ABSTRACT

Dental disease detection and diagnosis has become an emerging area of research encompassing the various image processing techniques for better analysis and cure. Dental diseases can include gum disease or tooth decay, discoloration of tooth, fracture in tooth, abnormal eruption of wisdom tooth, plague, cancer or may result in tumor. The dental tooth decay is arises due to the presence of fermentable carbohydrates such as sucrose, fructose and glucose. The presented research work is focused to detect the level of dental cavity in dental images for tooth decay using different clustering approaches and image processing operations. There are very limited techniques based on which the level of damage due to dental cavity done to the tooth under observation, can be described. In the presented work, study and analysis of the various clustering algorithms with its advantages and drawbacks is discussed in details. The sizing operation is used to determine the penetration level of cavity in the tooth. A comparative analysis of performance of the existing and proposed methods with root-mean-square error (RMSE) and Peak Signal to Noise Ratio (PSNR) error is presented. The results show significance improvements over the existing techniques in cavity extraction and segmentation using the hybrid approach of K-means and PSO. The radial features bear fair quality in determining the cavity size and its penetration into the teeth.

Keywords: Image Segmentation, SVM Classifier, Texture Features, Statistical Features.

I. INTRODUCTION

Dental disease detection and diagnosis has become an emerging area of research encompassing the various image processing techniques for better analysis and cure. Dental diseases can include gum disease or tooth decay, discoloration of tooth, fracture in tooth, abnormal eruption of wisdom tooth, plague, cancer or may result in tumor. The dental tooth decay is arises due to the presence of fermentable carbohydrates such as sucrose, fructose and glucose. The dental caries occur on smooth surfaces and on pits and fissures. The proximal caries are difficult to be identified. Dental caries is an infectious disease caused by acidogenic bacteria, may lead to dissolution of enamel and dentin, (coronal caries) and cementum and dentin (root caries).

Clustering is grouping of the objects based on their common characteristics. The main aim of clustering is to group the similar objects into one cluster. The better the similarity within the group and dissimilarity to the other group better is the clustering. It plays crucial role data mining applications such as scientific data exploration, information retrieval and text mining, spatial database applications, Web analysis, CRM, marketing, medical diagnostics, computational biology, and many more. The clustering is sometimes confused with classification. The former forms the groups or clusters and is an unsupervised approach whereas the later is a supervised approach done under expert guidance having pre-defined class labels for the objects.

II. RELATED WORKS

Senthilkumaran (2012) performed an edge detection method for finding the boundaries of the teeth cavity region. In the X-ray for dental cavity, the problems in structures, injuries, damage to teeth can be easily detected. Detection of cysts, tumors or dental problems can be easily identified. Edge detection is produces some physical or geometrical variation on scene objects.

Saravanan et al. (2014), proposed a method using histogram and power spectrum computation for analyzing the presence of dental caries. The histogram in image processing depicts the information on location, spread and shape that helps the user to identify the caries.
Walter et al. (2009), performed cluster analysis on the children of age group of 5-6 years. The different caries patterns are analyzed for the dental assessment. The patterns include smooth surface, tooth other than maxillary incisors, maxillary incisors, molar occlusal surfaces, second molar pit and fissure surface.

Unnikrishnan et al. (2014), proposed method that utilizes optical imaging for detection of oral caries. The optical spectrum of tissues contains information about biochemical composition or structure of tissues.

Sharmila et al. (2013), proposed method utilizing the radiographic image for detecting the dental plaque. Radiography has become an important tool for detecting dental and maxillofacial lesions. The principal advantages of panoramic imaging are broad coverage of the facial bones and teeth, low patient radiation dose, ability to be used in patients who are unable to open their mouths, short time required to make the image.

Koutsouri et al. (2013), proposed method comprising of detection of decalcification areas and detection of occlusal caries with fusion of the results. The procedure converts the color image to gray scale eliminating hue and saturation retaining the illumination.

Kaushik et al. (2014), proposed method that uses X-ray of dental image for segmentation with the Level set Active Contour (LSAC). The method initiates with the image enhancement and conversion from RGB to gray scale.

Kang and Ji (2010), proposed method that automatically quantifies the dental plaque with mean shift algorithm. The basic step of dental plaque quantification is to separate the plaque from other anterior parts of teeth.

Rad et al. (2013), address the feature extraction and segmentation for diagnosis of dental problems. The segmentation is done with level set method for extracting the tooth from background image.

III. ALGORITHM

Dental Images with cavities are shown in below figure-1. The images are in RGB color format and are converted to gray scale image using RB to Gray scale color transformation.

![Figure 1: Dental Images with cavities](image_url)

In the PSO algorithm, the birds in a flock are symbolically represented as particles. These particles can be considered as simple agents “flying” through a problem space. A particle’s location in the multi-dimensional problem space represents one solution for the problem. When a particle moves to a new location, a different problem solution is generated. This solution is evaluated by a fitness function that provides a quantitative value of the solution’s utility.

The velocity and direction of each particle moving along each dimension of the problem space will be altered with each generation of movement. In combination, the particle’s personal experience, Pid and its neighbors’ experience, Pgd influence the movement of each particle through a problem space. The random values, rand1 and rand2, are used for the sake of completeness, that is, to make sure that particles explore wide search space before converging around the optimal solution. The values of c1 and c2 control the weight balance of Pid and Pgd in deciding the particle’s next movement velocity. For every generation, the particle’s new location is computed by adding the particle’s current velocity, V-vector, to its location, X-vector.

After the dental images are segmented using the particle swarm optimization algorithm, the respective gray areas are extracted from the gray image by mapping the segmented part to that of gray image. This way, the real gray segmented image is obtained. Following images shows the segmented binary image and corresponding gray segmented images.
The gray scale images are converted to binary image using Otsu algorithm and segmented dental images using PSO algorithm are given in figure-4.

Figure-2: Gray Image

Fig.3: Block Diagram
Figure 4: Segmented Binary Images in Different Frames using PSO algorithm

IV. RESULTS AND DISCUSSION

The teeth with dental cavities are extracted using the segmentation process as shown in figure 4. The cavity size is determined using the radial features that include minimum and maximum radii in each quadrant along with figure aspect i.e. the ratio of intercepts on x-axis and y-axis. The radial features are given in below table for the segmented teeth shown in figure 4

Table 1: Segmented Cavity’s Radial Features

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<tr>
<th>Fig. No. (4)</th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
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V. CONCLUSION

The results in the table 1 show the radial features of the segmented teeth with cavity or no-cavity. The cavity area less than certain threshold may be termed as teeth with cavity and can be decided with medically validation data in consent with expert dentist. A fine tuned threshold will depend upon the imaging device quality and segmentation criteria.
VI. REFERENCES


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