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Dental Caries Diagnose System

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Abstract

Recently AI techniques have lifelong impact in biomedical and widely accepted outcomes. The main objective of the paper is to evaluate accurate detection of caries using feature extraction and classification of the dental images along with K-NN classifier. Input image is acquired from database of dental images. This image is then pre-processed to remove noise. Here pre-processing is for improvement of the image data so as to suppress unwanted distortions or to enhance image features which are important for further processing. Dataset of dental caries is feed as input to training of K-NN classifier, in order to classify the image and to predict whether the feature extracted image is normal or affected by cavity.

Keyword*— Caries Diagnose, DWT, KNN Classifier, PCA etc*

I. INTRODUCTION

Dental disease can be detected using image processing. Image contains noise and other environment interferences. Here in this paper we proposed a method to detect dental caries from image. Here in dental caries detection, images can be analyzed manually but they may prone to error and might be time consuming. Generally radiographic films are used to diagnosis of dental diseases, due to this, noise and other environmental interferences introduces errors. This system which proposed in this paper will help dental practitioners to identify the caries with ease. Here we are using MATLAB and it performs caries detection process and in that we used image preprocessing phase for accurate result.

We used many image preprocessing steps to remove noise and other methodology to detect caries accurately because image is prone to noise and other environmental interferences Image Segmentation is used to detect dental caries so system can separate caries from tooth. It would be easy and accurate to detect caries. If in case caries are not detected, that means tooth is definitely healthy. We used image processing methodology to track caries. This system involves image processing steps and detection of dental caries. The proposed system is able to detect dental caries with 50-60% accomplishment rate. Dental caries is most common oral infectious disease. It is painful and caused by Streptococcus mutants, acid and carbohydrates. If these dental caries remain untreated then it will affects the root of the teeth and finally uprooted the teeth. Hence, if caries detected at its early stage then surgical interventions could be avoided. World Health organization (WHO) report reveals that 98% adult people and (60-90) % of school children are suffering from dental caries [2].

In this system, input image is acquired from database of dental images. This image is then pre-processed to remove noise. The aim of pre- processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing. Dataset of dental caries is feed as input to training of K-NN classifier. In order to classify the image

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and to predict whether the feature extracted image is normal or affected by cavity. Further, with the desire of classifying the non-caries and caries images, K-NN classifier is adopted in this research.

II. LITERATURE SURVEY

Paper [1] has built up an algorithmic investigation on novel caries location model so as to have an exact recognition in the tooth holes. The proposed caries recognition model was separated into two stages: highlight extraction and order. The element extraction was done dependent on MPCA, and the arrangement was finished utilizing NN classifier. The element extraction and arrangement were done on picture in the wake of preprocessing with differentiate improvement, Gray edge, and dynamic form. The extricated highlights were increased with the weighting component, and afterward the Nonlinear Programming Optimization was utilized with an aim of boosting the separation between the resultant element outputs. The preparing of NN classifier was practiced utilizing ADA calculation. At last, an algorithmic examination was conveyed for MPCA – ADA over the traditional classifier models like PCA-ADA, LDA-ADA and ICA-ADA as far as Accuracy, Sensitivity, Specificity, Precision, FPR, FNR, NPV, FDR, F1Score and MCC for Test case1, Test case2, and experiment 3.

Dental caries is a typical bacterial oral illness of teeth. Our mouth gets unhygienic because of the nearness of sugars, corrosive and microscopic organisms. These demolish the lacquer, dentine layer of the tooth. Streptococcus freaks are liable for dental caries. According to World Health Organization report around the world, 60–90% of younger students and practically100% of grown-ups have dental caries. Dental caries and periodontal ailment for long days without treatment causes tooth misfortunes. Not so distant future it will be a scourge. It is a constant illness that can influence us at any time old enough. Late research has shown that there are potential connections between oral contaminations and diabetes, heart, lung ailment, stroke, and untimely births. Thus early recognition of dental caries in finish would be extremely basic. Dental specialists for the most part use radiographs to recognize dental caries. Habitually taken x-beam is unsafe to human body. Shockingly there is certifiably not a solitary technique to identify caries in its beginning period. Consequently, the reason for paper [2] is to recognize the current caries location techniques and discover its escape clauses.

2-D radiographs, while ordinarily utilized for assessing sub-surface hard structures of teeth, have low affectability for early caries injuries, especially those on tooth occlusal surfaces. Radiographs are additionally every now and again denied by patients over wellbeing concerns. Translucency of teeth in the close infrared (NIR) extend offers a non-ionizing and safe way to deal with identify dental caries. Paper [3] reports the development of a NIR (850 nm) LED imaging framework, contained a NIR source and an intraoral camera for quick dental assessments. The NIR framework was utilized to picture teeth of ten consenting human subjects and effectively distinguished optional, amalgam-impeded and early caries sores without strengthening picture handling. The camera-wand framework was likewise fit for uncovering demineralized territories, profound and shallow splits, and other clinical highlights of teeth normally pictured by X-beams. The NIR framework's clinical utility, shortsighted structure, ease, and ease of use make it a successful dental caries screening innovation related or instead of radiographs.

Oral injuries are significant discoveries on registered tomography (CT) pictures. In [4], a completely programmed strategy to distinguish oral injuries in mandibular area from dental CT pictures is proposed. Two techniques were created to perceive two sorts of injuries to be specific (1) Close outskirt (CB) sores and (2) Open fringe (OB) sores, which spread a large portion of the sore kinds that can be found on CT pictures. For the identification of CB injuries, fifteen highlights were separated from each underlying sore applicants and multi layer perceptron (MLP) neural system was utilized to arrange suspicious districts. Additionally, OB injuries were distinguished utilizing a standard based picture preparing technique, where no element extraction or arrangement calculation were utilized. The outcomes were approved utilizing a CT dataset of 52 patients, where 22 patients had variations from the norm and 30 patients were typical. Utilizing non-preparing dataset, CB discovery calculation yielded 71% affectability with 0.31 bogus positives per quiet. Besides, OB

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location calculation accomplished 100% affectability with 0.13 bogus positives per understanding. Results recommend that, the proposed system, which comprises of two strategies, can possibly be utilized in clinical setting, and help radiologists for better conclusion.

New analytic techniques are required for the exact appraisal of caries injury movement to set up the requirement for careful treatment. Recognition of the profoundly mineralized surface layer that structures close to the outside of the sores because of remineralization is significant for analysis of the sore action. Past investigations have exhibited that novel imaging techniques can be utilized to identify remineralization of fake finish caries injuries. In paper [5], the movement of characteristic veneer caries injuries was surveyed in-vitro by means of location of the surface layer with polarization-touchy optical intelligibility tomography (PS-OCT) and drying out rate estimations with NIR reflectance and warm imaging modalities. A mechanized methodology for identifying the surface layer with PS-OCT yielded high affectability (=0.79) and high explicitness (=0.93) with moderate relationship (R 2 = 0.5920) with histology. Noteworthy contrasts in drying out rate estimations were found between the dynamic and the captured sores utilizing both the NIR reflectance and warm imaging modalities. These outcomes show that these novel imaging techniques are undeniably appropriate for nondestructive, noninvasive, and quantitative estimation of sore movement during a solitary clinical assessment progressively.

Paper [6] intended to survey the screening execution of the quantitative light-prompted fluorescence (QLF) innovation to recognize proximal caries utilizing both fluorescence misfortune and red fluorescence in a clinical circumstance. In addition, another rearranged QLF score for the proximal caries (QS-Proximal) is proposed and its legitimacy for recognizing proximal caries was assessed also.

Youngsters whose nourishment test brought about enormous particles and those from families with a higher month to month pay had a higher BMI. Youngsters with a more prominent number of teeth with cavitated dental caries had a lower BMI [7].This strategy is utilized to compute the pressure dissemination dependent on Lekhnitskii's expository arrangement. The examination plan factors incorporate fiber point, load edge, obtuseness, direction edge of cut-out and the material properties. Furthermore, the presentation of the DA calculation is contrasted and the Genetic Algorithm (GA) and Particle Swarm Optimization (PSO). The correlation of these strategies demonstrates the suitability of the DA calculation in streamlining the punctured plates. The limited component strategy has been utilized to confirm the exactness of the scientific outcomes. The outcomes demonstrate that by choosing the previously mentioned parameters appropriately, we can expand the auxiliary burden bearing limit.

Proximal dental caries are analyzed utilizing dental X-beam pictures. Lamentably, the analysis of proximal dental caries is regularly smothered because of the low quality of dental X-beam pictures. Accordingly, Joonhyang Choi [9] proposes a programmed recognition framework to identify proximal dental caries in periapical pictures just because. The framework contains four modules: level arrangement of envisioned teeth, likelihood map age, crown extraction, and refinement. We initially adjust the envisioned teeth on a level plane as a pre-procedure to limit execution corruption because of turn. Next, a completely convolutional arrange is utilized to deliver a caries likelihood map while crown areas are removed dependent on improvement plans and an edge-based level set technique. In the refinement module, the caries likelihood map is refined by the separation likelihood demonstrated by crown districts since caries are situated close to tooth surfaces. Likewise we receive non- most extreme concealment to improve the discovery execution. Tests on different periapical pictures uncover that the proposed framework utilizing a convolutional neural system (CNN) and crown extraction is better than the framework utilizing a credulous CNN.

Patil., et al. [10] proposed a caries discovery strategy dependent on versatile dragonfly technique and neural system classifier. When the highlights are extricated, they are duplicated with a weighting factor. Further non straight programming improvement system is utilized with an aim of amplifying the separation between the subsequent element yields. The NN classifier is prepared utilizing a versatile DA calculation.

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III. PROPOSED SYSTEM

Input image is acquired from database of dental images. This image is then pre-processed to remove noise. Here the purpose of pre processing is to enhancement of the image data so that it reduces unwanted distortions which are important for further processing. Dataset of dental caries is feed as input to training of K-NN classifier. In order to classify the image and to predict whether the feature extracted image is normal or affected by cavity. Further, with the desire of classifying the non-caries and caries images, K-NN classifier is adopted in this research.

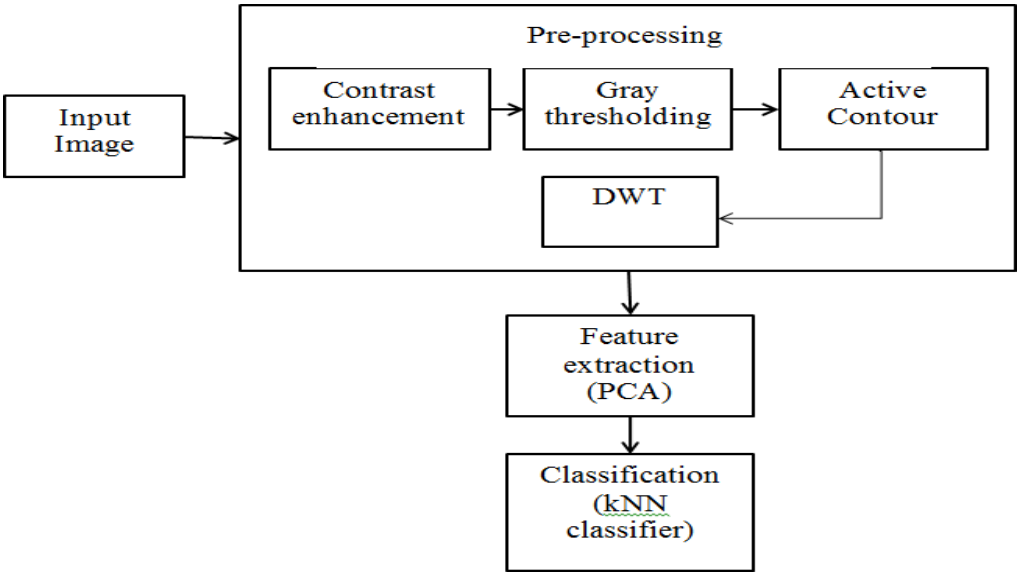

Fig 1 block diagram of proposed system

- Input image: image is taken from dataset of teeth
- Pre-processing:
  - **Contrast Enhancement:** contrast of teeth image is enhanced improves the quality of image by expanding the dynamic range of input gray level.
  - **Gray Thresholding:** Grey scale image of teeth (0 up to 256 gray levels) converted in to black and white image (0 or 1)
  - **Active Contour:** it is computer-generated curves that move within images to find object boundaries, used here for selecting Region of Interest (ROI)

- DWT (Discrete Wavelet Transform)

Generally Wavelets is used to convert the image into a series of wavelets so that it can be stored more efficiently than pixel blocks. In DWT, a timescale representation of the digital signal is obtained using digital filtering techniques.

- **Erosion:** Erosion removes small-scale details from a binary image. The erosion of a binary image f by a structuring element s (denoted $f \ominus s$) produces a new binary image $g = f \ominus s$ with ones in all locations (x,y) of a structuring element's origin at which that structuring element s fits the input image f, i.e. g(x,y) = 1 is s fits f and 0 otherwise, repeating for all pixel coordinates (x,y).
- **Dilation:** The dilation of an image f by a structuring element s (denoted $f \oplus$) produces a new binary image g = f s

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- **Opening:** The opening of an image f by a structuring element s (denoted by $f \circ s$) is an erosion followed by a dilation:

$$f \circ s = (f \ominus s) \oplus$$

- **Closing:** The closing of an image f by a structuring element s (denoted by f • s) is a dilation followed by an erosion:

$$f \bullet s = (f \oplus srot) \ominus srot$$

- Feature Extraction:

Feature extraction is a special form of dimensionality reduction, which is measurement of the geometric properties like size and shape and surface characteristics of regions like color and texture. PCA is a statistical method and the purpose of PCA is to reduce the large dimensionality of the data space i.e. observed variables to the smaller intrinsic dimensionality of feature space i.e. independent variables.

- Mean:

Mean is classified as spatial filtering and used for noise reduction.

$$f(x,y) = \frac{1}{mn}\sum_{(r,c)\epsilon W} g(r,c) \qquad \ldots\ldots\ldots\ldots(1)$$

Where 'g' is the noisy image, f(x,y) is the restored image, and 'r' and 'c' are the row and column coordinates respectively, within a window 'W' of size 'm×n' where the operation takes place.

- Skewness:

Skewness is a measure of the asymmetry of the probability distribution of a real-valued random variable. The skewness value can be positive or negative, or even undefined.

$$Skewness = \frac{\frac{1}{mn-1}\sum_{(r,c)\epsilon W}\left\{\frac{1}{mn-1}\sum_{(r,c)\epsilon W}\left(g(r,c)-\frac{1}{mn-1}\sum_{(r,c)\epsilon W} g(r,c)\right)^{1}\right\}^{2}}{\left(\frac{1}{mn-1}\sum_{(r,c)\epsilon W}\left\{\frac{1}{mn-1}\sum_{(r,c)\epsilon W}\left(g(r,c)-\frac{1}{mn-1}\sum_{(r,c)\epsilon W} g(r,c)\right)^{1}\right\}^{2}\right)^{3/2}} \qquad \ldots\ldots\ldots\ldots(2)$$

In terms of digital image processing, Darker and glossier surfaces tend to be more positively skewed than lighter and matte surfaces. Hence we can use skewness in making judgements about image surfaces.

- Standard Deviation:

A low standard deviation indicates that the data points tend to be very close to the mean, whereas high standard deviation indicates that the data points are spread out over a large range of values. A standard deviation filter calculates the standard deviation and assigns this value to the center pixel in the output map. Mathematically standard deviation is given by

$$\text{standard deviation} = \sqrt{\frac{1}{mn-1}\sum_{(r,c)\epsilon W}\left(g(r,c) - \frac{1}{mn-1}\sum_{(r,c)\epsilon W} g(r,c)\right)^{2}} \qquad \ldots\ldots\ldots\ldots\ldots(3)$$

Entropy:

Entropy shows the amount of information of the image that is needed for the image compression. Entropy measures the loss of information or message in a transmitted signal and also measures the image information

$$\text{Entropy} = \sum_{i,j=0}^{N-1} - \ln(P_{ij})P_{ij} \qquad \ldots\ldots\ldots\ldots...(4)$$

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- Classification

The aim of image classification is to identify and represent, as a unique gray level, the features occurring in an image in terms of the object.

IV. RESULT AND DISCUSSION

Fig a. Result 1 Fig b. Result 2

Above figures shows the expected results. In this paper for dental caries diagnose we will take the image from database which is to be diagnose. Then this image is preprocessed using contrast enhancement, gray thresholding, and active contour. Here we are using PCA for feature extraction. We are taking statically features like mean, standard deviation, skewness, entropy for feature extraction. Then according to the values of features this image is classified for different diagnose. Here for classification we are going to use KNN classifier.

V. CONCLUSIONS

Dental caries is not only associate with tooth ache but also irritates in the mouth, it is one of the heralds of other life threatening diseases to adult and as well as children. So, proper care and treatment from the early stage of caries region are essential. The care and treatment procedure of caries region has changed with the evolution of technology. This paper has proposing an algorithmic analysis on novel caries detection model in order to have an accurate detection in the tooth cavities. The classification will done using NN classifier. The feature extraction and classification were done on image after preprocessing. The proposed caries detection model was divided into two phases: feature extraction and classification. The feature extraction will be done based on PCA, and the classification will be done using k-NN classifier. The feature extraction and classification will be done on image after preprocessing with contrast enhancement, Gray threshold, and active contour.

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REFERENCES

[1] Shashikant Patil, Vaishali Kulkarni and Archana Bhise, "Algorithmic analysis for dental caries detection using an adaptive neural network architecture," Heliyon 5 (2019) e01579
[2] Soma Datta, Biswajit Modak and Nabendu Chaki1, "A Complete Review on Dental Carious Lesion Detection Methods and its Challenges ," ACTA SCIENTIFIC DENTAL SCIENCES (ISSN: 2581-4893) Volume 3 Issue 9 September 2019
[3] KEITH ANGELINO1 , DAVID A. EDLUND2 , AND PRATIK SHAH , "Near-Infrared Imaging for Detecting Caries and Structural Deformities in Teeth ," Received 27 January 2017; revised 23 March 2017; accepted 4 April 2017. Date of publication 19 April 2017; date of current version 1 May 2017. Digital Object Identifier 10.1109/JTEHM.2017.2695194
[4] Shaikat Galib,a F. Islam,a M. Abir,b and H. K. Lee , "COMPUTER AIDED DETECTION OF ORAL LESIONS ON CT IMAGES ," arXiv:1611.09769v1 [cs.CV] 29 Nov 2016
[5] Robert C. Lee ; Michal Staninec ; Oanh Le ; Daniel Fried, "Infrared Methods for Assessment of the Activity of Natural Enamel Caries Lesions," IEEE Journal of Selected Topics in Quantum Electronics (Volume: 22 , Issue: 3 , May-June 2016)
[6] Kim, E.-S., Lee, E.-S., Kang, S.-M., Jung, E.-H., de Josselin de Jong, E., Jung, H.-I., & Kim, B.-I. (2017), " A new screening method to detect proximal dental caries using fluorescence imaging. Photodiagnosis and Photodynamic Therapy," 20, 257–262. doi:10.1016/j.pdpdt.2017.10.009
[7] Soares, M. E., Ramos-Jorge, M. L., de Alencar, B. M., Oliveira, S. G., Pereira, L. J., & Ramos-Jorge, J. (2017), " Influence of masticatory function, dental caries and socioeconomic status on the body mass index of preschool children. Archives of Oral Biology," 81, 69–73. doi:10.1016/j.archoralbio.2017.04.032
[8] Jafari, M., & Bayati Chaleshtari, M. H. (2017), "Using dragonfly algorithm for optimization of orthotropic infinite plates with a quasi-triangular cut-out,"European Journal of Mechanics - A/Solids, 66, 1–14. doi:10.1016/j.euromechsol.2017.06.003
[9] Joonhyang Choi Hyunjun Eun Changick Kim , "Dental Caries Detection via Combination of Variational Methods and Convolutional Neural Network ," Journal of Signal Processing Systems January 2018, Volume 90, Issue 1, pp 87–97| Cite as Boosting Proximal
[10] Patil., et al. , "Algorithmic analysis for dental caries detection using an adaptive neural network architecture," Heliyon 5.5 (2019): e01579

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