BEASF-Based Image Enhancement for Caries Detection Using Multidimensional Projection and Neural Network

Shashikant Patil, EXTC Department, MPSTME, Mumbai, India
Vaishali Kulkarni, MPSTME, SVKMs NMIMS Mumbai, India
Archana Bhise, MPSTME, SVKMs NMIMS Mumbai, India

ABSTRACT

Tooth caries or cavities diagnosing are concerned as the most significant research work, as this is the common oral disease suffered by humans. Many approaches have been proposed under the topics including demineralization and decaying as well. However, the imaging modalities often suffer from various critical or complex aspects that struggles the methods to attain accurate diagnosis. This article turns to introduce a new cavity diagnosis model with three phases: (i) pre-processing (ii) feature extraction (iii) classification. In the first phase, a new bi-histogram equalization with adaptive sigmoid functions (BEASF) is introduced to enhance the image quality followed by other enhancements models like grey thresholding and active contour. Then, the features are extracted using multilinear principal component analysis (MPCA). Further, the classification is done via neural network (NN) classifier. After the implementation, the proposed model compares its performance over other conventional methods like principal component analysis (PCA), linear discriminant analysis (LDA) and independent component analysis (ICA) and the performance of the approach is analyzed in terms of measures such as accuracy, sensitivity, specificity, precision, false positive rate (FPR), false negative rate (FNR), negative predictive value (NPV), false discovery rate (FDR), F1 Score and Mathews correlation coefficient (MCC), and proves the superiority of proposed work.

KEYWORDS

BEASF, Demineralization, Feature Extraction, NN, Teeth Cavities

1. INTRODUCTION

For the past few decades, the image processing modalities have become as the most popular techniques almost in all the applications of day-to-day aspects (Chang & Su, 2008; Sultana et al., 2018; Angelino et al., 2017; Kang et al., 2010; Keem & Elbaum, 1997; Sherifi & Senja, 2015). Medical field is considered as the most important real time application, and various research works are going on under early disease diagnosis that spotted as the significant need of human being (Ranjith V Ravi 2015). This medical image processing mainly approves the number of segmentation algorithms, registration as well as classification algorithms to diagnose the prospective disease. Further, the processes comprise of image analysis, tracking and segmenting. Many advanced and intelligent applications are there to attain time consumed algorithms.

Tumor detection, cancer detection, mass detection is the common scenarios in the field of medical imaging. Moreover, the detection models also make their extension works under early detection
by determining the significant features like cell size and other parameters from medical images (Sampathkumar et al., 2014). Cavity detection is one of the important criteria in medical field, as this is the common oral disease suffered by human beings. Many imaging techniques are there in this field including Optical imaging, infrared imaging, Photacoustic (PA) imaging and so on. Almost in all cases, the dental tissue health is diagnosed by PA imaging since this is the common imaging technique. Current methods for detecting tooth decay employing the dental explorer and X-ray radiography are subjective. In fact, the feature extraction and classification are the most important phases for any of the diagnosing model (Madhuri et al., 2013). The common conventional diagnosis model is Support Vector Machine (SVM), ANN (Artificial Neural Network) classifier and so on. Even though the classifiers can diagnose the effect of tooth, the classifiers need some advanced improvement for early detection of tooth decay even accurately.

Dental cavities are the most general pathology in the world. In the modern era, almost all individuals had the experience of this pathology at least once in their life time. Early detection of dental caries can help in a sharp decrease in the dental disease rate. Though cavity detection is seemed to be a challenging issue this paper contributes a new caries detection approach that includes three phases: Pre-processing, Feature Extraction, and Classification. In pre-processing phase, a new BEASF-based image enhancement is done to improve the quality of input image. After the contrast enhancement, grey thresholding and active contour is processed. Then, MPCA based feature extraction process begins and attains an effective generalization capability over PCA model, particularly in the image reconstruction. Finally, NN is used to do the classification process using the extracted features. Once the implementation process is completed comparison with another existing model takes place.

The rest of the paper is arranged as follows: Section II reviews the literature work; Section III explains the framework of the proposed caries detection model. Further, Section IV discusses the results that obtained, and Section V concludes the paper.

2. LITERATURE REVIEW

In 2010, Zakian et al. (2010) have utilized the total of 72 sites on 25 teeth (human) with different natural demineralisation degrees. Subsequently, Continuous water evaporation inside the pores was utilized for producing a thermodynamic response on the surface of tooth. The temperature’s temporal profile would depend on the water amount at every position, which was studied in the relation to the porosity degree and the severity of lesion as well. The authors have used DQ for the lesion quantification. Finally, the proposed thermal imaging has shown the capability of discriminating.

In 2013, Lin et al. (2013) have presented an efficient and fully automated tooth isolation approach for dental x-ray images that includes upper-lower jaw separation, isolation of single tooth, verification of over-segmentation, and the detection of under-segmentation as well. In this, the separation approach (upper lower jaw) was based on grayscale integral projection, which was for avoiding feasible data loss and was incorporated with the angle adjustment. In the single tooth separation, they have developed an adaptive windowing approach for enhancing the accuracy rate. Further, in over-segmentation, they have developed an isolation-curve verification approach for removing extreme curves. Finally, the investigations were carried out in terms of accuracy rate.

In 2017, Ahmed et al. (2017) have developed a 635-nm He-Ne laser-tissue interaction approach to characterize the human teeth. They have used the spectroscopic measurement for sound as well as lesion in caries teeth for assessing the properties of averaged optical. Further, they have developed the One-layer Monte Carlo approach for sound, along with the caries lesion for optimizing the position of source-detector in terms of sample. Subsequently, the captured images were progressed using inspection algorithm, which was on the basis of Hilbert transform edge detection. At last, the developed optical imaging has proven its superiority over other methods.

In 2003, Mitchell et al. (2003) have described the erosion detection model and early experiences that was on the basis of outcome of the 1st 100 subjects. The process has identified the erosion
Optimizing Society: The Social Impact Theory Based Optimizer
www.igi-global.com/chapter/optimizing-society-social-impact-theory/19657?camid=4v1a

A Statistical Scrutiny of Three Prominent Machine-Learning Techniques to Forecast Machining Performance Parameters of Inconel 690

Online Evolution of Adaptive Robot Behaviour
www.igi-global.com/article/online-evolution-of-adaptive-robot-behaviour/113296?camid=4v1a