TCDR based on Efficiency and Accuracy of the Intelligent Systems

AzmiShawkat Abdulbaqi[1], AbdAbrahem Mosslah[2], ReyadhHazim Mahdi[3]
[1]Dept. of Computer Science, College of Computer& Information Technology,University of Anbar,IRAQ
[2]Dept. of Fiqih, College of Islamic Science,University of Anbar,IRAQ
[3]Dept. of Computer Science, College Science,University of Mustanseriah,IRAQ

Abstract:*According the recent world health organization (WHO) reports, one person every hour of every day dies of oral cancer in the united states. Oral cancer is a term used to describe any tumor appears in the oral cavity. The origin of the tumor may be a prototype of the oral tissues or may be a minor mouth tumor. Tongue cancer is one of oral diseases and it's a common disease. In this paper, tongue cancer detection and recognition (TCDR) system using Radial Bases Function (RBF) Neural Network, MultiLayer Perceptron (MLP) and Genetic algorithm (GA) is proposed. The proposed system consists of mainly three steps: first, pre-processing are applied to the input image (Mouth image, gum image and tongue image). Second, extracted the features of tumor tissue. This feature is being as input parameters to the hybrid algorithm. The final step, the proposed algorithm is implement the classification to acquire the results.*

Keywords*: Radial Bases Function (RBF) neural network, MultiLayer Perceptron (MLP), Feature Extraction, Genetic Algorithm (GA), Canny Edge Detection (CED).*

1. Introduction

Oral cancer is the most common form of cancers among people, this class of cancers is deadly. In the United States of America, one person every hour of every day dies of oral cancer especially tongue cancer. This disease is increasing rate among young adults , rating 25% of victims. Oral cancer does not discriminate and most people are not even aware that they are at risk. There is a high survival rate among sufferers when detected early, but in its late stage, the rate is decreasing gradually[1].With increasing of technological revolution, It has opened a new age for humans to enter into a new world. This occurs because of human be a leader and produce a new generation of these technologies lead to achieve task easy. With the advancement of technology, early detection of tongue cancer is possible. The growth of computer society was becoming the most important due to achieve a visual recognition comparable with humans where the electronic medium plays an important role in civilized societies[2]. Oral cancer is very deadly disease affecting the many people. It's appear as a malicious or benign tumor in mouth tissues or over tongue. Malicious tumor appear as a bleeding fester inside mouth. This disease arises from inflammation occur inside the mouth or over tongue. Diagnosis of this disease is hard and needs more laboratory tools for sample tests but , if diagnose at the right time, the recuperation rate is high[3]. Laboratory sample tests often. Sampling tests often cause a spread malicious tissue over all mouth or tongue if these tests are carried out by a specialist or unhealthy method.Disorderly abnormal region and color intensity various are mostly symptoms of oral disease. Diagnosis based on the computer can help to discover disease symptoms early. Sample tests include , take a tumor sample or tissue . This appears clearly by color variation or bleeding secretion[4].

2. Overview Of Tongue Cancer (TC)

Tongue cancer of is a branch of neck cancer and head cancer. This type of cancers is evolved from cells of squamous of the tongue. This infection led to growth tumor over the tongue and spread. Tongue cancer is part of popular oral cancer, such as lip cancer, cheek lining, gum and etc.[5].

2.1.Cause Of Tongue Cancer

The term cancer refers to malicious growths. Cancer cause when the tongue cells divide continuously and be out of control, this led to tumor growth. It is not clear exactly what causes of tongue cancer, but there are indications lead to infection with tongue cancer:

(1) Smoking cigarettes, cigars, or a pipe (2) Use of chewing tobacco, snuff, or other tobacco products (3) Heavy alcohol consumption[6][7].

3. TC Dataset

There are a various available collections of image database, including high resolution tongue images and

others[15]. This database can have different formats and came from different sources, various databases on the internet and hyperspectral tongue images took by Velscope Oral Cancer Screening (VOCS) described in the next figure 1 [16][17].

4. Literature Review

Most of the research work in oral cancer tumor detection is done towards enhancing and increasing the lifetime of patient by proposing a new ways of efficient healthcare:

- In 2011, KeheCai, Mengyi Liu and Yuyu Zhang suggests a novel recognition algorithm for detecting tongue cancer stem cells with respect to appropriate scaling factors.This algorithm based on three biological parameters ,the curvature variance of cell contour, the nuclear-cytoplasmic area ratio, and the average optical density of cytoplasm as the measurement parameters[8].
- In 2012, R.H.Kumar, N.S.Vasanthi and etc., proposed a generic classification of the oral and breast cancer stages from clinical parameters using MLP & RBF neural network was considered [9].
- In 2012, K. Anuradha and K.San. presents a new technique to detect cancers in mouth provided by an Orthopantomogram.This study depend on dental X-Ray image ,captured and the series of operations to enhance the quality of the image and detection of tumor is performed. In this study, the quality of the image is enhanced using linear contrast stretching[10].
- In 2012, ZhiLium, H.Wang and Qingli Li proposed a hyperspectral imaging system to measure and analyze the reflectance spectra of the human tongue with high spatial resolution for tongue tumor detection.In this proposed system, reflectance data were collected using spectral acousto-optic tunable filters and a spectral adapter, and sparse representation was used for the data analysis algorithm[11]
- In 2013, S.W.Chang, S.A.Kareem and etc., present a non traditional model for oral cancer diagniose by applying methods of hybrid feature selection and machine learning based on the parameters of the correlation of clinicopathologic and genomic markers. [12]
- In 2014, S.W.Chamg, S.A.Kareem and etc. proposed a new hybrid artificial intelligent technique in the prognosis of oral cancer based on the correlation of clinicopathologic and genomic markers .The model consisting of two stages, where stage one with ReliefF-GA feature selection method to find an optimal feature of subset and stage two with ANFIS classification to classify either the patients alive or dead after certain years of diagnosis. [13]
- In 2015, F.Mohd, N. M. Mohamad Noor and etc., implement a new proposed technology to predict more accurately the presence of oral cancer primary stage. The integrated diagnostic model with hybrid features selection methods is used to determine the attributes that contribute the most to the diagnosis of oral cancer, which, indirectly, reduces the number of features that are collected from a variety of patient records [14] .

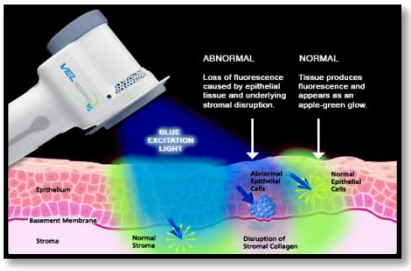
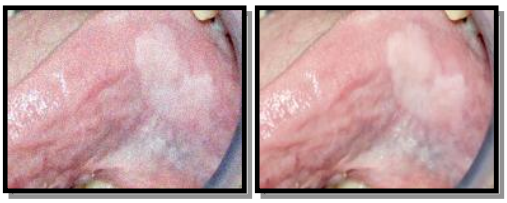


Figure1 VELSCOPE System Hand-Held Device for Early Oral Detection of Abnormal and Cancerous Tissue

5. Image Enhancement and Denoising

Usually, input tongue images are contained garbage or noise (corrupted image and salt and peppers). These images must be enhanced before input these images to the proposed system (image denoising). To enhance the quality of processing tongue image (preprocessing), filtering is required to solve contrast enhancement, noise suppression, blurry issue and data reduction. Initially, the system starts pre-processing by capturing a frame to normalize the illumination and reduce image noise before tongue tumor detection[18]. Next, the capturing image converts from RGB image to grayscale image in order to analyzing the pixel intensity values in the converted image. Image enhancement performed to obtain denoising image using 3×3 median filter or any enhancement filters . A median filter is used to remove the noise effects. Figure 2 shows tongue image before and after enhancement [19] [20].



(A) **(B)**

Figure2 (A) Original Tongue Image (Tongue image contain Salt and Peppers) (B) After Enhancement

6. Histogram Equilizer Based Model

Histogram Equalizer (HE) it is a graphical representation of the intensity distribution of an image. HE can carry out to minimize the various illumination parameters.It quantifies the number of pixels for each intensity value considered. It is a method that improves the contrast in an image, in order to stretch out the intensity range. HE method is one of the frequently used for image segmentation techniques. In this method, we will produce a vertical histogram only (figure 3). This process is to get

a group of pixels in vertical regions where they will lead to distinguishing the gray levels of the image. In common, an image will have two regions: background and object [21]. Normally, the background is assigned as one gray level whiles the object (or also called as subject) is another gray level. Usually, the background will securethe largest part of the image so the gray level of it will have a larger peak in the histogram compared to the object of the image [22].

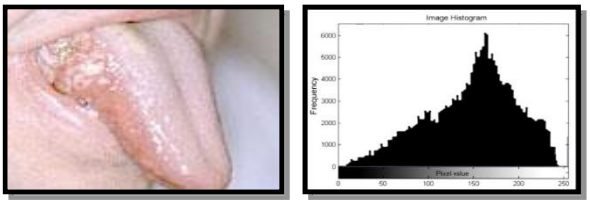
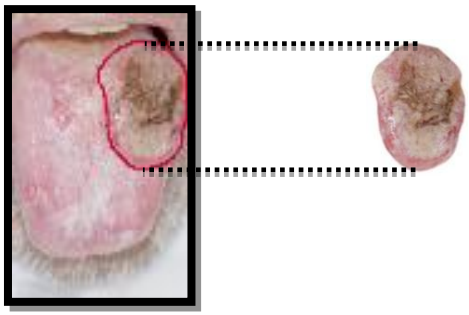


Fig. 3 Original Tongue Image with its Histogram Equilizer (HE)

7. Image Segmentation Applying

Digital Image Segmentation (DIS) means the important field in (DIP) and many relational applications such as medical images and etc. This field consider a key role in (DIP) .So, this field used to discover the main important areas in digital image after analysis it.Segmentation method depends on several factors and these factors depend on what application kind is used. The segmentation process shown in figure 5 starts when find the collections that correspond to the important regions in the tongue tumor image. When it is separate regions related to each other in the input image, identifying areas of collections, the result is called Pixel classification and the same collections are called classes[23]. Pixel classification is often a desirable goal in images, particularly when disconnected regions belonging to the same tumor texture class need to be identified. Labeling is the process of assigning a meaningful designation to each region or class and can be performed separately from segmentation [24]. Figure 5 display full tongue image before segmentation (part a) , and part (b) show image segmentation and tumor specification.



(a)Filtered Image (b) Segmented Image
Figure 4 Segmentation

Image segmentation techniques can classify into three parts, which are: (1) Region is growing and shrinking: subset of clustering .(2) Clustering methods and (3) Boundary detection: extensions of the edge detection techniques. Pixel classification techniques can be classified into main five phases: (1) Thresholding approaches (2) Classifiers (3) Clustering Approaches (4) ANN (5) Markov Random Field Models (MRF). MRF help user to make better image segmentation ,image restoration, or image enhancement. However, using segmentation methods based on (MRF) models, requires a huge computing power and quite a lot of time[25].

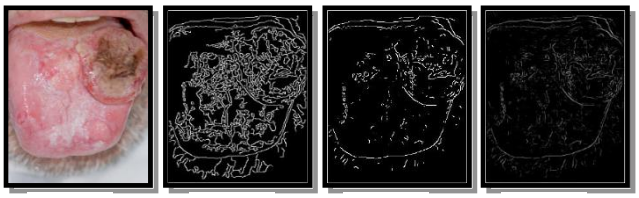
8. Feature Exctraction (FE) Applying

FE stage is an important stage comes after image segmentation . This stage related to extracting important data related to the tumor. To extract features of a tumor , first the image is converted into a binary image. From the converted image only the tumor in the image has been cropped and convert the rest of the image into the gray level , finally , the features have been collected [26].

9. Canny Edge Detection (CED) Filter

In general, the purpose of edge detection is to reduce the amount of data in an image, while preserving the structural properties to be used for further image processing. Due to edge defines all boundaries of different objects in a digital image , edge detection is the popular problem in digital image processing . In this proposed algorithm, the (CED) is known as the optimal edge detector for tumor contour (figure 5) [27]. CED is widely used in computer vision to locate sharp intensity changes and to find object boundaries in an image. There are five steps to detect edges using (CED) : (1) Smoothing: Blurring of the image to remove noise. (2) Finding gradients: The edges should be marked where the gradients of the image have large magnitudes.(3) Non-maximum suppression: Only local maxima should be marked as edges. (4) Double thresholding: Potential edges are determined by thresholding. (5) Edge tracking by hysteresis: Final edges are determined by suppressing all edges that not connected to a very certain (strong) edge. The technical reasons for using (CED) to improving the edge detection by following criteria: (1) Low Error Rate (LER) (2) Edge Points are well Localized (EPL). LER means edges occurring in images should not be missed. During a process, the (CED) first smoothes the image to eliminate the noise (denoising) ,then finds the image gradient to highlight regions with high spatial derivatives

[28] . Figure 6, show a different view of tongue after applyingcanny filter and different Threshold values[29].



(A) (B) (C) (D)

Fig. 5 (A) Original (MTCT) Image (B) After Applying Canny Filter with Threshold 0.02 , (C) After Applying Canny Filter with Threshold 0.04 , (D) , After Applying Canny Filter with Threshold 0.1

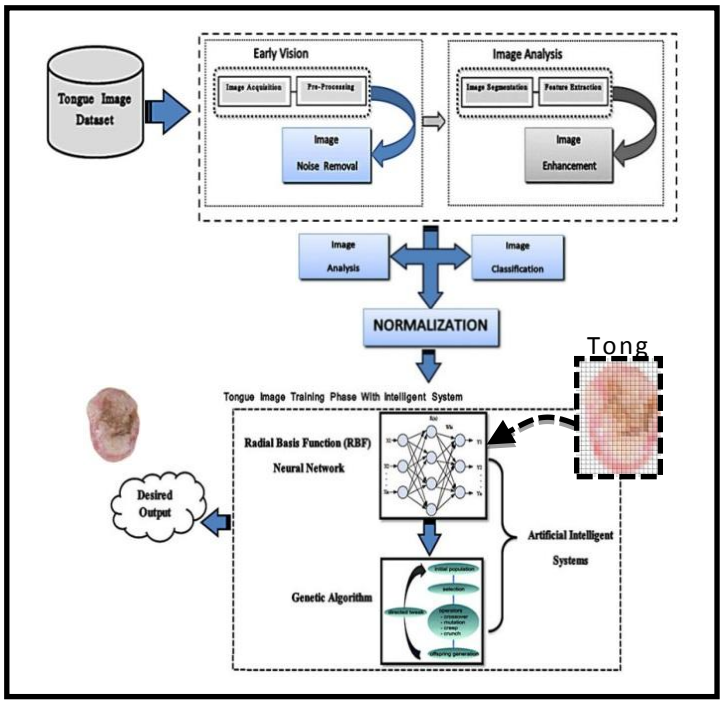
10. Proposed System Description

The proposed robust system called (TCDR), consists of mixed artificial intelligent systems, (RBF) network, MLP network and (GA). One of the most novel methods to be used with neural networks involves the hybridization of two types of network. The scientific truth behind the hybrid network is to succession phases of identical or not identical network models of examples to function as building blocks in analyzing a complex data structure. The hybrid proposed program developed by using RBF networks to minimize the scope of problem analysis in (MLP) network. Notice that the function of (RBF) network is collecting input features by characteristics of features distinguished. The (MLP) network has arranged those features categories into the entities desired to be recognized. To Improve the behavior of networks, compare the work of each net individually. These artificial intelligent computes a network size by the number of weights required for each (RBF) and (MLP) network, then foreword the result of the genetic algorithm directly. These results show that the hybrid approach can have some beneficial results. In addition, each stage of the network can be modified with a different paradigm to yield the desired results. Other benefits to using the hybrid network is to improve convergence speed and reliability of nets and fix the error cases on the global minimum by developing the structure of the input form to RBF network and (MLP) network. The disadvantage with hybrid networks is suffer data accuracy lost. To exceed this problem ,reducing the amount of input data in the first stage and pass only the input with robust features. This is leading to improve system speed , accuracy and efficiency. When we compare (RBF) with other kinds of artificial neural networks ,note that (RBF) network achieves very high accuracy for most of the data sets . Initially, the robust feature on input images fed to both (RBF) and (MLP) networks to start learning. The input of tumor image has been verified by (GA) that not verify by both artificial neural networks in order to gain optimum solution (recognition of tumor image).

11. System Implementation

The proposed model is a recognition and verification system. This system consists of two main passes stages: image processing (IP), when the system processes the input image, the second stage is the matching and recognition. In the second stage highlights the importance of artificial intelligence to reduce the error rate down to the desired output . In this system, it is detected the tumor through good draw (FE) of the region and detect the edges of malicious region. The main reason for using (ANN) in (MTCT) is the accuracy of these networks to reach the ideal solution. The GA is included in this paper in order to achieve better work , error rate minimization and additionally get the best results. Begin to detect cancer of the tongue during a comprehensive examination by a specialist doctor. If the doctor finds any tumor, capture multiple images of the tongue tumor through a special device industry for these purposes . Next, detect edges to determine tumor stage, size and place to start. Here is done by particular filters for this purpose. Here (CED) Filter used for this purpose due to its efficiency in high-determine the edges. The penultimate stage is extracting feature implementation, to be after it the last stage, which is to prepare images that have been processed to enter these images to the proposed system that consisting of an (ANN) and (GA) .The principle work of RBF network is similar to the work of backpropagation neural network (Bp) in the work area . When the learning starts with RBF, learning start by putting an image as a block, each block (iteration) consists of 8×8 matrix elements (PE) by multi iterations to suggested net .The 1st iteration putsinto the net as an input block and applying feedforwordneural network. First iteration input, compares with desired output if its, if there is an error(defects) ,then adjust the weights of each node by applying feedback neural network for the same iteration (i.e. during the training process these weights are adjusted to achieve optimal accuracy and coverage). After learning with both (RBF) and (MLP) networks, the output learned iterations fed to (GA) directly to begin the training phase with(GA). GA is dealing with the inputs from (RBF) and (MLP) networks as a chromosome. Finally, the best chromosome has good fitness is representing the best solution.Figure 6 below shows the above description of training iterations by both (RBF) , (MLP) and (GA) briefly. MLP network was used for image classification.The (RBF) network was used for neural network training. According to the evolutionary algorithm , a genetic algorithm starts with a population

(collection) of individuals, which evolves toward optimum solutions through the genetic operators (selection, crossover, mutation), inspired by biological processes. Each element of the population is called chromosome and codifies a point from the search space. The search is guided by a fitness function meant to evaluate the quality of each individual. The efficiency of a genetic algorithm is connected to the ability of defining good fitness function. The optimization will involve the random searching for the optimal values of the weights assigned to the connections between the neurons within the network where each (PE) represents a neural network with a particular set of weights. The aim of the hybridalgorithm is to find the population producing the smallest value of the error function.In the below full chart, the infrastructure of neural network , (GA) and (DIP)for (MTCT) .



12. Experimental Results

In this section, experimentalresultsby hybrid proposed model will describe in details.In the following tables , network structure was trained with the parameters applied by MATLAB and listed below. With this model, we have tested 50 different images of VELSCOPE system device for early oral detection of abnormal and cancerous tissue applied to the above discussed algorithm.Table (1) shows MATLAB output training parameters by both (RBF) and (MLP) networks structure and (GA) structure. The output table includes accuracy and efficiency with error rate for both (ANN) and (GA).

Table (2) displaysin details of training system with number of tongue images, this table shows recognition , accuracy and efficiency for hybrid proposed models .

Table (1) of ANN and GA individually

No. of Tongue Images	Matching by ANN	A & E	Error Rate	Matching by GA	A & E	Error Rate	Elapse Time
7	5	73%	1	3	44%	2	2.3s
15	10	75%	2	11	54%	4	2.61s
19	15	75%	6	16	66%	4	1.8s
24	20	79%	5	18	70%	6	2.45s

30	26	80%	7	20	74%	7	1.8s
40	35	87%	6	28	77%	7	2.00s
50	44	92%	7	34	80%	8	1.7s

Note that A&E: refers to Accuracy and Efficiency .

Table results comparison between (ANN), (GA) and Hybrid Model

No. of Epochs	Table Components of ANN			Table Components of GA			Table Components of Hybrid Proposed Model		
	ANN(RBF & MLP) Parameters	*Output Value*	*RR*	*GA Parameters*	*Output Value*	*RR*	*Hybrid Model*	*Output Value*	*RR*
80	The range of Initial weight	[0, 0.06]	**83.1 %**	Population Size	6- Binary Code	**71.2%**	Recognition Time	90%	**93.5 %**
150	No. of Input nodes	3		Length of Chromosome	8		Learning Rate	0.5	
1200	No. of Hidden nodes	25		Fitness Function	Max		-	-	
1600	Learning rate between input and hidden layers	0.7		Selection Method	Roulette Wheel		-	-	
2200	Momentum term between input and hidden layers	0.9		Crossover	0.1		-	-	
3000	Momentum term between hidden and output layers	0.9		Mutation	0.02		-	-	
5000	-	-		Iteration per Generation	6/50		-	-	

13. Conclusion

The oral cancer detection and recognition is an exciting and constantly progressing area of research and technology. The tools for tongue cancer detection are increasing accuracy and efficiency.In this present paper, a model of the tongue cancerrecognition system using the concept of (RBF) Neural Network, MultiLayer Perceptron (MLP) and Genetic algorithm (GA) is discussed.Thisproposed system consists of mainly two types of artificial intelligence and image processing.The maximum efficiency of neuralnetwork during training and learningis 83.1 % for tumorrecognition and the maximum efficiency of genetic algorithm is 71.2% for tumor recognition. The efficiency of the system has been increased by using a hybrid model where the efficiency isbetter than previoustechniques, equal to 93.5.System can development by make it online package through Telemedicine technique in order to diagnosis of difficult cases by professional doctors to provide immediate medical and therapeutic services to people everywhere.

References

[1] J.Bouquot, F.Pm, et al , *"The pathology of oral cancer and Precancer Revisited. Current Diagnosis Path"*, 2006.

[2] F.Ercal, A.Chawla, ,et al. ," *Neural Network Diagnosis of Malignant Melanoma From Color Images"*, IEEE Transactions on Biomedical Engineering. vol. 41, No. 9, 1994 .

[3] H.K, S.PC, et al.," *Sensitivity of direct tissue fluorescence visualization in screening for oral premalignant lesions in general practice"*, Gen. Dent ,57:34-38, 2009.

[4] A.Shahbahrami, J.Tang," *A Colour Image Segmentation algorithm Based on RegionGrowing"*, IEEE Trans. on Consumer Electronics Euromicro, pp 362-368, 2010.

[5] L.Dm., Hi.Tg, et al., *"Oral cancer: Just the facts"*, Journal of the Canadian Dental Association, 2008; 74(3).

[6] Canadian Cancer Society, National Cancer Institute of Canada. Canadian Cancer Statistics , p.p 1-112 ,Toronto, Canadian Cancer Society, 2007.

[7] L.PM, G.T, et al.," *Simple device for the direct visualization of oral-cavity tissue fluorescence*", Journal of Biomedical Optics; 11(2):024006 , 2006.

[8] K.Cai,M.Liu ,et al , *"The automatic detection algorithm of tongue cancer stem cells based on fuzzy pattern recognition*", Computer Science & Education (ICCSE), 6thInternational Conference, IEEE Publisher, 2011.

[9] R.H.K., N.S.V., et al. ,*"Performance Analysis of Artificial Neural Networks and Statistical Methods in Classification of Oral and Breast Cancer Stages*", International Journal of Soft Computing and Engineering (IJSCE) ,Vol.2, 2012.

[10] K. Anu. and K.San," *Detection of Oral Tumor based on Marker – Controlled Watershed*

Algorithm", International Journal of Computer Applications ,Vol. 52, 2012.

[11] Zhi Liu, H.Wanget al. ,*"Tongue Tumor Detection in Medical Hyperspectral Images"*, Multidisciplinary Digital Publishing Institute Journals, ISSN 1424-8220, Sensors 12, 162-174, 2012.

[12] S.W.Chang , S. A.Kareemet al. ,*"Oral cancer prognosis based on clinicpathologic and genomic markers using a hybrid of feature selection and machine learning methods*", BMC Bioinformatics Central, 2-15, 2013 .

[13] S.W.Chamg, S.A.Kareem and et al. ,*" A Hybrid Prognostic Model for Oral Cancer based on Clinicopathologic and Genomic Marker"s*, SainsMalaysiana 43(4),567–573, 2014.

[14] F.Mohd, N. M.Mohamad, et al. , *" Analysis of Oral Cancer Prediction using Features Selection with Machine Learning*", The 7th International Conference on Information Technology (ICIT), 2015 .

[15] S.PM, P.S, et al.,*" The cost-effectiveness of screening for oral cancer in primary care*", Health Technology Assessment; 10(14), 2006 .

[16] S. R, R. K., et al., *"Effect of screening on oral cancer mortality in Kerala"*, India: a cluster-randomised controlled trial. The Lancet; 365(9475):1927-1933,2005 .

[17] Early screening, diagnosis, and treatment planning saves lives. http://www.vincentlimdds.com/velscope/

[18] P.L., E.J., et al.*" Adjunctive techniques for oral cancer examination and lesion diagnosis"* , a systematic review of the literature. J Am Dent Assoc;139:896-905, 2008 .

[19] A.Buades, B.Coll et al., *"A review of image denoising algorithms, with a new one*",SIAM Journal on Multiscale Modeling and Simulation: A SIAM Interdisci- plinary Journal, 4 (2), pp.490-530, 2005 .

[20] J.A,*" Fundamentals of Digital Image Processing"*, Prentice Hall, 1991.

[21] T.Siranyi and A.Licsar. *"Supervised training based hand gestures recognition system"*, Proc. of the 16th International Conference on Pattern Recognition, Vol. 3, p.p 30999 – 31003, 2002.

[22] M. J. Swain and D. H. Ballard, *"Color Indexing"*, International Journal of Computer Vision, 7(1), pp. 11-32, 1991.

[23] A. Singh and K. Kant Singh, *"A Study Of Image Segmentation Algorithms For Different Types Of Images"*, International Journal of Computer Science Issues, vol. 7,Issue 5, pp 414-417,2010.

[24] E.A. , M.J. Berg, K.J. Parker, J. Weisberg, C.W. Chen, and L. Ketonen, et al ,*"Segmentation and Feature Extraction Techniques, with Applications to magnetic resonance images Head Studies"*, Mag. Res. Med., 33,1995:pp.670-677.

[25] A.M, H.L. et al.,*"Evaluation for Uncertainty Image Classification and Segmentation. Pattern Recognition"*, 39(11):1987–1995, Nov. 2006.

[26] G., I. , et al. ,*"An Introduction to Variable and Feature Selection"*, Journal of Machine Learning Research, 3, pp.1157-82, 2003 .

[27] Y. Luo and R. Duraiswami, *"Canny edge detection on nvidiacuda*" Computer Vision and Pattern Recognition Workshop, vol. 0, pp. 1–8, 2008.

[28] J.F.Canny,"*A computational approach to edge detection"*, IEEE Transactions on Pattern Analysis and Machine Intelligence (IEEE TPAMI), Vol. 8(6), 1986.

[29] A. Shawkat et al.," *Eczema Disease Detection and Recognition in Cloud Computing*", Computer Technology and Application 7, 56-63 doi: 10.17265/1934-7332/2016.01.005, 2016.

[30]