IDENTIFICATION OF SUSPICIOUS REGIONS TO DETECT ORAL CANCERS AT AN EARLIER STAGE– A LITERATURE SURVEY

K. Anuradha[1] and K.Sankaranarayanan[2]
[1]Research Scholar, Karpagam University, Coimbatore
[2]Dean, Electrical Sciences, Easa College of Engg. and Technology, Coimbatore

ABSTRACT
Oral cancer is a significant health problem throughout the world. Most oral cancers are identified at a later stage where, treatment becomes less successful. It is very important to detect such types of cancer at an earlier stage. Early detection helps surgeons to provide necessary therapeutic measures which also benefit the patients. Dental Radiographs are the X – rays that help to identify problems with teeth, mouth and jaw. In this paper, a detailed survey has been done on various methods analyzed by the researchers for the detection of oral cancers at an earlier stage. A comparison is made between various methods for the identification and classification of cancers. An overview of algorithms in each step of the cancer detection algorithms is given.

KEYWORDS: *Oral cancer, Dental Radiographs, X – rays.*

I. INTRODUCTION

Oral cancer ranks as the fourth most frequent cancer among men and eighth for women worldwide and may affect the tongue, cheeks, peridontium or any other part of the oral pharynx. Oral cancer is a significant health problem throughout the world. Tumors that arise from odontogenic (tooth forming) tissues are referred to as odontogenic tumors. Tumors are either benign or malignant. Malignant tumors are cancerous. Oral cancer can affect any area of the oral cavity including the lips, gum tissues, tongue, cheek lining and the hard and soft palate. This paper focuses on identifying oral cancers at an earlier stage. Oral cancer detection at an earlier stage saves lives [1]. Beyond oral cancer, many problems can occur within the bones of the mouth. Systemic problems those that affect the entire body many times appear in the mouth first. In general, the mouth is a good indicator of what's going on in the body, which is why the physicians for generations have asked patients to open their mouth. X – Rays are an essential part of dental care. Although X – rays are effective diagnostic tools, some dental practices particularly those that handle a large number of dental implant cases, are using more advanced imaging techniques to ensure an even higher degree of accuracy.

Oral cancers are often located on the tongue, MR images may become blurry because of moving artifacts induced by the moving tongue and jaw. So an efficient image processing algorithm is needed to identify the suspicious region in the cancer area with high accuracy. Dental radiographs are used for screening oral pathologies continuously and it is often a difficult task to detect early stage cancer tissues in a dental radiograph. Unlike other types of cancers, oral cancers are visibly seen with the naked eye, some cancers are located internally in the mouth, making their detection difficult. And also some non cancerous tissues are not harmful.

The organization of the chapter is as follows: In section 2, a literature study has been performed for cancer. Some of the recent methods for cancer detection are presented in Sub Section 2.1. Sub Section 2.2 is devoted to feature extraction and cancer classification methods. Discussions about the techniques are made in Section 3. Finally Section 4 summarizes and concludes the section.

II. LITERATURE SURVEY

If oral cancer is detected at an earlier stage it is curable. The exact cause of cancer is not known, however, there are certain risk factors, which may trigger this disease in individuals. Among the common factors are chemicals, which may be in the form of tobacco or chemicals present in food, air, water etc [2]. These chemicals are known as Carcinogens. Detection and Diagnosis of cancer has become one of the most significant areas of research in the Medical Imaging and Image Processing Communities.

Symptoms:

The symptoms for an oral cancer at an earlier stage [3] are: 1) Patches inside the mouth or on lips that are white, red or mixture of white and red 2) Any sore or area in the mouth which does heel for discolored more than 14 days 3) Bleeding in the mouth 4) Difficulty or pain when swallowing 5) A lump in the neck. These symptoms identify the suspect for a cancer. The system identifies that a cancer has occurred with image processing Techniques.

A surgeon who suspected the presence of cancer in a patient has few options: X –rays studies to find the cancer's exact location, providing proper medications can recovery from cancer, excise a portion of the unhealthy tissue for biopsy, remove the cancer, explore the surrounding tissues to determine if the cancer has spread.

Over the last few decades, imaging technology refinements have substantially widened the range of medical options:

- The Tests now provide much clearer and more detailed pictures of organs and tissues.
- New imaging technology allows us to do more than simply view anatomical structures such as bones, organs and tumors.
- Functional imaging - the visualization of physiological, cellular, or molecular processes in living tissues – enables us to observe activity such as blood flow, oxygen consumptions or glucose metabolism in real time.

Imaging technology already has had lifesaving effects on our ability to detect cancer early and more accurately to diagnose the disease. Image Processing [4] algorithms have been continuously applied to get better results. The literature survey carried out has revealed that a fair amount of research has been put in the areas of cancer imaging.

2.1 Cancer Detection Techniques

[Banumathi.A et al 2009] [5] have proposed cyst detection and severity measurement of cysts using image processing techniques and neural network methods. The suspicious cyst regions are diagnosed using Radial Basis Function Network. The severity of the cysts is calculated using circularity values and the results show the part of the cysts extracted.

[Woonggyu Jung et al] [6] has proposed a technique in oral cancer detection using Optical Coherence Tomography. For the imaging depth of 2-3 mm, OCT is suitable for oral mucosa. They also detected oral cancer in 3-D volume images of normal and precancerous lesions.

[Simon Kent] [7] has proposed a diagnosis method for oral cancer using Genetic Programming. The Technique proposed solved many complex problems. The comparison between a Genetic Programming system and Neural Network model was provided. The Genetic Programming system played a major advantage in diagnosing the tumor.

[Ranjan Rashmi Paul et al] [8] has proposed a detection methodology to detect oral cancer using wavelet - neural networks. The wavelet coefficients of TEM images of collagen fibers from normal oral sub – mucosa and OSF tissues have been used in order to choose the feature vector which, in turn, used to train the Artificial Neural Network. The trained network could satisfy the normal and precancer stages.

[Ireaneus Anna Rejani.Y, Dr. S. Thamarai Selvi 2009] [9] have proposed a technique to detect breast cancer at an earlier stage using SVM Classifier. The proposed system focused on two problems. One is to detect tumors as suspicious regions with a very weak contrast to their background and another is to extract features which categorize tumors. They used Gabor filtering technique for image enhancement and Top hat transform operation for image extraction.

[Saheb Basha.S, Dr. K. Satya Prasad 2009] [10] have proposed an automatic detection of Breast cancer mass in mammograms using Morphological operations and Fuzzy C-means clustering. They

developed an algorithm to distinguish masses and micro calcifications from background tissue using morphological operators and fuzzy C- means clustering (FCM) algorithm has been implemented for intensity – based segmentation. The proposed technique showed better results.

[Man Kin Derek Ho 2007] [11] have proposed an algorithm to segment images for Medical confocal images. The results provide accurate count (95% with 6.2% standard deviation) of cells or droplets.

[Ghassan Hamarneh, Artur Chodorowski, Tomas Gustavsson, 2000] [12] have proposed the application of active contour models for the segmentation of oral lesions in medical color images acquired from the visual per of the light spectrum. The proposed work also classifies cancerous and non – cancerous lesions. The automatic segmentation algorithm simplifies the analysis of oral lesions and can be used in clinical practice to detect potentially cancerous lesions.

[S. Murugavalli, V. Rajamani, 2007] [13] proposed an improved implementation of brain tumor detection using segmentation based on neuro fuzzy technique. Various tissues like white matter, gray matter, cuff and tumor were detected. The Fuzzy C means algorithm is used to classify the image, layer by layer. The neuron fuzzy technique shows that MRI brain tumor segmentation using HSOM – FCM also perform more accurate one.

[Mohammed.M.M et al 2003] [14] has proposed Prostate cancer diagnosis based on Gabor filter texture segmentation of ultrasound image. Multichannel filtering is an excellent method for prostate texture investigation. Using human visual system (HVS), medical doctors use three features for texture analysis, mainly repetition, directionality and complexity. A set of Gabor filters that is well distributed to cover the entire frequency plane is designed to mimic the HVS and therefore it is an excellent tool that can be used for prostate texture segmentation.

[Seshadri.H.S, Kandasamy.A] [15] has proposed detection of breast cancer at an early stage by Digital Mammogram Image analysis. The gradient of the preprocessed image is calculated and finally the segmentation algorithm is applied to the image. They have tested the proposed method on digital mammograms taken from mini – MIAS database and found the lesion segmentation algorithm closely matches the radiologists outlines of these lesions.

Varsha.H. Patil et al, [16] proposed an automated system for detecting breast tumor at an earlier stage. The system uses super resolution technique to display the necessary information for boosting the physician's diagnosis. CAD tools are used to design the system.

[Poulami Das, et al, 2009] [17] have proposed a method to identify abnormal growth cells in breast tissue and suggested further pathological tests. They compared normal breast tissue with malignant invasive breast tissue by a series of image processing steps. Features of cancerous breast tissue are extracted and analysed with normal breast tissue.

[Shekar Singh et al 2011][18] have proposed the detection of breast cancer and classification of histopathological images. They used Feed Forward Back Propagation Neural Network for classification of benign and malignant breast cancers. The breast cancers were classified into type 1, type 2, type 3. They extracted eight features after cancer detection. Feed forward Neural Network gives fast and accurate classification of breast cell nuclei.

Computer aided diagnosis systems for detecting malignant texture in biological study have been investigated using several techniques. Vijay Kumar.G et al [19] proposed an approach in computer aided diagnosis for early prediction of brain cancer using Texture features and neuro classification logic. Nine distinct invariant features with calculation of minimum distance for the prediction of tumor in a given MRI image. A neuro fuzzy approach is used for the recognition of the extraction region.

Yan Zhu and Hong [20] suggested the Hopfield neural network for the detection of brain tumor boundaries which was based on an active contour model. This is more suitable for real time applications.

Automated detection of tumors in different medical images is motivated by the inevitability of high accuracy when we deal with human life. L. Jeba sheela et al [21] proposed a system using imaging techniques to categorize the images as normal or abnormal and then classify the tissues of the abnormal brain MRI to identify brain related diseases.

2.2 Feature extraction and cancer classification techniques

[DSVGK Kaladhar, B. Chandana, P. Bharath Kumar, 2011] [22] have predicted oral cancer survivability using Classification algorithms. The classification algorithms used are CART, Random

Forest, LMT, and Naïve Bayesian. The algorithms classify the cancer survival using 10 fold cross validation and training data set. Out of the other techniques, the Random Forest classification technique correctly classified the cancer survival data set. The absolute relative error is less when compared to other methods.

[Xiaowei Chen et al 2006] [23] have proposed Automated segmentation, classification and tracking of cancer cell nuclei in time – lapse microscopy. Existing computational imaging methods are rather limited in analyzing and tracking such time – lapse datasets and manual analysis is unreasonably time – consuming and subject to observer variances. An automated system that integrates a series of advanced analysis methods to fill this gap. The cellular image analysis methods can be used to segment, classify and track individual cells in a living cell population over a few days. Experimental results show that the proposed method is efficient and effective in cell tracking and phase identification.

[Yung – nien Sun et al 2010] [24] have proposed an automatic color – based feature extraction system for parameter estimation of oral cancer from optical microscopic images. Parameter comparisons between four cancer stages are conducted, and only the mean parameters between early and late cancer stages are statistically different. The proposed system provides a useful and convenient tool for automatic segmentation and evaluation for stained biopsy samples of oral cancer.

[Yung –nien Sun et al 2007] [25] have proposed a new color – based approach for automated segmentation and classification of tumor tissues from microscopic images. The algorithm is evaluated by comparing the performance of the proposed fully – automated method against semi – automated procedures. The experimental results shows consist agreement between the two methods. The proposed algorithm provides an effective tool for evaluating oral cancer images. It can be applied to other microscopic images prepared with the same type of tissue staining.

[Neha Sharma, Nigdi Pradhikaran, Akurdi 2011] [26] have compared the performance of data mining techniques for oral cancer prediction. The two data mining techniques used are Multilayer Perceptron Neural Network model and tree Boost model. For Training data as well as validation data, Multilayer Perceptron Neural Network and Tree Boost indicates the same specificity and sensitivity. Misclassification of data is not seen in both training and validation data in Multilayer Perceptron Neural Network as well as tree boost model. Also the most important variable for the prediction of malignancy is "Presence of Lymph Node" as seen on USG. As per the study, Tree Boost Classification Model and Multilayer Perceptron Neural Network model both are optimal for predicting malignancy in patient.

[M. Muthu Rama Krishnan, Chandran Chakraborthy, Ajoy Kumar Ray, 2010] [27] have proposed a wavelet based texture classification for oral histopathological sections. As the conventional method involves in stain intensity, inter and intra observer variations leading to higher misclassification error, a new method is proposed. The proposed method, involves feature extraction using wavelet transform, feature selection using Kullback – Leibler (KL) divergence and diagnostic classification using Bayesian Approach and Support Vector Machines

[A. Chodorowski et al, 1999] [28] have proposed a method for oral lesion classification using true color images. Five different color representations were studied and their use for color image analysis of mucosal images evaluated. Four common classifiers (Fisher's Linear Discriminant, Gaussian quadratic, KNN nearest neighbor and Multilayer perceptron) were chosen for the evaluation of classification performance. Classification accuracy was estimated using resubstitution and 5 – fold cross validation methods. The best classification methods were achieved in HIS system and linear discriminant function.

[A. Ji Wan Han 2008] [29] have investigated the classification of radicular cysts and odontogenic keratocysts. The classification was made using cascaded haar classifier. Three separated classifiers were trained respectively for each type of cyst to process unseen histological images in turn, to return a statistical count of the number of each corresponding cyst nuclei type present. The experimental results show the success of these classifiers in locating individual cells nuclei and in classifying the cyst types.

[Laine. A.F et al] [30] have proposed Mammographic feature enhancement by multiscale analysis. Methods of contrast enhancement are described based on three over complete multiscale representations: 1) the dyadic wavelet transform (separable), 2) the φ – transform (non – separable,

nonorthogonal), and 3) the hexagonal wavelet transform (nonseparable), Multiscale edges identified within distinct levels of transform space provide local support for image enhancement.

[Sebastian Steger, Marius Erdt, Gianfranco Chiari and Geirgious Sakas] [31] have proposed a method for novel image feature extraction approach that is used to predict oral cancer reoccurrence. Several numeric image features that characterize tumors and lymph nodes are also proposed. In order to automatically extract those features Registration and supervised segmentation of CT/MR images form the base of automated extraction of geometric and texture features of tumor and lymph nodes. Higher accuracy and robustness is achieved compared to today's clinical practice.

Literature survey reveals that cancer imaging in one of the active areas of research today. According to researchers, it is important to detect, segment and classify cancers at an earlier stage. The researchers working in this area have contributed towards development of algorithms in cancer detection, segmentation, classification etc.

III. COMPARISON OF METHODS

Table 1. Comparisons of various cancer detection methods

S. No	Authors	Cancer type	Technique	Algorithm used	Results	Future Enhancement	Limitations
1.	A. Banumathi, Praylin Mallika, S. Raju, V. Abhai Kumar	Oral Cysts	Neural Networks, Image processing	Contrast Stretching, Radial Basis Function	Severity of cysts is measured. For each dental image accuracy is calculated for classification of cysts.		
2.	S. Murugavalli, V. Rajamani	Brain Tumor	Neuro Fuzzy	Fuzzy C means clustering algorithm	Detected brain tumor at an earlier stage		
3.	Ghassan Hamarneh, Artur Chodorowski, Tomas Gustavsson	Oral cancer	Image Processing	Active Contour model (Snakes)	Segmentation of oral lesion is obtained in single band images from true color images.	To further automize and improve segmentation, additional or enhanced energy terms and more human knowledge should be incorporated	User assistance is required due to larger variability of objects
4.	Varsha H. Patil , Dattatraya S. Bormane, Vaishali S. Pawar	Breast cancer	CAD, Image Processing	Super resolution technique	Detected cancers at very early stage.	To simulate the system	
5.	H.S.Seshadri, A. Kandasamy	Breast cancer	Image processing	Watershed segmentation	Detected cancer tumors at an early stage	A new methodology to extract various parameters which helps to view automatically identifies the suspect lesions.	
6.	Sebastian Steger, Marius Erdt, Gianfranco Chiari, Georgios Sakas	Oral Cancer	Image Processing	Supervised Segmentation, Image Feature Extraction	Oral cancer reoccurrence is predicted automatically	Incorporation of other source modalities like PET	
7.	Ranjan Rashmi Paul et al	Oral cancer	Wavelet, Neural Networks	Multi Layered Perceptron (MLP) Feed – Forward Neural Network	The feature vectors are extracted from each contiguous 64 x 64 blocks by wavelet decomposition.		
8.	M. Muthuramakirhsnan, Chandan Chakraborty, Ajoy Kumar Ray	Oral Cancer	Wavelets, Data mining, Neural Networks	Bayesian Classification, Support Vector Machines	48 gabor wavelet features and 9 wavelet feature are extracted	Improvement in accuracy. Because only 76.83% accuracy has been achieved using Bayesian Classification	

The above referred research works are classified as cancer detection methods and cancer classification methods. A comparative study is made between the detection methods and the classification methods separately.

3.1 Comparison of Cancer Detection Techniques

In [13], a neuro fuzzy model was used to achieve a higher value of tumor pixels. The algorithm used classifies the image layer by layer. Brain Tumor was detected using a Neuro Fuzzy model. The performance of MRI image in terms of weight vector, execution time and tumor pixels detected and compared the results with the existing one. A higher value of detected tumor pixel than any other was achieved.

Ghassan Hamasneh et al, [12] applied snakes for semi-automatic segmentation of oral lesions in color images of the human oral cavity. Snakes reduced the need for edge linking compared to traditional edge based segmentation and lead to small segmentation errors. But operator interaction was needed due to large variability of the objects and images in this application. In [8], the first procedure is

determining the seed regions. The Fuzzy C means clustering algorithm is used a segmentation strategy to function as better classifier and aims to classify data into separable groups according to their characteristics. As the number of clusters increases, more and more information is obtained about the tissue which cannot be identified by pathologists.

Varsha.H. Patil et al, [16] proposed an automated system for detecting breast tumor at an earlier stage. The system was online and interactive, hence faster and accurate than manual process. The system uses super resolution technique to display the necessary information for boosting the physician's diagnosis.

In [15], the proposed approach provided promising segmentation results. However, several control parameters are not automatically defined and the identification of lesions needs further development. In future, a new methodology is proposed to extract various parameters characterizing each basin. These parameters will be used in view to automatically identify the suspect of lesions.

Woong et al [6] used 2D and 3D OCT for early detection and diagnosis of oral premalignancy and malignancy. 3D images provide detailed structural information at any location, and may be viewed at any desired by the clinician. OCT has the potential to become a powerful method for early oral cancer detection.

3.2 Comparison of Cancer Classification methods

Muthu Rama Krishnan et al, [27], classified oral tumor using Bayesian Classification and Support Vector Quantization. All wavelet family has been used as an input to classifier to determine the signification of measurement. 48 gabor wavelet features and 9 wavelet features of epithelium are extracted. The signification of each feature is tested using KL divergence. Classification accuracy with wavelet and Gabor wavelet based texture features is also made. Wavelet family with gabor texture features leads to 92% average overall classification accuracy for Support Vector Quantization and 76.83% accuracy for Bayesian one.

Ji Wan Han et al [29] used Haar cascade classifier for classification. The classifiers were able to find the individual cell nuclei, but there were much false positive detection. These false detections have a negative influence on the overall classification results of the technique. However, the performance of this technique against that of [30] is based on lesser information. Landini [32] analysed epithelial lining architecture in radicular cysts and odontogenic keratocysts applying image processing algorithms to follow traditional cell isolation based approach.

Ireaneus Anna Rejani.Y et al [9] used a thresholding method for segmentation. The classification of breast cancer is done by SVM classifier. The method was tested on 75 mammographic images, from the mini – MIAS database. The methodology achieved a sensitivity of 75%.

A. Chodorowski et al, [28], proposed a method for oral lesion classification using true color images. Classification accuracy was estimated using res resubstitution and 5- fold cross validation methods. The best classification results were achieved in HSI color system and using linear discriminant function 94. % of accuracy was achieved. The comparisons of various techniques are tabulated in Table 1.

IV. DISCUSSION

There are many techniques for detecting cancers. Some researchers have suggested neuro – fuzzy models for classifying cancers. Many methods aim for high accuracy, more features and enhancements. In [19], the considerable iteration time and the accuracy level is found to be about 50 – 60% improved in recognition compared to the existing neuro classifier. In [20], the desired detection strongly depends on active contour model. Hence in this work adaptive active contour model was used. The accuracy and speed of detection can be further modified by modifying model and neural network training approach. These papers focus more on accuracy. But the approaches applied for breast cancers or brain cancers cannot be applied directly for oral cancers, because of the moving artifacts induced by the moving tongue and jaw.

V. CONCLUSIONS

In this paper, various methods to detect cancers are analyzed. The proposed work will identify oral cancer at an earlier stage which helps surgeons to provide medications and other treatments necessary

for the particular cancer type. The proposed work will explore different enhancement techniques to improve the quality of images capturing devices like Ultra – Sonography (US), Positron Emission Tomography (PET), Single photon Emission Computed Tomography (SPECT), Optical Imaging (OI), Computed Tomography (CT), X ray, Ultrasound and MRI. This will benefit the patients suffering from oral cancer.

ACKNOWLEDGMENT

The authors would like to thank Dr. T.P.Swamy, MDS (Orthodontist, Annai Orthodontist Centre, Coimbatore) for his valuable suggestions about the occurrence and diagnosis of oral cancer. The authors devote their sincere thanks to the Management and Staff of Karpagam College of Engineering for their constant support and motivation.

REFERENCES

[1] Arlene Guagliano, "Dental Tribune – Middle East and African Edition",June – August 2011.
[2] National Cancer Institute Website, www.cancer.gov
[3] Crispian Scully, Jose.V. Bagan, Colin Hopper, Joel. B. Epstein, "Oral Cancer: Current and future diagnostics techniques – A review article", American Journal of Dentistry, Vol. 21, No.4, pp 199 – 209, , August 2008.
[4] R.C. Gonzales and R.E. Woods, "Digital Image Processing", Addison Wesley 1992.
[5] A. Banumathi, J. Praylin Mallika, S. Raju, V. Abhai Kumar, "Automated Diagnosis and Severity Measurement of cyst in dental X – ray images using Neural Network", International Journal of Biomedical Soft Computing and Human Sciences, Vol.14, No.2, pp 103 – 107, 2009.
[6] Woonggyu Jung, Jun Zhang, Jungrae Chung, Petra Wilder – Smith, Matt Brenner, J. Stuart Nelson and Zhongping Chen, (2005) "Advances in Oral Cancer Detection using Optical Coherence Tomography", IEEE Journal of Selected Topics in Quantum Electronics, Vol. 11, No.4.pp 811 – 817.
[7] Simon Kent, "Diagnosis of oral cancer using Genetic Programming – A Technical Report", CSTR -96-14.
[8] Ranjan Rashmi Paul, Anirban Mukherjee, Pranab K. Dutta, Swapna Banerjee, Mousumi, Pal, Jyotirmoy Chatterjee and Keya Chaudhuri, "A novel wavelet neural network based pathological stage detection technique for an oral precancerous condition" , Journal of Clinical Pathology, Vol.58, Issue.9, pp 932 – 938, 2005.
[9] Ireaneus Anna Rejani.Y, S. Thamarai Selvi, "Early Detection of Breast cancer using SVM Classifier Technique", International Journal of Computer Science and Engineering, Vol. 1(3), pp 127-130, 2009.
[10] S. Saheb Basha, K.Satya Prasad, "Automatic Detection of Breast cancer mass in mammograms using morphological operators and fuzzy C – means clustering", Journal of Theoretical and Applied Information Technology, pp 704 – 708.
[11] Man Kin Derek Ko," Watershed Segmentation for Medical Confocal Image Analysis Towards in Vivo Early Cancer Detection", Journal of Biological Applications, pp 14 – 15, 2007.
[12] Ghassan Hamarneh, Artur Chodorowski, Tomas Gustavsson, "Active Contour models: Application to oral Lesion detection in color images", IEEE Conference on Systems, Man, and Cybernetics" in IEEE Conference in Systems, Man and Cybernetics, Nashville, TN , USA, October 2000, pp 2458 – 2463.
[13] S. Murugavalli, V. Rajamani, "An Improved Implementation of Brain Tumor Detection using Segmentation based on Neuro Fuzzy Technique", Journal of Computer Science, Vol.3, Issue. 11, pp 841 – 846, 2007.
[14] M.M. Mohamed, T. K. Abdel-galil, M. M. A. Salama, A. Fenster, K. Rizkalla, D. B. Downey, "Prostate Cancer Diagnosis Based on Gabor Filter Texture Segmentation of Ultrasound Image", IEEE Canadian Conference on Electrical and Computer Engineering (CCECE'03), Montreal, Canada, Vol. 3 , pp. 1485 – 1488, May 2003.
[15] H. S. Seshadri, A. Kandasamy, "Detection of breast cancer tumor based on morphological watershed algorithm", International Journal on Graphics, Vision and Image Processing, Vol.5, Issue. 5, 2005.
[16] Varsha H. Patil , Dattatraya S. Bormane, Vaishali S. Pawar, "An automated computer aided breast cancer detection system", International Journal on Graphics, Vision and Image Processing, Vol.6, Issue. 1, 2006, pp 69 – 72.
[17] Poulami Das, Bebnath Bhattacharya, Samir. K. Bandyopadhyay, Tai – hoon Kim, "Analysis and Diagnosis of Breast cancer", International Journal of u- and e- Service, Science and Technology", Vol.2, September 2009.
[18] Shekar Singh, Dr.P.R.Gupta, Manish Kumar Sharma, "Breast cancer detection and classification of histopathological images", International Journal of Engineering Science and Technology, Vol 3, No.5, May 2001, pp 4228 – 4232.
[19] G. Vijay Kumar, Dr.G.V.Raju, "Biological early brain cancer detection using Artificial Neural Network", International Journal of Computer Science and Engineering, Vol. 2, No.8, pp 2721 – 2725, 2010.

[20] Yan Zhu, Hong, "Computerized Tumor boundary detection using Hop Field Network", IEEE Transactions on Medical Imaging, 1997.
[21] L. Jeba Sheela,Dr. V. Shanthi, "Image mining Techniques for classification and segmentation of Brain MRI Data", 2005 – 2007, JATIT.
[22] DSVGK Kaladhar, B. Chandana and P. Bharath Kumar, "Predicting cancer survivability using Classification algorithms", International Journal of Research and Reviews in Computer Science (IJRRCS) Vol.2, No.2, pp 340 – 343, April 2011.
[23] Xiaowei Chen, Xiaobo Zhou and Wong, S.T.C, "Automated segmentation, classification, and tracking of cancer cell nuclei in time-lapse microscopy", IEEE Transactions on Bio medical Engineering, Vol. 53, Issue.4, pp 762 – 766, 2006.
[24] Yung –nien Sun, Yi-ying Wang, Shao-chien Chang, Li-wha Wu and Sen – tien Tsai, "Color – based tumor segmentation for the automated estimation of oral cancer parameters", Microscopy Research and Technique, Vol. 73, Issue. 1, pp 5- 13, 2010.
[25] Yung –nien Sun, Yi-ying Wang, Shao-chien Chang, Li-wha Wu and Sen – tien Tsai, "A color – based approach for automated segmentation in Tumor Tissue Classification", Proceedings of the 29th Annual International conference of the IEEE EMBS, 2007.
[26] Neha Sharma, Nigdi Pradhikaran, Akurdi, "Comparing the performance of data mining techniques for oral cancer prediction", Proceedings of the 2011 International Conference on Communication, Computing & Security (ICCCS'11), ISBN: 978-1-4503-0464-1, New York, USA, 2011.
[27] M. Muthu Rama Krishnan, Chandran Chakraborthy, Ajoy Kumar Ray, "Wavelet based texture classification of oral histopathological sections", International Journal of Microscopy, Science, Technology, Applications and Education, pp 897-906.
[28] A. Chodorowski, U. Mattsson, T. Gustavsson, "Oral Lesion classification using true color images", Proceedings of SPIE, Vol. 3661, ISBN. 978081943132, pp 1127 – 1138, 1999.
[29] A. Ji Wan Han, Toby Breckon, David Randell, Gabriel Landini, "Radicular cysts and odontogenic keratocysts epithelia classification using cascaded Haar classifiers" – A review article published by University of Birmingham.
[30] Laine, A.F. Schuler, S. Jian Fan Huda, W. "Mammographic feature enhancement by multiscale analysis" IEEE Transactions on Medical Imaging. Vol.13, Issue.4, pp 725 – 740, December 1994.
[31] Sebastian Steger, Marius Erdt, Gianfranco Chiari and Georgios Sakas, "Feature Extraction from Medical Images for an oral cancer reoccurrence prediction environment", World Congress on Medical Physics and Biomedical Engineering, September 7 - 12, 2009, Munich, Germany.
[32] G. Landini, "Quantitative analysis of the epithelial lining architecture in radicular cysts and odontogenic keratocysts", Head and Face medicine, Vol.2, February 2006.

Authors

K. Anuradha completed her B.Sc (Applied Science) from PSG College of Technology, Coimbatore in 2000 and MCA from Bharathiar University in the year 2003. She is currently pursuing her Ph.D (Computer Science) at Karpagam University, Coimbatore. She has published a paper in the International Journal. She has presented 5 papers in National and International Conferences. She has got 8 years of teaching experience and 1 year industrial experience. Her areas of interest include Medical Image Processing, Computer Graphics and Distributed Computer Systems.

K. Sankaranarayanan, born on 15.06.1952, completed his B.E. (Electronics and Communication Engineering) in 1975 and M.E. (Applied Electronics) in 1978 from P.S.G. College of Tech., Coimbatore under University of Madras. He did his Ph.D. (Biomedical Digital Signal Processing and Medical Expert System) in 1996 from P.S.G.College of Technology, Coimbatore under Bharathiar University. He has got more than 32 years of teaching experience and 10 years of research experience. He has guided 10 candidates for Ph.D and presently guiding 18 candidates for Ph.D. His areas of interest include Digital Signal Processing, Computer Networking, Network Security, Biomedical Electronics, Neural Networks and their applications and Opto Electronics. He has published more than 50 papers in National Journals and International Journals.