Detection of Decay and Restoration Teeth Using Particle Swarm Optimization Algorithm

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Abstract—Detection of decay and restoration tooth has done by dentists up to now. We need to change this produce using intelligent application. In future new systems will be able to repair decay and restoration tooth without a dentist intervention. We need to start to research in about intelligent of detection of decay and restoration tooth. In the recent years there is severe competition in fast and high process by development of optimization algorithms and other ones. By fast and least-error process, we can implement intelligent processing of images in many applications especially for detection of decay and restoration tooth without human intervention. In the research, we have explained particle Swarm optimization Algorithm (PSO) for detection of decay and restoration teeth in pictures. These pictures are taken by radiography systems of tooth. The error rate would be reported, which it is indicated below 8 percent in reviews. This method can use the detection of decay and restoration teeth using dentist in this time. Also it can use by any new system for repairing of decay and restoration teeth in future.

Keywords— Image processing, Particle Swarm Optimization (PSO), Decay Teeth.

I. INTRODUCTION

The image processing has evolved since 1964. It led to creation of digital images of earth such as usage of multispectral images in agriculture and forestry. Since mid of 70’s until 80’s, the medicine has been evolved by invention of CAT scanners or (Computerized Arial Topography and magnetic resonance imagery). The industry of print is the next user. At end of 80’s, the process of digital images entered entrainment world so that nowadays, this is normalized. Thus, the world of industry was revolved by robots which actually see, i.e, by appearance of machine vision and still is evolving. The purity in production of food vessels is so important and also, mass production of such vessels was led to expend more time and cost on behalf of producers to control these pieces. The high detection of decay and restorations tooth by dentist, needs to mechanized...
system with high quality and rate. By mechanized systems control as well as communication of these data with optimal data bank and comparing it with valid values in real time of control units could provide the best and fast way of machine vision system [1].

It could by photography from one teeth, detect its decay and restoration it by image processing (OCR) in fractional of second, and also this detection could be conducted continuously. If the qualitative problems occur, A new system stops and again detection starts when that problem is solved. [2]. These pictures show that stay model of tooth in mouth. A dentist detect the place of decay and restoration teeth in mouth after that he/she starts repairing of decay and restoration teeth (Fig 1 and 2).

Figure 1. This picture shows that any teeth don’t have decay and restoration.

Figure 2. This picture shows that two teeth have decay and restoration.

In the second section, we review the previous research in detecting of decay and restoration teeth. Also we explain researches related to detection with PSO or other algorithms in another area. In the third section, we explain briefly our proposed method for detection of one decay and restoration teeth. In the last section, you can see the results that are obtained by our proposed method after running.

II. RELATED WORKS

In this section about previous proposed method, we couldn’t find any method for intelligent detection of decay and restoration teeth with image processing and algorithms [3,4]. All of detection has done by dentist. A dentist looks at picture and based on his-self/her-self experience detect decay and restoration teeth. A dentist detected a place of decay and restoration in one of tooth (fig 3).

Figure 3. Detection of decay and restoration teeth by dentist.

In another area has done research for detecting of liquid level in bottle (fig 4). But authors of that research didn’t implement particle swarm optimization (PSO). They have used some algorithms that they are not popular algorithms and very application. In following, you can study some of them.

Figure 4. Detection of surface level of liquid in bottle.

A. Techniques of Optimal Edge Recognition

1) Algorithm LOG

The LOG is shown that the location of edge occurrence isn’t well there as well as isn’t thin. Still it is so better than previous method on low signal over noise. Algorithm LOG[5,6]:

a) Canalution of image I by Bidimensional Gaussion function.

b) Calculation of Canalution image’s laplace, is reffered by.

c) edge pixel, for pass from zero is in L.

2) Algorithm Kani
Kani was assumed edge conditional to white Gaussian noise. The edge detector was considered with Canulation filter $f$ which distributed noise and location of edge. Here, the problem is to determine a filter which optimize three criteria in recognition of edge. Algorithm Kani [7,8]:

a) Reading of image $I$.

b) Canulation on unidimensional Guassian cover with $I$.

c) Creating an unidimensional cover for Guassian first derivative in the directions $x$ and $y$.

d) Canulation $I$ with $G$ along rows to reach $I_x$ and along bottom of columns to obtain $I_y$.

e) Canulation $Ix$ with $Gx$ to reach $Ix'$ and $Iy$ with $Gy$ to have $Iy'$.

f) Finding result in any pixel.

III. PROPOSED METHOD

Standard algorithm PSO indicated a population with $m$ member. Any member is one potential solution in D-dimensional space of the problem (M. Jiang n.d [9,10]) which is displayed as following:

$$X = (X_{i1}, X_{i2}, ..., X_{id})$$

Any member saves one memory of own previous best situation (pbest):

$$P = (P_{11}, P_{12}, ..., P_{id})$$

And also one rate along any dimension:

$$V = (V_{11}, V_{12}, ..., V_{id})$$

The vector $\vec{P}_{gbest}$ also is obtained for best neighborhood fitness. In any iteration, $\vec{P}$ and vector of $\vec{P}$ current member integrate together until adapt rate of member along any dimension. Then, given rate is used to calculate new situation of member. That section of rate adaption which is affected by previous best situation is called cognition section and that section affected by best neighborhood is considered as social section. Now, consider minimalization on which, $f$ is fitness function, that should be minimized. The equation (4) show $d$th dimension change of best situation of member.

$$P_i^d(t+1) = \begin{cases} P_i^d(t), & \text{if } f(X_i^d(t+1)) \geq f(P_i^d(t)) \\ X_i^d(t+1), & \text{if } f(X_i^d(t+1)) < f(P_i^d(t)) \end{cases}$$

In standard algorithm PSO, in iteration $t$, the $d$th dimension of rate and situation of ith member change with equations (5) and (6) respectively, $w$, $C1$ and $C2$ are f non-negative real constant parameters. $r1$, $id(t)$ and $r2$, $id(t)$ are independent random numbers with uniform distribution in the range of $[0,1]$.

$$V_i^d(t) = \beta_i = \alpha_i^d(t) + \phi_1^d(t)(P_i^d(t) - X_i^d(t)) + \phi_2^d(t)(g_{gbest}^d(t) - X_i^d(t))$$

$$X_i^d(t+1) = X_i^d(t) + V_i^d(t+1)$$

The equation of rate change also could indicate as equation (7). $\phi_1, \phi_2, \beta$, and $x$ are of non-negative real constant parameters.

$$V_i^d(t) = \beta_i = \alpha_i^d(t) + \phi_1^d(t)(P_i^d(t) - X_i^d(t)) + \phi_2^d(t)(g_{gbest}^d(t) - X_i^d(t))$$

There are many factors which could have affect on convergency and efficiency of algorithm PSO, such as $w$, $c1$ and $c2$, restricting rate and situation, neighborhood topology and ... are provided following summary of algorithm PSO (Q.He. n.d [11,12]):

a) Primary valuation in population of members with random situations and rates in which any member involves $d$ variable.

b) Calculation of fitness value of total members and setting pbest of any member and equality it’s fitness value to current situation and fitness, setting gbest and it’s equating it’s fitness with situation and fitness of best primary member.

c) Changing the rate and situation of any member corresponding equations (e) and (g).

d) Evaluating fitness value of total members

e) For any member, comparing it’s fitness value with it’s pbest one, if the current value be better, then updating of pbest and it’s fitness value with present fitness and situation.

f) Determination of best member of current population through it’s fitness value. If the value of fitness is better than gbest, then updating gbest and it’s fitness with situation and fitness value of best current member.

g) If condition of stop is met, then giving gbest and it’s fitness value as a output, otherwise go to step 3.

The flow chart diagram of bird algorithm (PSO) has been shown which through steps of flowchart, could understand bird algorithm (PSO) easily (fig.12).

In algorithm PSO, the primary population value is the same pixels from image randomly [18], which based on two main formula PSO (3) and (6), these pixels are changing, in the other words, if now the pixel cell $x$ is selected, in next time, the cell around or some distant one would be selected. For any pixel, the value in function FITNES is considered based on certain criterion. If, our program PSO is based on minimum selection, any pixel which is the nearest, has least value in function FITNES and as be in more distance, it’s value would be higher. In any step, some of pixels are selected, one of them is designated as the best point, if it’s
value is lesser than general best value, replaces it, otherwise, the same general best value is remained in same step. At end of program, the general best program which is the place of decay and restoration teeth is found.

**IV. EXPERIMENTS AND RESULTS**

In this section, you can see our results. One of pictures shows that tooth doesn’t have decay and restoration. Two other pictures show that one of tooth has decay and restoration. All of pictures are black and white. Two pictures are taken same mode and another picture is taken in different mode.

Firstly Particles have disturbed in three pictures for detection. You can see disturbing of particles in left pictures. Secondly particles start to move in any picture. During running, PSO algorithm calculates value of transferring for any particle. After running program, if there is a decay and restoration teeth, PSO algorithm can find the place of decay and restoration. You can see in one picture there isn’t decay and restoration teeth and two other pictures there aren’t a decay and restoration teeth. Our algorithm in first right picture don’t show any decay and restoration teeth but another left pictures. Our algorithm show the place of decay and restoration teeth using crossing a green line with and a yellow line (figure 6, 7, 8).

You can show converge of PSO in during of 400 steps in the picture 9. In during of 40 steps has done converge very fast after that converge has done very slowly.
I. CONCLUSION AND FUTURE WORK

In this research, we introduce image processing for some application. Image processing method hasn’t used for detection of decay and restoration teeth. Firstly we use image processing for our research. In our research we used both image processing and Particle Swarm Optimization (PSO) Algorithm for detecting of decay and restoration teeth. Our result shows that this method can detect decay and restoration teeth in radiography pictures. In addition, the error rate of our research would be reported, which it is indicated below 8 percent in reviews. This method can use the detection of decay and restoration teeth using dentist in this time. After development this method, the error rate can be less than 0.5 percent. In that time we can use by any new system for repairing of decay teeth in future.

For future work, we can advise that any researcher development detection of decay and restoration teeth using image processing and other popular algorithms.

REFERENCES