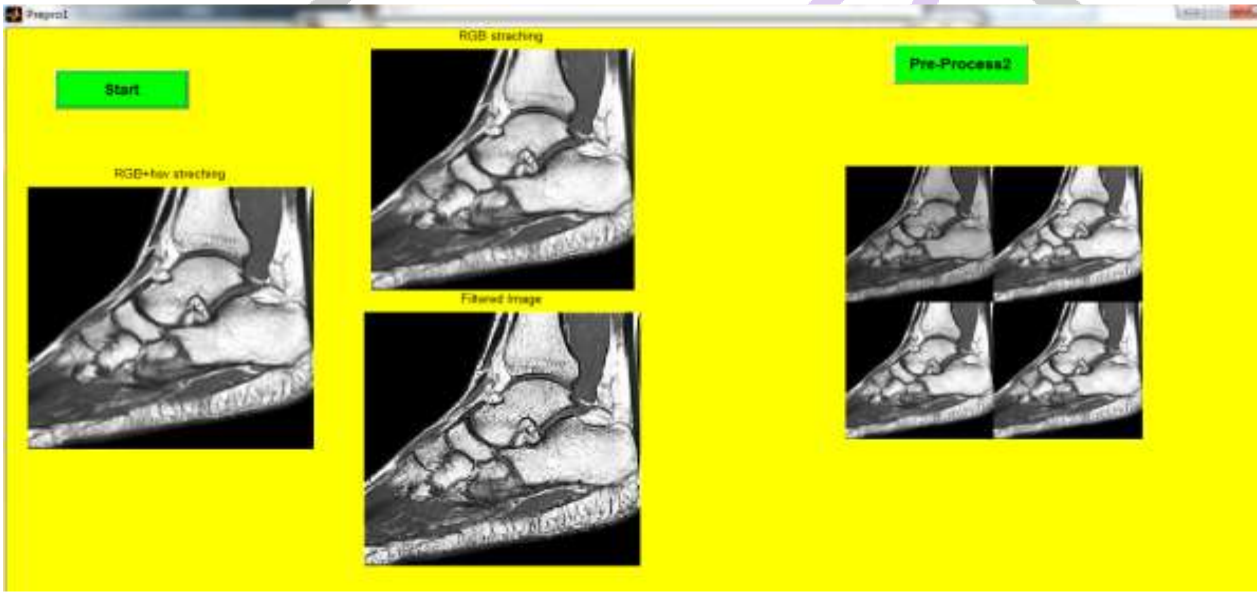

Figure 3 GIU for image enhancement of MRI-1

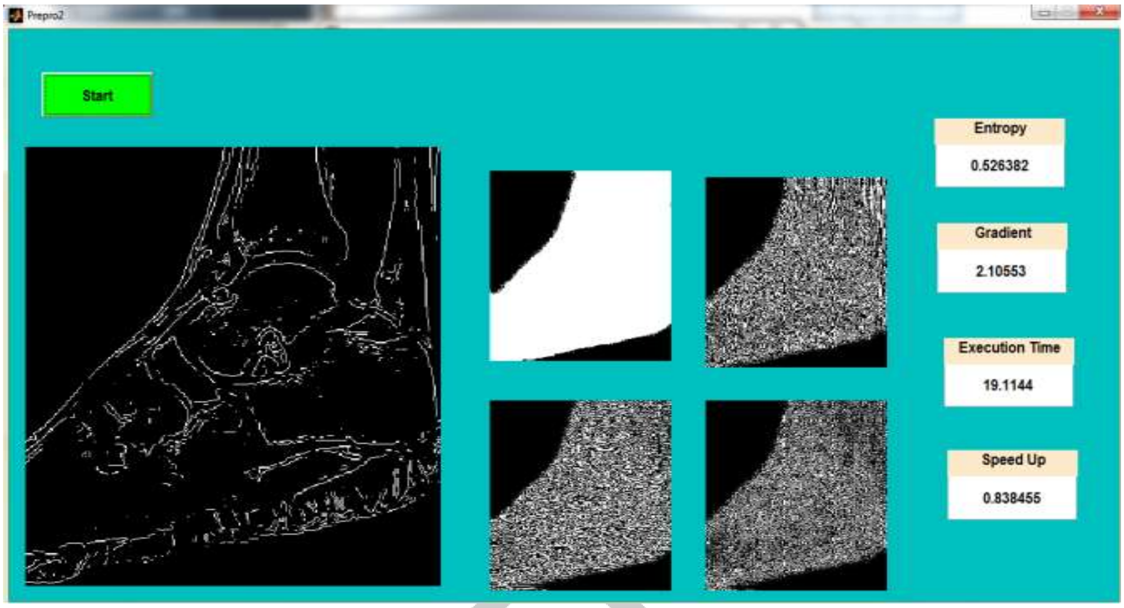

Figure 4 GIU for Edge detection and Results of MRI-1

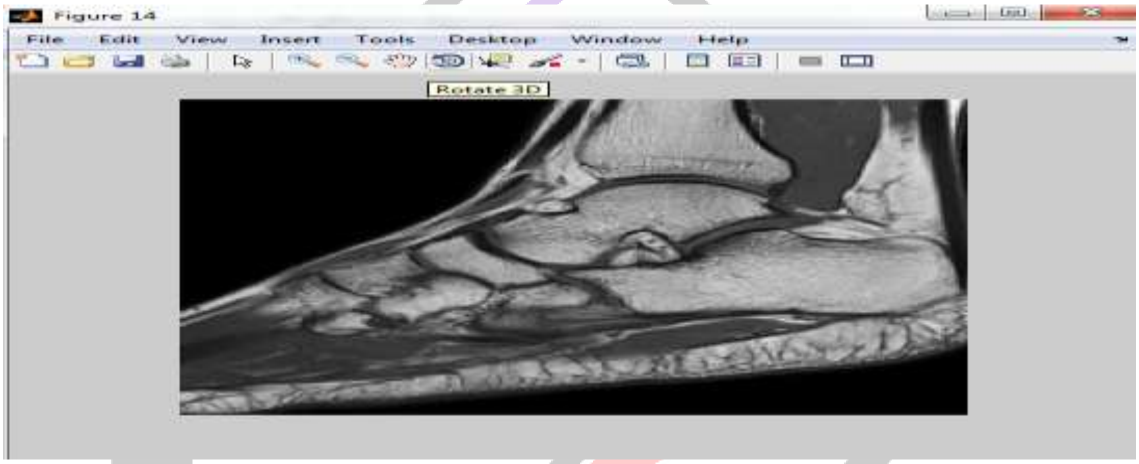

Figure 5 MRI-1 original Image

Figure 6 MRI-1 Enhanced Image

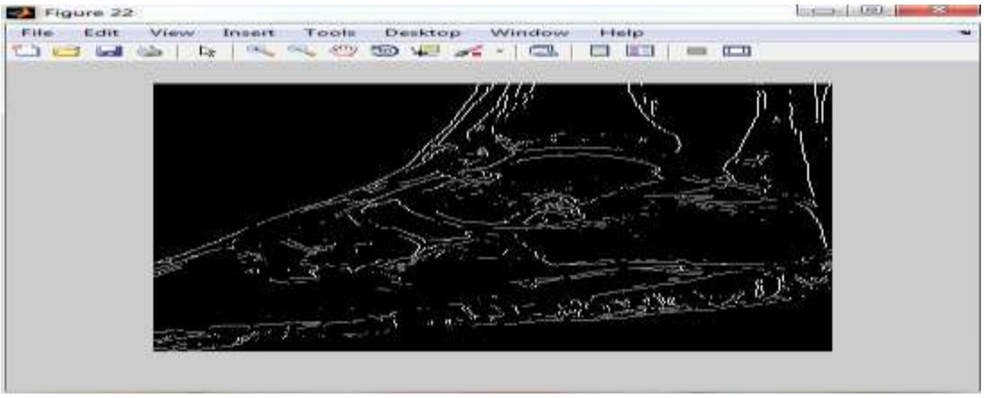

Figure 7 MRI-1 Edge Detection Image

SN	Image	Entropy
1	Lena	0.510453
2	Baboon	0.628696
3	Medical MRI-1	0.526382
4	Medical MRI-2	0.457748
	Average Entropy	0.525

Table 1 Observe results of Entropy for Different Input Images

SN	Image	Gradient
1	Lena	2.04181
2	Baboon	2.51478
3	Medical MRI-1	2.10553
4	Medical MRI-2	1.83099
	Average Gradient	2.12

Table 2 Observe results of Gradient for Different Input Images

SN	Image	Execution Time
1	Lena	30.9863 sec
2	Baboon	32.7936 sec
3	Medical MRI-1	32.1961 sec
4	Medical MRI-2	25.1398 sec
	Average Execution Time	30.27 sec

Table 3 Observe results of Execution Time for Different Input Images

SN	Image	Speed Up ratio
1	Lena	1.31809
2	Baboon	1.7181
3	Medical MRI-1	1.41229
4	Medical MRI-2	0.958973
	Average Speed Up ratio	1.345

Table 4 Observe results of Speed Up ratio for Different Input Images

SN	Work	Gradient
1	Proposed	2.12
2	Li Xuan/ IEEE/2017	3.15
3	Tapan Sharma/ IEEE/2016	3.84

Table 5 Comparative results of Gradient

SN	Work	Entropy

1	Proposed	0.525
2	Abdelilah El Amraoui/ IEEE/ 2016	0.3662

Table 6 Comparative results of Entropy

SN	Work	Execution Time (seconds)
1	Proposed	30.27
2	Bogdan Popa/IEEE/2017	75
3	Meriem HACINI/IEEE/2017	85.036

Table 7 Comparative results of Entropy

SN	Work	Speed Up Ratio
1	Proposed	1.345
2	Tapan Sharma/ IEEE/2016	1.24

Table 8 Comparative results of Speed Up Ratio

V-CONCLUSION

This study highlights that there are algorithms such as Robert or Sobel for edge detection and practical ways to improve traditional algorithms with new technology by the full utilization of the CPU on the full capacity. This article offers a comparative results study on the proposed new algorithm for edge detection and the classical ones. The new proposed strategy is based on the possibility of multiple calculus and good performances in time to the results. These analyses can convert to a good practical utilization presented in the last chapter. As edge detection is one of the fundamental operation in computer vision it is expected to be fast, accurate and reliable. Image data is typically massive in nature and it is always desirable to devise methods that can be implemented using parallel algorithms Parallel proposed strategies perform faster than sequential processing in terms of speed but with a trade off with the performance and the efficiency of utilizing the processors individually. John Canny considered the mathematical problem of deriving an optimal smoothing filter given the criteria of detection, localization and minimizing multiple responses to a single edge Nowadays with the increasing of the data size, the number of faster calculus and the speed of processing information and transfer of the important data, multi core provide a welcome alternative for fast processing. This research provides some analyzes that can be the start for another research studies that identify suitable methods to process large data fast and offer some practical features in different fields such as the agricultural domain. Starting from the three proposed types of improvement and the tests given, it can be said that at this moment it is necessary to explore all the possibility to speed up this algorithm in all terms of costs. It will be a new challenge to run such kind of faster system in practical sides in real world and with all the applications that can be done.

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