

Histogram Based Enhancement of Dental Pantamograms to Detect Jawbone Cysts and Tumours Using Otsu's Segmentation Method

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Abstract— Dental Radiographs have been commonly used by Dentists to recognize any bone pathology which is difficult to investigate solely by clinical assessment. The utilization of Dental x-beam pictures has accomplished an unprecedented change in clinical discovering in view of its brief openness and for the most part lesser radiation estimation. Orthopantomograms (OPG) or Panoramic Imaging is one of the imaging strategy as regularly as conceivable used as a piece of dentistry to recognize any dental irregularity. Nevertheless, the dental all-encompassing pictures experience the evil impacts of fluctuating superimposition of part of anatomical structures and have a trademark particular issue which prompts package of ambiguity when associated as a manual for finding.

Keywords: Orthopantomograms, Processing of Image, Segmentation of Image, Otsu's Segmentation Method

I. INTRODUCTION

As per an article distributed in paper; the giants of the threat of head and neck have incited an overall protest on the need to in general location this scourge. Head and neck tumors speak to more than 5, 60,000 cases wherever all through the world, and situating sixth in number conversely with all sicknesses. Due to augment in alcohol use and tobacco, there is an upsetting augmentation in its frequencies over the earlier decade, especially in making countries like India. In light of high usage of tobacco in country, 30-50 percent of these developments are found in the oral gap. The greatest number of oral gloom tumors occur in South and Central Asia, with around 1, 20,000 cases. 66% of these developments are truly found in India. Before long, the nation will transform into the oral development capital of the world, with the greatest recurrence of cases. Recognizing blisters in jaws is a champion among the most befuddling challenges in maxillofacial radiology. A development is a fluid filled over the top opening lined by an epithelium, distinguished as growth. Growths are more normal in jaws than some other bone since a large portion of them begins from different cell rests of epithelium after the tooth course of action. Basically, blisters are described taking into account developmental and red hot origin. The most as regularly as conceivable happening pimples are radicular developments of flammable beginning stage and dentigerous blisters of advancement starting point. By and large they are round or oval shape with corticated or scalloped breaking point. A convincing finding can be made by age, sexual direction and prevalence of Cyst. In case the Cysts are not perceived at a starting time, it may provoke tumors.

II. LITERATURE SURVEY

A. Literature Survey

1) *Title: Using the finite element method and radial point interpolation method to analyze the jaw bone.*

Author: M.B.F. Moutinho, J. Belinha and R.M. Natal Jorge
Year: 2018
Abstract: The purpose of this study is to perform an elastic analysis of the jaw considering distinct external loads. Methods: This article describes the steps required to obtain the final geometric model of a jaw from CT images.

Using the constructed model, the FEM and RPIM were applied with the objective of analyzing/comparing the obtained stress/strain levels. Results: It was possible to verify that the loads that are imposed in the model induce higher stress levels in the region where the loads are inserted. Also, it was possible to analyze the displacement, exercised by the model, through a comparative symmetric evaluation. Conclusion: The two methods present very similar results for the different variables under study. Nevertheless, the RPIM produces slightly higher values when compared with the FEM.

2) *Title: Panoramic X-Ray Analysis Using Edge Detection Method on Mandibular Cortex*
Author: Darmastuti, Eri Prasetyo Wibowo, Metty Mustikasari, Johan Harlan
Year: 2018

Abstract: Panoramic X-Ray is one type of image that can be used in the health world to identify various diseases and damage that occur in the jaw and teeth. This study aims to identify the inferior mandibular cortex and detecting mandibular resorption as an indication of osteoporosis. Several stages are conducted in the proposed method. The first step in the pre-processing stage to be done is cropping, to obtain the Region of Interest (ROI).

The next step in the pre-processing stage is image improvement to get image with favorable quality. The extraction stage is conducted in two steps. In the first step the image is processed using the edge detection method. In the second step of the extraction stage we use quantum edge detection to produce the upper edge of inferior mandibular cortex. Then, the lower border of inferior mandibular cortex is projected to obtain a difference between the upper and the lower border of the inferior mandibular cortex. As the result of study, we can identify bone resorption in the inferior mandibular cortex. Resorption of the mandibular cortex is an indication of osteoporosis. It is concluded that damage to the jaw bone can be seen from the result of panoramic X-Ray images after performing image processing.

3) *Title: Deep Learning-Based Super-Resolution Applied to Dental Computed Tomography*
Author: Janka

Hatvani, Michetti, Adrian Basarab, Denis Kouame
Year:2018

Abstract: The resolution of dental computed tomography (CT) images is limited by detector geometry, sensitivity, patient movement, the reconstruction technique and the need to minimize radiation dose.

Recently, the use of convolutional neural network (CNN) architectures has shown promise as a resolution enhancement method. In the current work, two CNN architectures a subpixel network and the so called U-net – have been considered for the resolution enhancement of 2D cone-beam CT image slices of ex vivo teeth. To do so, a training set of 5680 cross-sectional slices of 13 teeth and a test set of 1824 slices of 4 structurally different teeth were used. Two existing reconstruction-based super-resolution methods using 2-norm and total variation regularization were used for comparison. The results were evaluated with different metrics (peak signal to- noise ratio, structure similarity index, and other objective measures estimating human perception) and subsequent image segmentation-based analysis. In the evaluation, micro-CT images were used as ground truth. The results suggest the superiority of the proposed CNN-based approaches over reconstruction-based methods in the case of dental CT images, allowing better detection of medically salient features such as the size, shape, or curvature of the root canal.

III. PROPOSED SYSTEM

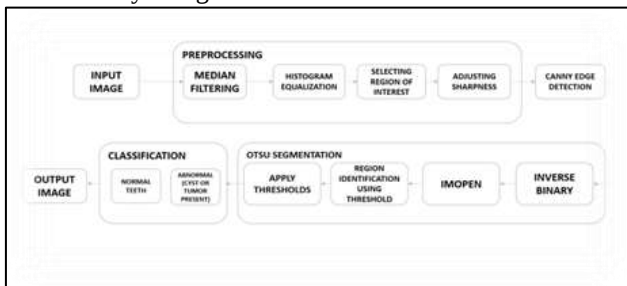
This project exhibits a detailed survey of Image enhancement algorithms connected on dental X-ray pictures and its examination as far as subjective and target picture quality measurements with the supervision of radiologists. This work is a summarization of the previous works carried out and it gives an outline about the panoramic image analysis.

The aim of processing is to segment regions of jawbone soft tissues cysts and evaluate their local descriptors.

The Shape Descriptors got for the district of Cysts, for example, territory, border, circularity, strength and so on can be utilized as a component vectors in Image characterization where the classifiers can naturally recognize the anomalous tissues or tumors from OPG pictures helping in its conclusion and treatment.

A. Advantages:

- Cysts can naturally recognize the anomalous tissues
- The process time is very less
- Low cost
- Accuracy is high.



IV. ALGORITHMS DETAILS

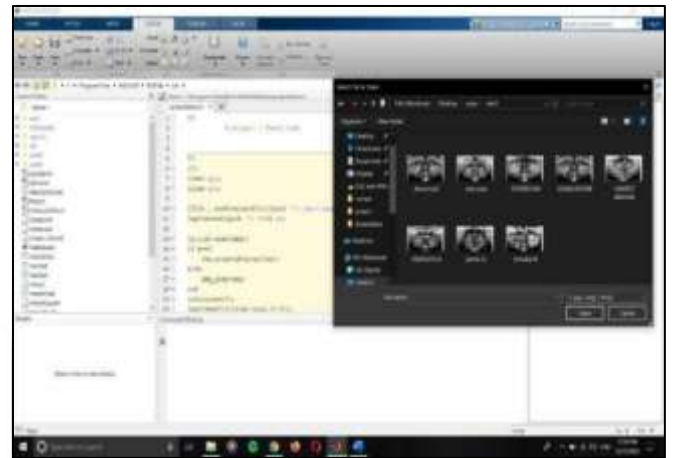
Input
Preprocessing : Median Filter
Edge detection : Canny edge
Segmentation : Otsu's segmentation
Simulated Output:

V. FLOW OF ALGORITHM

A. Reading Input Image

Reading the input x-ray image is done by specifying the path of the image file's location, and image format in the `uigetfile()` command and declaring a variable for input image in `imread()` command with images's path as arguments

B. Selecting the Desire Input



C. Original Image:



D. Median Filter:

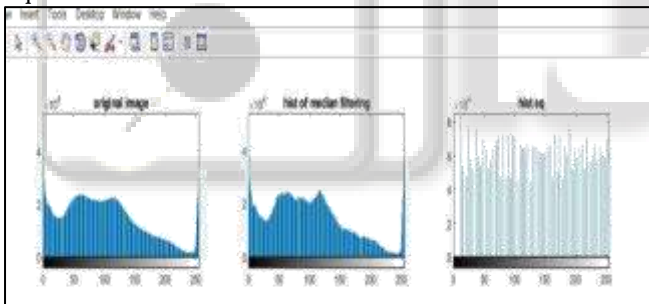
Median Filter is a non-linear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise.



E. Histogram Equalization



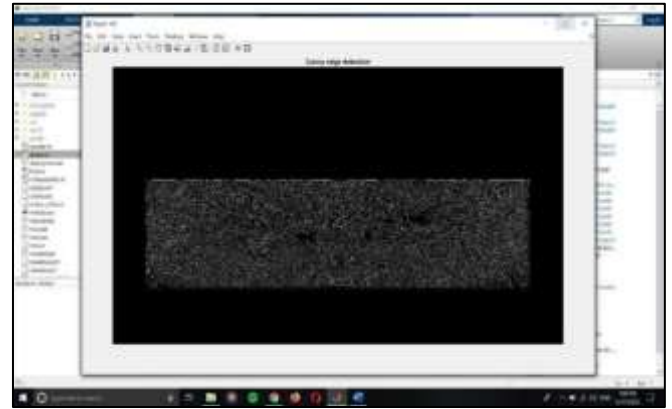
Histograms of Original Image, Median Filter, Histogram, Equalization



F. Canny Edge Detection

Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. It has been widely applied in various computer vision systems. Canny has found that the requirements for the application of edge detection on diverse vision systems are relatively similar.

Thus, an edge detection solution to address these requirements can be implemented in a wide range of situations. The general criteria for edge detection include: Detection of edge with low error rate, which means that the detection should accurately catch as many edges shown in the image as possible. The edge point detected from the operator should accurately localize on the center of the edge.



A given edge in the image should only be marked once, and where possible, image noise should not create false edges.

G. OTSU'S Segmentation

In computer vision and image processing, Otsu's method is used to perform automatic image thresholding.

In the simplest form, the algorithm returns a single intensity threshold that separate pixels into two classes, foreground and background.

This threshold is determined by minimizing intra-class intensity variance, or equivalently, by maximizing inter-class variance.

Otsu's method is a one-dimensional discrete analog of Fisher's Discriminant Analysis, is related to Jenks optimization method, and is equivalent to a globally optimal k-means performed on the intensity.



CYST WITH LEVEL 1 ABNORMALITY



CYST WITH LEVEL 2 ABNORMALITY



NORMAL RESULT

VI. RESULT ANALYSIS

Analyzing the proposed method for detection of jawbone cysts, the developed algorithm with image enhancement with segmentation is tested with 50 dental x-ray images, out of which 47 cases were correctly identified whether it is normal or level 1 abnormality or level 2 abnormality (True Positive), 3 images were unpredicted (False Positive) and 2 of which is wrongly identified (False Negative).

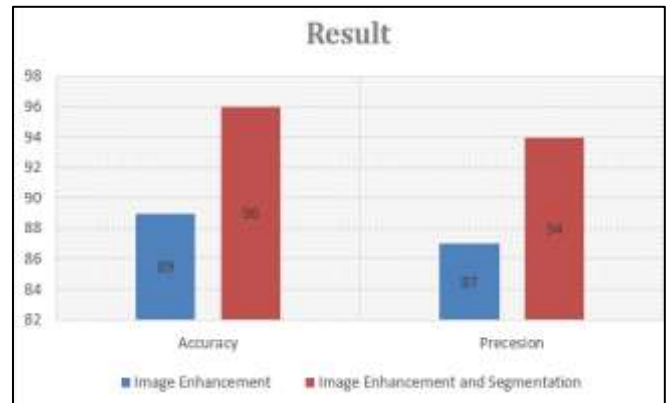
Accuracy and precision are two important factors to consider when talking data measurements. Accuracy is how close a value is to its true value. Precision is how repeatable a measurement is. Percent error is used to assess whether a measurement is sufficiently accurate and precise. The proposed algorithm works with the accuracy of 96% and precision of 94%.

A true positive (TP) is an outcome where the model correctly predicts the positive class. Similarly, a true negative (TN) is an outcome where the model correctly predicts the negative class. A false positive (FP) is an outcome where the model incorrectly predicts the positive class. And a false negative (FN) is an outcome where the model incorrectly predicts the negative class.

method	Total image	TP	FP	FN	Accuracy	precision
Image Enchaneme-nt	50	40	6	5	89	87
Image enhancement and segmentation	50	47	3	2	96	94

Comparison of Image Enhancement of Dental X-rays and Image Enhancement with Segmentation to identify Cysts

Graphical representation of Comparison of image enhancement of dental X- rays and image enhancement with segmentation to identify cysts.



Time Consumption: Total time consumed by the algorithm for identification of jawbone cysts varies from 16.5 Seconds to 29.5 Seconds based on the level of increase in abnormality, from which we can conclude that the algorithm can produce the result within the total run time of 23 Seconds as average.

VII. CONCLUSION

Using Image enhancement techniques and OTSU's segmentation method a very effective way of identifying Cysts and Tumors in soft issue of Jawbone area is developed with an accuracy of 96 percent and precision of 94 percent in comparison with the previous method which uses only image enhancement techniques without segmentation which has an accuracy of 90 percent and precision of 88percent

VIII. FUTURE WORK

The developed algorithm identifies Cysts developed in the soft tissue around the lower jawbone while ignoring Cysts in the region where the teeth are completely removed due to other dental complexities occurred earlier, which has to be modified in near future upgrades. And also, this design can be modified to provide identification of Cysts and tumors with very high accuracy which gives the exact place or location of the cysts and tumors present.

REFERENCES

- [1] Acharya, Tinku, and Ajoy K. Ray. Image processing: Principles and Applications. John Wiley & Sons,2005.
- [2] Anuradha, K., and K. Sankaranarayanan. "Detectional of Oral Tumor Marker-Controlled Watershed Algorithm." International Journal of Computer Applications 52, no. 22012.
- [3] Feng, Ding. "Segmentation of soft tissues in medical images." PhD Diss., National University of Singapore,2005.
- [4] Liao, Qingwei, Jingxin Hong, and Meiqun Jiang. "A comparison of edge detection algorithm using for driver fatigue detection system. In Industrial Mechatronics and Automation (ICIMA), 2010 2nd International Conference on, vol. 1, pp. 80-83. IEEE,2010.
- [5] Li, Chunming, Chenyang Xu, ChangfengGui, and Martin D. Fox, "Distance regularized level set evolution and its application to imagine Segmentation", IEEE transactions on image processing 19, no. 12 Page no.3243-3254,2010.

- [6] Mikulka, Jan, et al. "Classifiaction of jawbone cysts via Orthopantomogram processing." Telecommunication and Signal Processing (TSP), 2015 35th International conference, IEEE, 2012.
- [7] Miora Decusara "Use of orthopantomogram in Dental practice", International jounal of Medical Density, volume 1, Dec2011.
- [8] OGE MARQUES "Practical image and video processing using MATLAB" John Wiley & Sons, Inc. PublicationHoboken, New Jersey,2011.
- [9] R. Gonzalez and R.Woods, Digital Image Processing, Prentice Hall, 3rd Edition, Jan.2008.
- [10]Shear M, Speight PM. Cysts of the Oral & Maxillofacial regions.4th ed Hongkong: Blackwell Munksgaard;2012.
- [11]Yu, Bing, Daron G. Ferris, Yang Liu, and Vivek K. Nagarajan. "Emerging optical techniques for detection of oral cervical and anal Cancer in low-resource settings". Austin J Biomed Eng 1, no.2 (2017): 1007

