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Medical Image Processing Using the Hybrid Genetic Algorithm

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Abstract: In this research, it has been providing some kind of intelligent systems, artificial intelligence and objective application of Genetic algorithm in the field of medical image processing by using two methods and comparing this to a decision tree and the way hybrid. Medical images taken usually noise this applied the principles of image processing to remove noise from images that have been processed in this research and qualitative assessment of the solution by the function fitness random population and a group of similar operations in Genetic algorithm through the application of MATLAB Simulation program in two methods implemented in the search, the efficiency of the Genetic algorithm high by 90% proved valuable identification of infected sites in medical images used in the search and a time executive compared to a few ways that segmentation and correlation in medical images.

Key words: Genetic, algorithm, image processing, artificial, intelligence, medical, images

INTRODUCTION

The theory of the Genetic algorithm from Darwin's theory of nature (Darwin's theories) is that nature chooses the best individuals to survive in the hope of a better society for each new generation based on the survival of the fittest. The good over time because it is less likely to fall within the solutions that are spent in one generation applied this theory to the construction of mathematics rather than biological (Booker, 2000). John Holland is a random search algorithm that uses probability to guide the search. Ramos also introduced a hybrid approach that combines the Genetic algorithm with k-means technology. The hybrid method was used to improve images based on quantize vector. Representing the center-based and division-based solution and using elite selection as a method of selection characteristics of the Genetic algorithm:

- The Genetic algorithm uses the evaluation function directly and does not expand on additional information (Kenneth and Laudon, 2010)
- The Genetic algorithm looks at the population which is a set of solutions, not a single solution
- The Genetic algorithm symbolizes all latent solutions to the problem rather than directly adjusting the resolution variables of the problem
- The Genetic algorithm uses some probabilistic laws and does not use traditional laws (O'Brien and Marakas, 2010; Ralph and George, 2012)

Decision tree: A chromosome is a tree made up of number of nodes and arcs. Each node is a mathematical process,

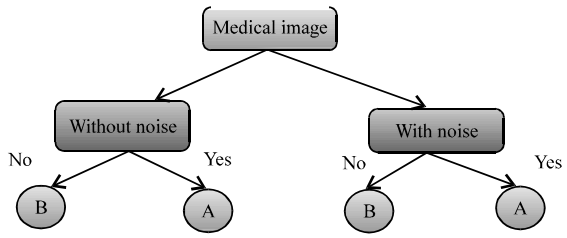

Fig. 1: Sample of decision tree

variable or fixed value. A hierarchical structure of the two nodes in the top of the decision tree is called the root node the starting point of the decision sequence and the dissociated branches of the root node which defines an individual representing the conditions in the decision to be made. Each final condition is followed by several other conditions shown in Fig. 1.

Representation and the population individuals: The constants to be optimized are usually represented as a string because genetic operators are suitable for this representation (DeMillo *et al*., 1978).

In GA, conjugation is used to express the viability of individuals to survive and continue to be able to choose the best and is called the fitness function. GA is therefore, an iterative process and during each repetitive generation individuals are evaluated in the existing society and based on this feedback. A new population of individuals nominated for selection (Baudry *et al*., 2000).

Since, the Genetic algorithm generator to find the maximum coupling J(x) by selecting individuals with the (x) character, the chain is a chromosome or an organism shown in Fig. 2. The object whose length (N) is

vector is X_1, X_2, ..., X_n where, X1 is a dye and the problem of the Genetic algorithm is two types (Kim *et al*., 2001):

- Binary encoding
- Many character and real

The first type is more common for a number of reasons, one of which is its early work with a lot of theory (GA) based on the assumption that the length is specific (Baudry *et al*., 2002). The specific order of the coding as well as Holland gave justification for the use of binary encoding. It compares two symbols roughly for the same information one with a small number of pigments as well as long chains (a series of symbols along the length of 100) and the other with a large number of pigments and a short chain (a series of two-length 30) and here has a double-chromosome serious or sharpen in the sites of genes (Gene location), Fig. 3 illustrates the basic stages of the Genetic algorithm (Offutt *et al*., 1996a, b).

Encoding chromosomes: If we want to solve the problem programmatically, each chromosome must be encoded in a way that is easy to handle before computer, depending on the question. If the variables discrete are a limited number then we can use the representation. Binary to encode all cases but if the variables are continuous (Variables continuous) it is (Gamma *et al*., 2015). The

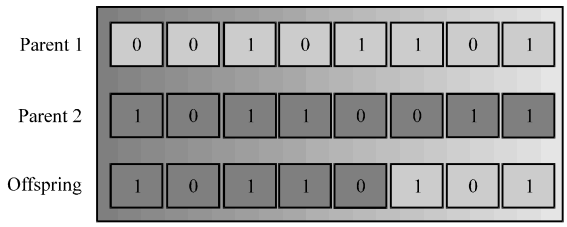

Fig. 2: Sample of mutation and crossover

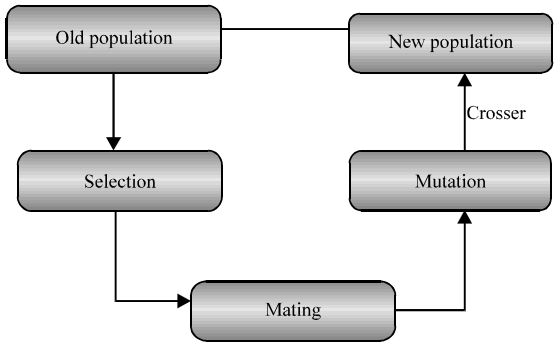

Fig. 3: The basic stages of the Genetic algorithm

number is endless and this requires a solution. One of the suggested solutions is to find a degree of precision and then divide it by the number of binary digits. To them specify the number of binary cells and then specify the size of the step us for coding, it can also (Offutt *et al*., 1996a, b).

MATERIALS AND METHODS

The solutions are encoded as chromosomes representing strings of cells called genes in each cell. Or a character that represents certain values or transactions to solve the issue (Hassan, 2004) and usually identifies chromosomes as binary numbers shown in Fig. 4.

Fitness function: It is a mathematical dependent used. In determining the efficiency of the chromosome. The best solution is that the value of the fitness function is greater minimized by issue type (Hassan and Crossley, 2003) in research the fitness represented in the Eq. 1 and 2:

$$\text{Ftness} = \text{alpha} * \text{PSNR} * \text{beta} * \text{CR} \quad (1)$$

$$\text{CR} = \frac{\text{No. of intial pixel}}{\text{No. of total pixel}} \quad (2)$$

where, the value of alpha and beta between 0 and 1 (Beasley *et al*., 2001):

$$\text{PSNR} = 10\log_{10} 225^2/\text{MSE} \quad (3)$$

$$\text{MSE} = 1/\text{MN}\sum_{m=0}^{M-1} \sum_{n=0}^{N-1} X(m,n)\text{-}(m,n)\text{^}2 \quad (4)$$

Research procedure: For the purpose of treatment of medical images, two methods were used including the implementation of the decision tree, the function C(x) was generated by the cumulative probability function. This function gives each individual (x) the cumulative probability according to the mathematical relationship:

$$C(x) = \sum_{1=0}^{x} P(i) \quad (5)$$

where, p(i) is the probability function. Determine the parameters used in the Genetic algorithm:

- The initial population selected is equal to 50
- The chromosomes encoding used binary encoding
- The mutation was used uniform crossover

Chromosome 1 0 1 0 1 1 1 0 0
Chromosome 2 1 0 0 0 1 0 0 0

Fig. 4: Chromosomes as binary numbers

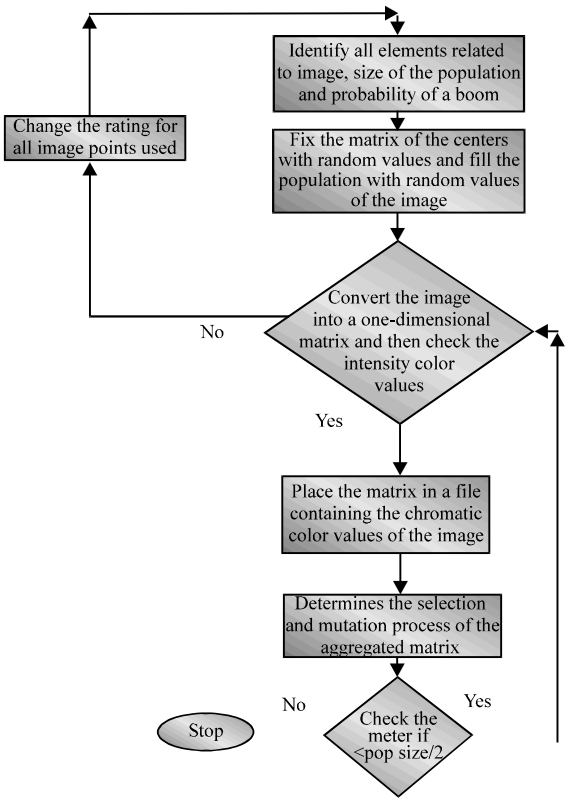

Fig. 5: Steps of classification

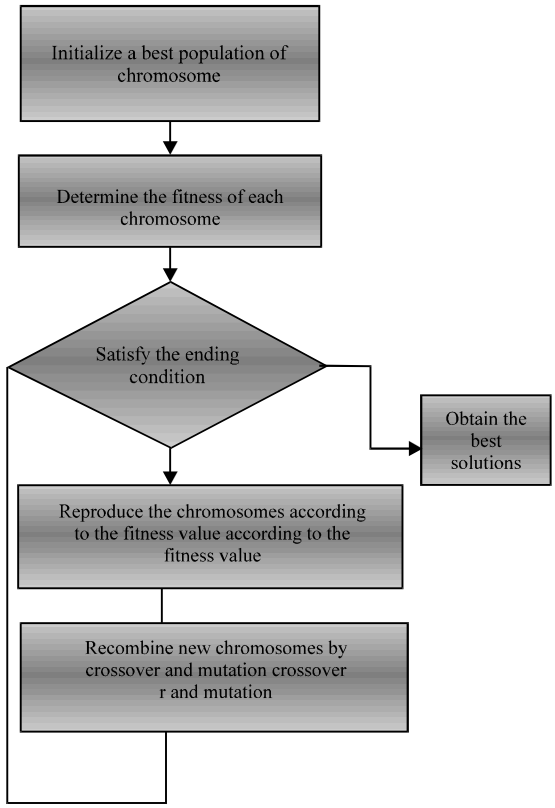

Fig. 6: The basic stages of the hybrid algorithm

The method election of ratio: 0.02 was selected adopted in the selection of mating individuals. Substitution method: A substitution method was used based on the selection of highly qualified individuals, of the generated generation, so as not to neglect any part of the existing generation. Represented by the following steps as shown in Fig. 5:

- Enter the image title and the number of classifications
- Reading the image by using the function is one of the functions of language
- View the image before sorting by using the function
- Convert the image into a one-dimensional matrix and then check the labels and color chromatography of the image where the matrix is obtained
- Find the number of points in the classification of final classifications and values of finding the classification that contains the lowest number of points and added to the classification that precedes and continues to repeat this process
- Each classification in the matrix gives a specific color according to the number of final classifications and then display the images after classification

The method included the algorithm:

- Enter the title of the image and the size of the population (po) Number of classifications () probability of a boom is the value between zero and one
- Read the image and fill the matrix centers with random values of the image
- Fill the population with random values of the image
- Calculate distance by using (r) Fig. 6 shown the method of the hybrid Genetic algorithm that used

RESULTS AND DISCUSSION

After running the program in the MATLAB environment, you can adjust the steps after identifying the treated medical images of dimensions (64*64), 5 bit were allocated for both horizontal and 5 bit vertical displacement. The matrices were (40*5) and Fig. 7 and 8 refer to medical images (blood cell) of the two methods, from results of images.

After the application of Eq. 1-4 on medical images and hybrids, the results shown in Table 1 can be obtained. The results indicate the importance of repetition of all probabilistic values for the purpose of obtaining the

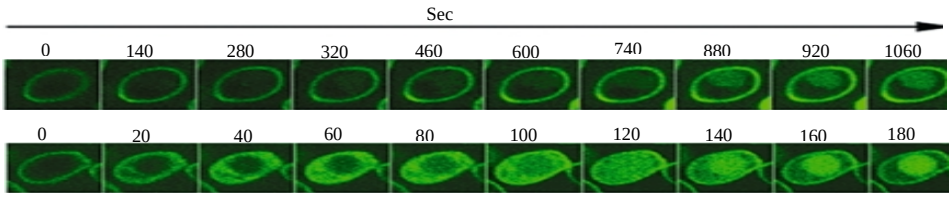

Fig. 7: Sample of medical images

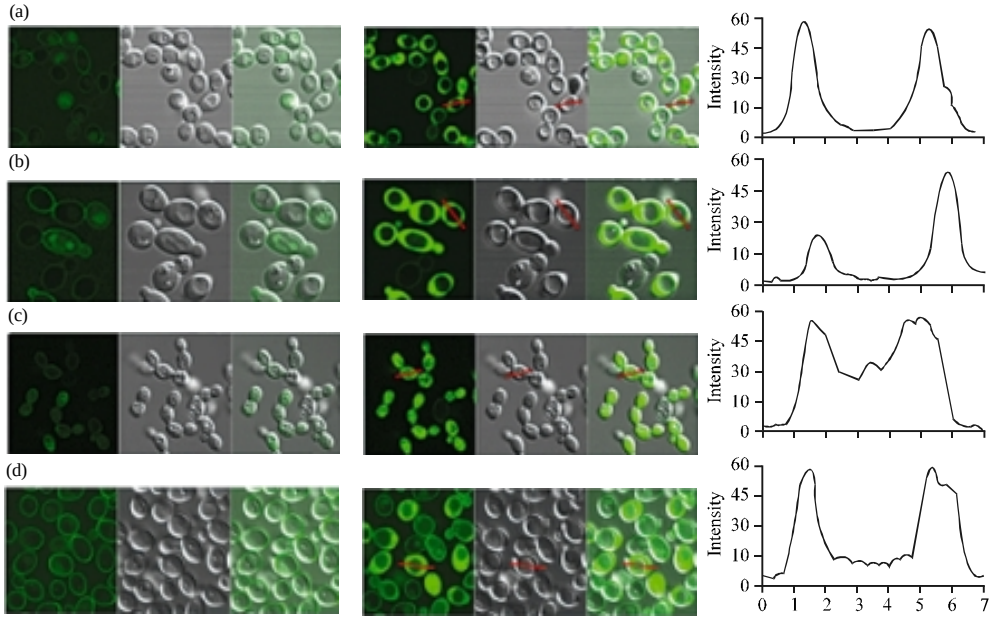

Fig. 8a-d): Medical image

Table 1: The Genetic algorithm

Subjects	1%	2%	3%	4%
Rough fitness	50/50	25/25	15/15	10/10
PSNR	7.14/36.5	5.1/26.1	4.0/20.5	3.32/16.9
P0	0.0441	0.0327.8	0.02	0
Linear normalization	40/40	30/30	20/20	10/10
CR	654.36	754.23	856.25	1250

Table 2: The Genetic algorithm

Subject	Fitness	Probability
1	2	2/8 = 0.25
2	2	2/8 = 0.25
3	3	3/8 = 0.375
4	4	4/8 = 0.5
Total	11	11/11 = 1

best selection for the members of population. The smallest value was (654.36) which emerged from a random generation (1250) simulate Table 1. Increasing the division of the size of society also leads to a reduction in the percentage of error that may occur. The values range from 4.66 and 4.02 as the lowest value and high value as for the increase in the number of mutations there is a problem at the time of implementation, inversely proportional to the number of mutation. The possibility of reducing the number for the purpose of obtaining the speed of implementation of the program.

The program shown the implementation of the fitness function within the MATLAB program as Table 2 shows the most important results for that fitness function.

The stop criterion in the program depends on the algorithm stopping when it is better the value of the fitness function is greater than the fitness value you have selected (in the maximize state).

CONCLUSION

The tree resolution is one of the methods easy to use in the classification of the variety of applications used in it and despite the simplicity in the classification of medical images, it gave accurate results. The traditional Genetic algorithm method was used because it is one of the methods for the classification of images with many data which gave accurate results in images with grayscale. Uniform crossover was adopted in the proposed hybrid

algorithm to obtain fast delivery and access to a short method for the end of algorithm work. The importance of using the Genetic algorithm in the case of failure of traditional methods to solve complex issues. The use of Genetic algorithm and Artificial Neural Networks (ANN) in medical image processing to obtain high accuracy in diagnosis.

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