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URGENT HEART DISEASE DIAGNOSIS BEFORE SURGERY: A COMPUTER AIDED

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Abstract. A quick diagnosis of heart disease is important before surgery. Sometimes delayed diagnosis caused an emergency surgery to be delayed. Therefore, in this study, diagnostic methods using rapid algorithms and medical engineering optimization methods is proposed. We presented an optimal evolutionary fast diagnostic model. The Coronary angiography using dedicated X-ray imaging systems has long been the preferred modality for diagnosis and treatment of Coronary Artery Disease (CAD) and its concomitants. Experimental results on several test images of patients with various techniques are presented. The results of our fast evolutionary diagnostic model performed well. Using bioinspired algorithm as particle swarm optimization and optimize the edge detection algorithm including noise reduction, the angiogram interpretation has been done.

Keywords: *coronary artery disease, angiography, particle swarm optimization, image processing.*

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1. Introduction

True imaging and diagnosis can be very helpful to the surgeon, and if the imaging is disturbed, it may have a bad impact on the individual. Angiographic and interventional radiologic techniques are also performed with injected contrast. In this instance, catheter insertion or needle placement is performed under fluoroscopic guidance, so that a particular vessel or organ can be see and, in some instances, repaired via the catheter. A classic example is angioplasty, for which a catheter is threaded into an obstructed vessel. An attached balloon is inflated to increase the opening of the vessel thus improving blood supply to the tissues. This procedure is commonly performed on vessels in the heart, abdomen, and legs. As one might expect, these interventional techniques are complex procedures, involving teams of nurses, doctors, and technologists working together. The great advantage is that angioplasty and other image-guided interventional procedures replace the need for (and risks of) surgery and general anesthesia for many patients. Even for other surgeries, the doctor may need to have a better picture and diagnosis with higher accuracy. The interventional service offers more specific information and advice for patients undergoing these procedures (Liu *et al.*, 1994; Chilcote *et al.*, 1981; Ryan *et al.*, 2002; Derakhshan-Barjoei & Behrad, 2007). Apart from rare congenital anomalies (birth defects), coronary artery disease is usually a degenerative disease, uncommon as a clinical problem before the age of 30 years and common by the age of 60 years. One in four people will have a heart attack (Earls *et al.*, 2014).

Cardiac blockages are detected by means of Canny edge detector and Watershed image processing algorithms implemented on FPGA (Mudigoudar & Rasheed, 2016).

Conventional X-ray coronary angiograms were performed as part of a clinically indicated assessment with an integrated digital cardiac catheter imaging system. Atherosclerosis is a multifactorial chronic inflammatory, degenerative process of large- and medium-sized arteries characterized pathologically by the presence of atherosclerotic plaque. The clinical signs and symptoms of atherosclerosis are generally summarized under the term cardio-vascular disease. Shown in Fig.1, typical cardiovascular disease is coronary artery disease (angina and myocardial infraction), cerebrovascular disease (stroke) and peripheral arterial occlusive disease. Cardio-vascular diseases are the leading cause of mortality in developed countries (Jain, 1989; Shaw *et al*., 1982; Weinhaus & Roberts; 2005; Derakhshan-Barjoei & Bahadorzadeh, 2017). The best preprocessing is a nonlinear "variant" filtering, where each pixel is replaced by the average of the 3 X 3 neighborhood having the smallest variance (Romary *et al.,* 1985).

In this method, the patient's photos were first considered and then, with the optimal processing method we proposed, the results were estimated and diagnosed and consulted by the surgeon's opinion.

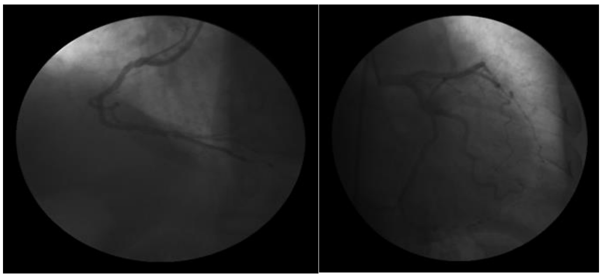


Figure 1. Two frame of Coronary angiology

2. Evolutionary algorithm for image processing

The particle swarm optimization algorithm was inspired by the behavior and movement of birds, bees and fish by Kennedy and Eberhart in 1995 (Kennedy & Eberhart, 1995). In fact, a powerful and random method for evolutionary computing based on the intelligent movement of animal categories in the search for food, which is becoming increasingly commonplace since, in contrast to the genetic algorithm, especially in issues involving continuous design variables, in Finding optimal global solutions has higher returns (Weinhaus & Roberts; 2005; Derakhshan-Barjoei & Bahadorzadeh, 2017; Kennedy & Eberhart, 1995; Clerc & Kennedy, 2002). This algorithm follows the conventional method of computational evolution. A: With random populations, possible answers begin. B: By updating the generations, it searches for the optimal answer. C. The population evaluation is based on previous generations. The algorithm of optimizing the congestion of particles The probable solutions (particles) in the solution space of the problem are displaced by looking for the optimal current particles. This transition is effected by a fitness function that evaluates the quality of each particle. If the search space is D-dimensional then the position of the ammunition of the particle of the category can be represented as a D-dimensional vector: $X_i = (X_{i1}, X_{i2}, ..., X_{iD})$. Also, the particle velocity (position change) is also represented by another D-dimensional vector can be displayed:

$$V_i = (V_{i1}, V_{i2}, ..., V_{iD}). \quad (1)$$

The best fit for particles and its corresponding positions are displayed as follow:

$$V_i(t+1) = \omega V_i(t) + c_1 r_1 (xpbest_i\ (t)\_X_i(t)) + c_2 r_2 (xgbest_i\ (t)\_X_i(t)) \quad (2)$$

$$X_i(t+1) = X_i(t) + V_i(t+1) \quad (3)$$

The optimality of the best particle in the category (Optimal Global) should also be stored in the memory of the algorithm. It has been proven that the use of weighted weight w improves the performance of the algorithm. In the particle swarm optimization algorithm, taking into account the inertia weight (inertia), particle update equations are performed with the following equations. Where $i = 1,2,\dots,N$ and N are the population of the group and c_1 and c_2 are the learning coefficients that have positive values. The coefficients r_1 and r_2 are random numbers in the interval [0,1], or the inertial weight is usually between 0.4 and 0.9. According to (Kennedy & Eberhart, 1995; Clerc & Kennedy, 2002), large values at the beginning of the search lead to a higher priority of global discovery than local discovery and to a more gradual search for more local issues, thus increasing the amount at the beginning of the search and gradually increasing the amount It slows down and slowly moves to zero. t also specifies the number of repetitions. The binary version of the particle swarm optimization algorithm was presented by Kennedy and Eberhart in 1997 (Kennedy & Eberhart, 1995; Clerc & Kennedy, 2002; Eberhart & Shi, 2000) and, contrary to the standard, can be optimized in discrete spaces. The choice of a feature is a binary discretization optimization problem. By considering a binary string for each particle, the optimization algorithm for binary particle swarm begins. In this field, 0 represents the deletion of the attribute and 1 indicates the selection of that attribute. The only difference that exists between the particle swarm optimization algorithm and the particle position update is the following:

$$\mathrm{S}(\mathrm{V}(t+1)) = \frac{1}{1+\exp(-V(t+1))} \quad (4)$$

$$\mathrm{X(t+1)} = \begin{cases} 1, if \ \frac{1}{1+\exp(-V(t+1))} > rand \\ 0, \qquad\qquad otherwise \end{cases} \quad (5)$$

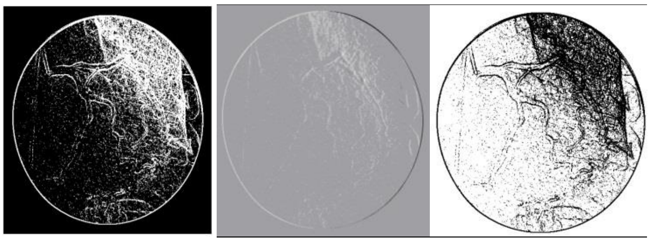
Where rand is a random number distributed uniformly over the interval [1,0]. The best values for the coefficients c_1 and c_2 can be calculated as follows:

$$\begin{cases} c_1 = \frac{1}{2Ln2} = 0.721 \\ c_2 = 0.5 + Ln2 = 1.193 \end{cases} \quad (6)$$

In the proposed algorithm, binary particle swarm optimization algorithm is used as a filter to select the characteristics with the best interactive information. The concept of mutual information was introduced for the first time to detect the relationship between these features of a data set. The speed and accuracy of the algorithm behaved better than our previous method (Derakhshan-Barjoei & Bahadorzadeh, 2012). Our proposed algorithm, involves the following steps.

Step 1*: Read the given angiogram image, and convert it into a matrix form, where each pixel value is in the range of gray level from 0-255.*
Step 2*: Apply median filtering and noise reduction method.*
Step 3: *Taking Histogram sample and equalization.*
Step 4*: Repeat process.*
Step 5*: Detect the edges of the angiogram using PSO to optimize the edge*
Step 6*: Repeat for the best result.*
Step 7: *Continue to optimize and update the parameters of PSO.*
Step 8*: Repeat.*

The output of the various edge detected angiogram images to obtain the edges of the blood vessel is shown by the histogram its histogram equalized image. The results show that the edges of the angiogram blood vessel so detected using the proposed algorithm is more efficient as compared to the canny edge detection algorithm.



a b c

Figure 2. Picture of one frame after: a) edge detection; b) derivative in x-dimension; c) negative edge detection.

In Fig. 2, the result of experience on one cardiac frame is showed, as our method shows, using optimal method is preferred and yields improved results. Now we are going to develop a method and algorithm to detect the disease of heart clearly and help the musicians to fast preventing and good health care.

3. Conclusions

In this way, the improvement of the images was very clear and accepted for recognition. In the problem data, the evolutionary technique showed the speed and accuracy of the algorithm better than related to our previous method. It is also very effective in detecting and demonstrating the effect of vascular or artery congestion in surgery. In this method, first, the patient's pictures were taken immediately and then, with the optimal processing method we proposed, the results of estimation and diagnosis were carried out by portable devices. Using this inspired algorithm and using the image-noise reduction filter, and fixing the image blurring, improved image quality and recognition.

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