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A Survey of Diagnosis of Dental Image Diseases using Soft Computing Techniques

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Abstract: ***Dental imaging is an area of research where imaging plays important role in disease diagnostic, treatment and analysis. Root Infection is the cause for the Dental cysts and tooth get affected by carious decay. There are mainly three types of Dental cyst i.e. Ameloblastoma, Keratocyst and Dentigerous cyst and treatment depends on the type. Odontogenic, Keratocysts and Ameloblastoma have high reoccurrence rates compared to other types. It is very necessary to differentiate between different forms of cysts to prevent disease progression.***
Keywords: Ameloblastoma cyst, Keratocyst cyst, Dentigerous cyst, Radiography, Soft Computing, Neural Network.

I. INTRODUCTION

Dental Radiograph based human bio-metric information is the latest research area in the biometric identifier domain [1]. The finger print and facial biometric suffers from the tampering problem as they are easy to manipulate. Even the face has the biggest threat of tampering. Face based biometric is not a reliable biometric as face is most susceptible to variation even by small change. However, dental profile is not possible to get tampered. No one would dare to get into it. As this being the costly affair and even the painful should be. The dental diseases targeted in the paper are Keratocyst, Ameloblastoma, Dentigerous cyst

However, the database generation using dental based bio-metrics features is not very common and needs a systematic arrangement as it involves the x-ray device for getting the profile[3]. X-ray machines are now-a-days digitized and a digital x-ray of the dental profile may be obtained in just short time. But, the problem is that the taking dental profile is not volunteer in nature. The person under scanner made to be present forcefully.

II. EXISTING WORK

Ayman Abaza et al. [1] in their paper “Retrieving Dental Radiographs for Post Mortem Identification” explained a technique based on Principal Component Analysis presented for fast searching mechanism of Automated Dental Identification System. In This Segmented tooth is compared with corresponding reference tooth. The Experimental Results shows that appearance based features are better results than average record to record matching. On the basis of primary observations the efficiency can be achieved.

Gamal Fahmy et al.[2] in their paper “Towards an Automated Dental Identification System” proposed an architecture for ADIS(automated dental identification system) used for identify missing persons by law enforcement agencies. but there is problem of migrating from region based image matching to case based image matching. The other computer aided identification systems CAPMI and Win ID but they donot provide high level of automation. To overcome this problem ADIS can be designed to achieve accurate results with minimum amount of time. Hang Chen et al.[3] in their paper “Dental Biometrics: Alignment and Matching of Dental Radiographs ” observed area based matric a method for matching dental radiographs. There are two stages which are feature extraction and matching. The feature extraction uses the anisotropic diffusion to enhance the images and for segmentation mixture of Gaussian model is used. With the help of shape registration method distance b/w two teeths can be calculated and can be further used to measure the similarity between images. For poor quality images shape extraction difficult. Samir Shah et al.[4] in their paper “Dental Automatic Tooth Segmentation Using Active Contour Without Edges ” discussed Active Contour without edges which is used to extract the contour of teeth. The technique which is used depends upon the intensity of the whole tooth region not only edges. Maja Omanovic et al.[10] in their paper” Exhaustive Matching of Dental X-Rays for Human Forensic Identification “proved computer aided framework for scoring and ranking method which is based on Sum of differences for matching dental radiographs. The system compare ROI (Roughly Circling Tooth of Interest) to AM radiographs one by one and calculate cost based SSD cost function. The best radiograph is that which has the lowest cost. SSD cost function helps to express the degree of similarity/overlap between two radiographs. Due to the versatility of the approach it can be either serial or parallel mode. Firstly the two methods run in parallel which are separate from each other, and after that we use two other approaches one for pre-filter the database and other is to refine the results. In further it is possible to validate the results for achieving high quality test data, and also possible to run more experiments by using more than one ROI and more than one radiograph.

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Aliaa A. A. Youssif et al.[14] in their paper" Automated Periodontal Diseases Classification System" showed an innovative system for classification of periodontal diseases using Haematoxyl in and Eosin(H&E). In this blood vessels count &percentage features are extracted for classification by using the technique of Artifical Neural Network. The report of classification is 100% accurate for identifying the different periodontal diseases. In this firstly take the H&E slide and then remove the background and undesired objects via some preprocessing steps, and then segment it into two components epithelium and connective tissue .By using these components features can be extracted. These features are helpful for classification alomg with the clinical data.

Xin Li et al.[15] in their paper" Fast and Accurate Segmentation of Dental X-Ray Records Periodontal Diseases Classification" gives automated hierarchical treatment for solving the problem of cropping the dental image records into films. This approach is based on the concepts of mathematical morphology and shape analysis. The experimental results shows that this approach achieves higher accuracy and timeliness. The process starts by using the rectangular film property and then separate the background which has different colors. Then according to the right corner and round corner the connected components may be classified. The round corner components can be cut whether they are 90degree or 180 degree and right corner can be cut by viewing the boundary films.

Mohammad Hossein et al.[17] in their paper" Automatic Classification of Teeth in Bitewing Dental Images" explained an automated algorithm using Bayesian Classification to classify teeth in bitewing dental images. On the basis of numbering system an absolute number is assigned to each tooth. Using Bayesian Classification molar and premolar teeth in bitewing images can be classified. The results shows that this classification of molars and premolars are highly accurate.

Santaji Ghorpadeetal.[19] in their paper "Pattern Recognition Using neural networks" developed recognition system for human faces by using Self Organizing Feature Map which is the algorithm of Neural Network. The proposed system gives subsets of faces which are similar to the query face which is given. Using self-organizing map system provides the integration of multiple feature-sets. Secondly, by using compressed feature vector SOM is trained to organize all the face images in a database. In this firstly the images were taken from database then transforming the input data into set of features to achieve the desired task. Then training is done with the help of SOM which forms clusters. Using Euclidean distance formula matching is performed with the trained clusters of the database. The minimum distance between input image and classifiers is the best match of the face recognition.

M. Robert et al.[23] in their paper "Improving the Detection of Osteoporosis from dental radiographs using active appearance models" located the mandibular edges by using the Active Shape Model to improve the accuracy from Osteroporotic enriched training set with complex texture model. In this firstly AAM texture model residual sum of squares is calculated. Then we transform it into Gaussian cumulative distribution.

Hanifan Prafiadi et al.[33] in their paper "Image Analysis for Correlation between Dental Panoramic and micro CT to measure bone density" identify the osteoporosis by using the Bone Mineral Density which is normally done by Dual Energy X-Ray Absorptiometry. In this two types of images were taken one from micro CT and other from panoramic images to measure the bone density. To determine the dental panoramic radiograph the bone density of both results of micro CT and radiography panoramic images are compared. The result shows that dental panoramic radiograph has the potential to detect osteoporosis.

Dr. N. Senthil kumaran.[34] in their paper "Edge Detection for Dental X-Ray Image Segmentation Using Neural Network approach" proposed a method of edge detection by using Neural network. Dental x-ray image is used in this to produce the edges of an image and efficiency can be confirmed. It helps to finds the problems in the mouth like tooth decay, dental injuries. The work may be extended for large cavities, difficult tooth removal.

Siti Arpah Ahmad, et al.[35] in their paper "An Analysis of Image Enhancement Techniques for Dental X-Ray Image Interpretation" showed the comparison of qualitative and quantitative comparison between the original images and image enhancement techniques Adaptive histogram equalization, CLAHE, median adaptive histogram equalization(MAHE)and Sharp contrast adaptive histogram equalization(SCLAHE) to dental X-ray image. On the basis of dentist evaluation quantitative analysis can be done by using Contrast improvement index, signal to noise ratio, and root mean square. The results show that enhancement techniques enhance the pathology better than the original image.

A. Farzana Shahar Banu, et al. [38] in their paper "Texture Based Classification of Dental Cysts" classifies the dental cysts by using the technique of Image negation and contrast stretching. Firstly the dental radiographs are enhanced using contrast enhancement. Then GLCM is extracted by using sample images of different types of cysts. The features include contrast, correlation, energy, homogeneity and mean. The results of classification are based on k mean clustering and centroid and then accuracy can be accessed.

Peiyi Li , et al. [39] in their paper "Trabecular Texture Analysis in Dental CBCT by Multi-ROI multi feature fusion" explained multi feature multi ROI approach inside oral cavity for analyzing trabecular patterns by using cone beam computed tomography. The result shows that the combination of machine learning techniques and texture analysis can be used for trabecular pattern analysis. With the help of region of interest fractal dimension and gradient based features are extracted.

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Then GMKL(generalized multi kernel learning) is used for distinguish the trabecular patterns from different groups. For validate the method trabecular patterns are distinguish from different gender age groups female younger than 40 years, female older than 40 years, male younger than 40 years, male older than 40 years.

Leila Ghaedi, et al.[40] in their paper "An Automated Dental Caries Detection and Scoring System for Optical Images of Tooth Occlusal Surface" designs automated system to detect and score caries lesions according to the guidelines of International Caries Detection and Assessment System. The system extracts 77 features of each image and then detects the tooth boundaries and irregular regions. The features include the statistical measures of color space, grayscale image ,wavelet transform, Fourier transform. The advantage of designed system is that it does not require expensive imaging sensors and external hardware.

M.V Bramhananda Reddy, et al. [41] in their paper "Dental X-Ray Image Analysis by Using Image Processing Techniques" showed how image processing techniques check the X ray and find the extent of caries present and then classify its type. The classification of dental caries is based on whether it is present within the enamel, dentin and it touches with the pulp. The implementation can be done by using an object oriented environment for image processing. The dental caries classification algorithm is followed. Edge detection algorithm is applied on segmented tooth. Object oriented environment is used in image processing.

A. Valenzuela,et al. [42] in their paper "The application of dental methods of identification to human burn victims in a mass disaster" proposed dental identification in case of burn victims of bus accident in spain. The results shows that Odontological and radiographic procedures are powerful in case of burn victims. On the basis of postmortem dental features an individual can be identified. The antimortem and postmortem records and radiographs were compared manually. To draw the conclusion the results were discussed between the two teams. A report which is generated shows the identity of each victims .

Paulo F. Ribeiro, et al.[43] in their paper" A hybrid particle Swarm and Neural Network Approach for Reactive Power Control" described the use of PSO to select optimal inputs, topologies and transfer functions for artificial neural network. Before training standard methods require user for choose the inputs, topology. ANN does not meet these requirements so to overcome these problems PSO can be used. For constructing the network sparm the main focus is to provide the training ANN with PSO. In this individual acts as particle and located in the hyperspace according to the weights of network elements. The second step is to provide the training with swarm of neural network. the training can be iterated over each network. The best network can be determined by compare all the network errors.

P. Mohanaiah,et al.[44] in their paper" Image Texture Feature Extraction Using GLCM approach" presents the application of gray level co-occurrence matrix to extract statistical features namely Angular second Moment, Correlation, Inverse Difference Moment and Entropy by using the technique Xilinx FPGA. The results shows that these features have high accuracy and it requires less computation time as compared to other techniques when RGB image converts into Gray level image and it is mainly used for real time Pattern recognition applications.

Vidushi Sharma,et al.[45] in their paper" A Comprehensive Study of Artificial Neural Networks" explained the description about the artificial Neural Network, its characteristics and its applications and its importance. ANN consists of processing elements which are interconnected with each other. Fault tolerance, Learning ability, Adaptability, Distribution representation and computation are the characteristics of ANN.

III. RESULT AND DISCUSSION

After analyzing the various research work, it is concluded that segmentation of teeth using Particle Swarm Optimization produced fair results in terms of segmentation. The teeth segmented can be further processed using various statistical features and using grey level co-occurrence matric and this has shown a fair distinction between the normal or healthy tooth and tooth with some decease. The texture features of the deceased tooth quite differ from the healthy tooth. The GLCM comes out to be quite effective tool in analysis of the tooth condition.

IV. CONCLUSION AND PROSPECTS

The algorithm may be embedded into the dental radiograph machine where the machine may give interpretation of the dental images under test. The interpretation needs to be developed with dental surgeon with very care and precaution. In that way, the work may be fully utilized for dental treatment and monitoring the progress of the treatment. Presently, the kind of algorithms is not associated with the x-ray devices. And prime focus is given on the image acquisition and its quality. Once the machines are associated with the interpreter, the machine becomes a useful tool where even the operator may be in a position to extract impression of the status of the teeth and communicate to doctor if doctor is at some remote location. The segmentation needs to be interpreted in a careful manner as human intervention is must in each diagnostic procedure. Human analysis or endorsement is very much required as it's the analysis domain and person to person analysis may be different however, machine to machine analysis will be same.

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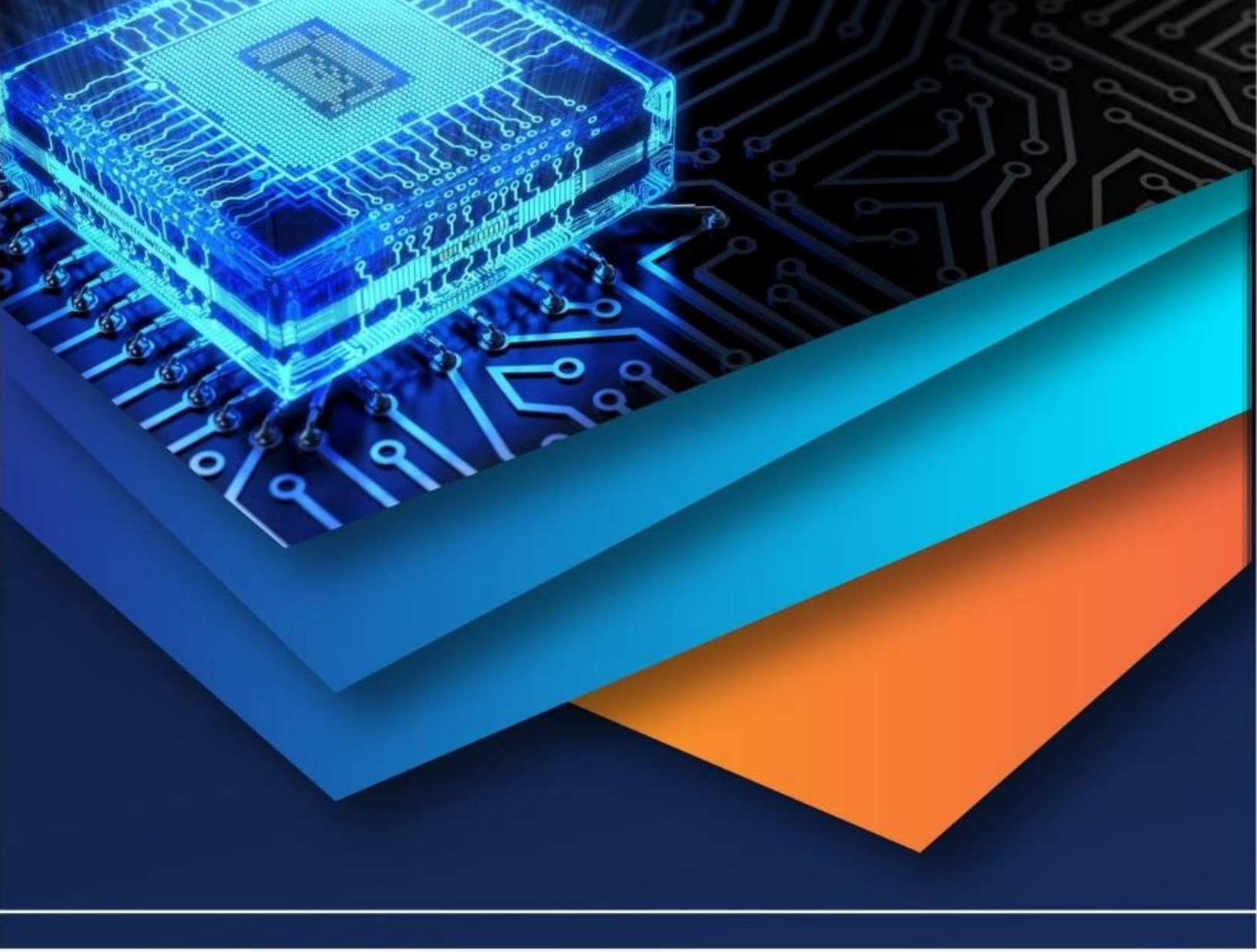

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