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EMF Absorption in the Human Body as a Design Issue for Implantable Medical Electronics

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Abstract

Oral cancer was a major global health issue, accounting for 606,520 deaths in 2020, with the majority of cases occurring in middle- and low-income countries. Allowing computerization in the diagnosis of potentially cancerous and malignant lesions in the buccal mucosa could lead to low-cost and early disease detection. The most significant goal of this study is to identify the afflicted region in tongue images for Oral Cancer Lesions. The current study used the GVF algorithm to detect oral cancer lesions using tongue image attributes. This article proposes a novel method for combining bounding box comments from various medical professionals. In addition, gradient vector flow was employed to segment the image, resulting in the complex patterns needed to complete this tough assignment. The hybrid classifier algorithm was evaluated using the original data collected in this study to detect Oral cancer lesions, and features such as colour, texture, and geometry were retrieved. The tongue images are collected by BioMed Chinese Medicine Repository. Additionally, performances are described with regard to categorizing as per the kind of referral decision. Our initial findings establish support vector machine has theprobable to challenge this stimulating task.

Keywords: GVF algorithm, Oral Cancer Lesions, hybrid classifier algorithm, support vector machine.

1. Introduction

Oral cancer occurs when the pancreas does not create enough insulin or when the body's cells do not respond effectively to the insulin produced. Type 1 Oral Cancer Lesions is a condition that results in the autoimmune destruction of the pancreas' insulin-producing beta cells. Oral Cancer Lesions Type 2 is a metabolic disorder characterised by elevated blood sugar levels in the context of insulin resistance and relative insulin resistance.

Basically, Oral Cancer Lesions is a grouping of metabolic diseases where high blood glucose levels over an extended period. This high blood glucose leads to the signs and symp- toms of increased urination, improved hunger, and improved thirst. Organic, Oral Cancer can cause many complications. Tongue images have been seized by utilizing a specifically constructed in-house device taking color correction into account. Every image was segmented to find its front pixels. The image processing primarily deals with image classification, feature extraction, image segmentation, image improvement, image acquisition. Oral Cancer Lesions is a significant health issue of 21st century. This characterises a huge economic responsibility to health care representatives and authorities. Based on the statistics from World Health Organization, in world deaths caused by Oral Cancer will reach about few million people in 2030. In recent years, technologies havebeen developed in medicalfieldtodetect Oral Cancer Lesions. Even the patients in the death condition also get cured by development in medical field. Imaginghas become an essential component in the field of biomedical research and clinical practice. It helped doctors in critical surgeries.

By utilizing a variety of image processing techniques, feature extraction, segmentation, and image classification is utilized to identify Oral Cancer Lesions using tongue. GradientVector Flow segmentation is providing accurate boundary, region and pixel-based segmenta- tion. Extraction of features is utilized to extract the geometry, texture andcolor from tongue image. Moreover, support vector machine, minimum distance and bayesclassifier is utilized to categorise whether the tongue image is oral cancer or healthy. Oral Cancer Lesions havebeen detected from various techniques utilizing classification and seg- mentation feature extraction. Especially, there were a significant number of attempts that depend onsegmentation todetect Oral Cancer Lesions. Tobetter understanddetecting Oral Cancer Lesions, Examining and analysing existing systems is beneficial. As a result, current methods and procedures for identifying Oral Cancer Lesions have been presented.

Xingzheng Wang et al. [2013] suggested a geometric distribution quality of human tongue colour for analytical feature extraction, as well as defining three tongue colour grades. Tongue colour gamut is a tool for predicting a wide range of colours. They suggest using a one-class SVM technique for colour range identifiers and show how to allocate colour to specific tongue traits to test efficiency.

AkaraSopharak et al. [2011] launched an Automatic identification of microaneurysm.The set of morphological operatives are utilized to identify the microaneurysm on low- contrast retinal and non-dilated pupil images. Initially, pre-processing is performed to detectmicroaneurysm to enhance the quality. A vessels and exudates could cause false detection that has been discovered in the second step. Vessels will be eliminated from the image prior to recognition of microaneurysm. Lastly, the microaneurysm was found on poor images. Though, it does notassess the seriousness ofthe disease it only exposes the microaneurysm.

[14] recommended a Gradient Vector Flow snake method to identify cancerous cells in breast tissues. GVF is utilized for segmentation to identifya specific cancer area in breast tissue. Gaussian Low Pass Filter is utilized to preprocess the mammography image to eliminate unnecessary noise. Finally, the Snake algorithm joins toward to cancerous area.

[10] specified computerised categorization magnetic resonance pictures of the human brain that can be used to determine whether a person is sick or healthy Wavelet transform is used to extract the feature from MRI pictures. Reduction of features PCA is used to reduce the number of dimensions, which increases the computational complexity and expense. Cuckoo and SVM are used in a hybrid technique to classify if an individual is sick or well.

Wenshu Li et al. [2009] An improved level set technique was used to forecast anoveltechnique for tongue contour extraction. Initially, the contour of the tongue was altered in the HSV colour space, and a method was demonstrated that improved the contrast between the tongue and other parts of the image. The tongue contour shape constraint is described by an energy function between parametric shape and the evolving curve model in an enhanced level set technique. This method yields accurate results.

WangmengZuo et al. [2004] By combining the active contour model and the polar edge detector, computerised tongue segmentation is advocated. Initially, a polar edge detector was meant to remove the tongue body's edge effectively. It is suggested that you use a local adaptive edge bi-threshold technique. Finally, to segment the tongue body from the tongue picture, an initialization and active contour model are provided.

Bob Zhang et al. [2014] recommended to identify Non proliferative Oral Cancer and Oral Cancer Lesions by utilizing SVM classifier. The tounge image is segmented by utilizing Bi-Elliptical Deformable Contour is. Thetongue geometry, textureandcolor characteristics are mined from the tongue front image. That can be categorized by utilizing SVM classifier.

The main objective of this work is to avoidtaking blood samples by injecting method and to improve the segmentation process by removing fake edges using GVF Snake technique.

2. Methodology

Oral Cancer Lesions application is given below,

- Oral Cancer Lesions is various difficulties with existing procedures for the treatment.
- Doctor could easily assess the difficulty through images and its segmentation. So, the appropriate

In the existing system, the detection of Oral Cancer Lesions is used to segment Bi-Elliptical Deformable Contour and extracting the features. Moreover Support Vector Machineisutilizedtocategorize theimage. Basedonthese three concepts are detecting Oral Cancer Lesions using tongue features (geometry, textureand color)in the existing work. These algorithms are detecting Oral Cancer Lesions using tongue features efficiently. In order to enhance the classification accuracy, the proposed work is done.

The system proposes Gradient Vector Flow (GVF) algorithm. In GVF algorithm the segmentation of Oral Cancer is based on image of the tongue. Feature Extraction is utilizedtoextract the geometry, textureandcolor fromtongue image. Hybrid Classifier is toimprove the efficiency of bayes classifier, the SVM and minimum range usingevolutionary algorithm has been utilized.

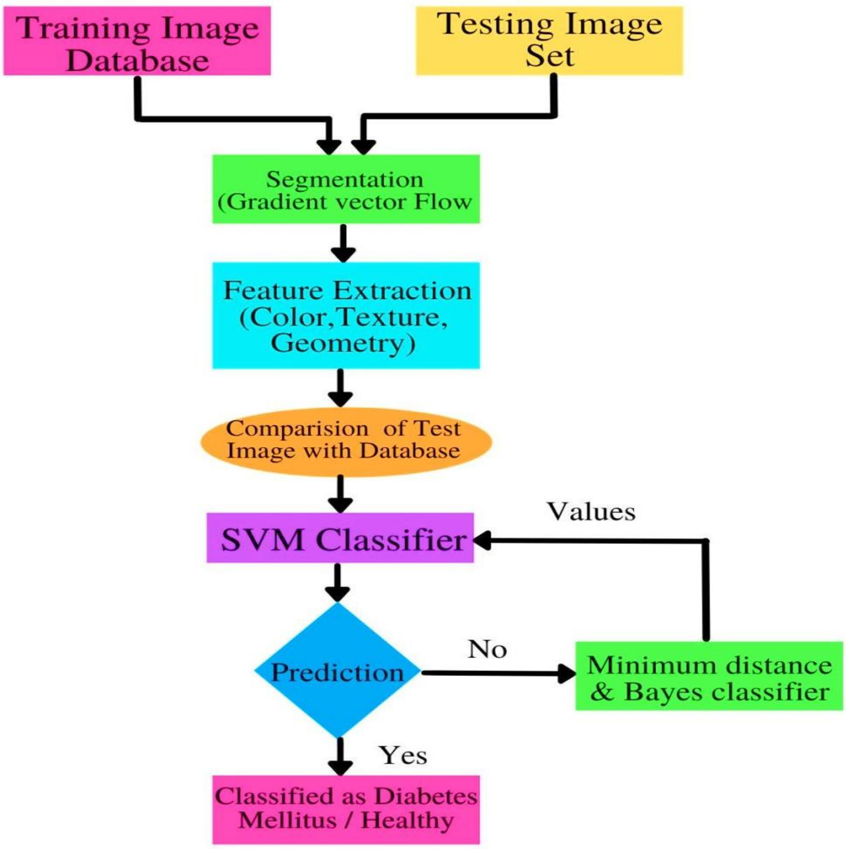

Figure 1: Overall Architecture of the System

3. Module Description

3.1. Tongue Capture Device

A special in-house device is designed to capture the tongue images.

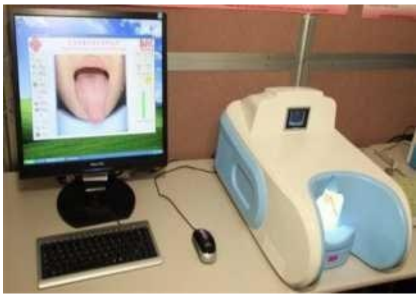

Figure 2: Capture Device

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Figure 2 indicates the designed in-house device which is composed of a three-chip 8-bit resolution. A CCD camera with two D65 fluorescent tubes located evenly over the camera to generate an even illumination. The angle among emergent light and the incident light is 45°, endorsed by CIE (Commission Inter-national de TEclairage). When showing their tongue to the camera patients should position their chin on a chinrest during capturing ofimage. The images will be captured in JPEG format that varied from 257 x 189 pixels to 443 x 355 pixels were color altered to remove any irregularity in color images resulting from the device dependence and modifications of illumination. The tongue images are collected by BioMed Chinese Medicine Repository.

3.2. PREPROCESSING

Preprocessing is the phase in which the image is enhanced prior to being given as an input to the other procedures. Usually, preprocessing deals with improving, eliminating noise, separating areas, etc. Preprocessing approaches utilize a tiny residential area of a pixel in an input image to achieve a new illumination value in the output image. Such Preprocessing processes are also known as filtration.

As per the aim of the processing, local Preprocessing techniques split intothe two group-ings like flattening conceals noise or additional minor variations in the image that is com- parable to the destruction of elevated frequencies in the frequency domain. Leveling also shapes sharp edges which bear vital knowledge about the image. Gradient operators will be depending on local derivatives of the image function. The objective of gradient operators is to reveal such places in the image. Elimination of noise and improving processes are performed in the pre-processing.

3.3. SEGMENTATION

3.3.1. Gradient Vector Flow Snake Technique

GVF Snake method is forecasted to perform the main role in the segmentation of tongue image. GVF Snake method dispersion of the gradient vectors of binary edge or a Gray level map originates from the edge. This can be revealed that GVF has a huge image capture by utilizing several dimensional images and has the ability to move the deformed model into boundary concavities. Figure 4.3 illustrates an input image and Figure 4.4 illustrates segmented image using GVF Snake. GVF snakes are an extension of the well-known active or snakes' contours approach. The difference between GVF and typical snakes is that the finals converge to boundary concavity and do not require modification in close vicinity to the boundary. The new snake v is a two-dimensional dynamic contour parametrically defined as v(s) = [y(s), x(s)], where s G [0, 1] decreases the energy function:

$$E = \int_{o}^{1} (Eint(v(S)) + Eimage\neg\, (v(S)) + Econ(v(S)) + (v(S))ds$$

The GVF snake extension utilizes a GVF field as limitation energy on equation 1. Other constraint energy tasks are pressure forces snakes (balloon snakes), multi-resolution snakes, and distance possibilities. Image gradient allows determining image gradient in a particular direction. The steps involved in detecting Oral Cancer in the proposed work,

- GVF-calculates gradient

- Sobel operator determines gradient by convolving filter mask with matrix comprising of image pixels.
- Gradient thickness signifies distance (in pixels) among two points, the disparity inintensity which characterizes the value of gradient.
- Iterations are the numbers of iteration done during GVF computation.
- Smoothing factors should be set in accordance with the quantity of noise present within the image. The greater the noise the larger the value Smoothing factor is the normalization factor regulating the exchange among the first and the second integralterm..
- Time length is computed for every iteration.

3.4. EATURE EXTRACTION

Feature extraction is the process of extracting feature from foreground tongue image using color, texture and geometry. The variety of color has been extracted by utilizing color feature extraction by means of tongue color gamut. In texture feature, eight blocks were divided with the help of 2-D Log gabor filter. Geometry features are calculated to themathematical formula.

3.4.1. TONGUE COLOUR

All potential colors were characterized by tongue color gamut that are displayed on thesurface of tongue and endures within the red limit displayed in Figure 4. The Color Feature Extraction is given in Figure 5.

Figure 3: Input Image Figure 3 Segmented Image using GVFSnake

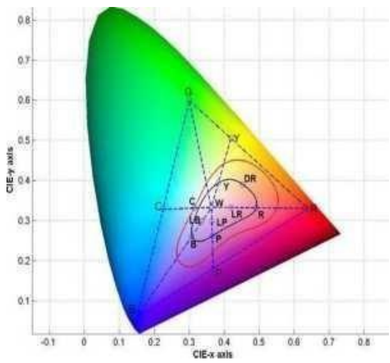

Figure 4: CIE-x axis chromaticity diagram

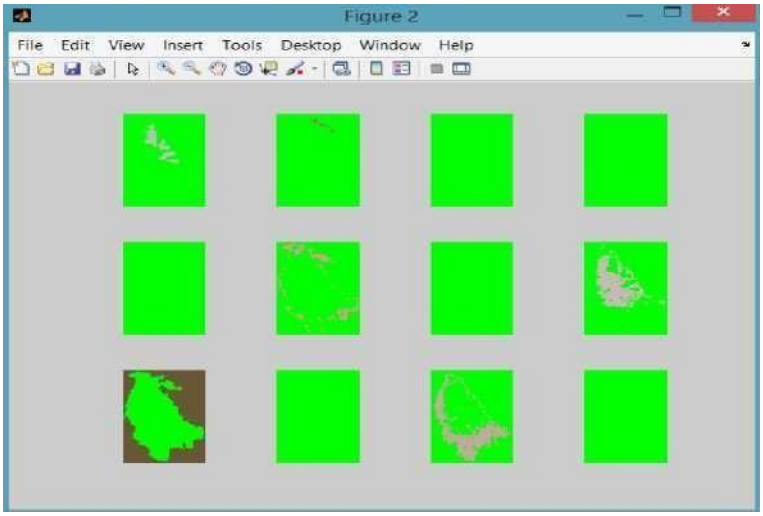

Figure 5: Color Feature Extraction

3.4.2. TONGUE TEXTURE

To identify the nine tongue texture features, the 8 blocks of texture values purposely found on the surface of the tongue are used, along with the added mean of all eight blocks. The following video shows how to extract a textural feature from the tongue.

Regions beyond the tongue boundary would be included in big blocks, which would intersect with other blocks..

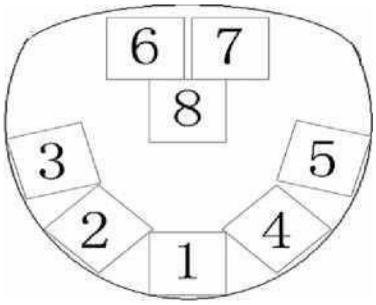

Figure 6: The eight texture blocks are located on the tongue in the following order.

Smaller block sizes will help to avoid colliding, but they will not be able to cover all eight regions as well. The blocks will be computed automatically by using a segmented binary tongue front image to determine the tongue's centre. Following that, the tongue's edges are formed, and similar portions are calculated from the tongue's centre to place the eight blocks. Block 1 is located at the tip; Blocks 7 and 6 are located at the root; Blocks 5 and 6, as well as Blocks 2 and 3 are located on both sides; and Block 8 is located in the middle. The entire tongue block is then calculated using the 2D Log Gabor Filter.

The Tongue Log Gabor Filter is the technique which is utilized to extract the blocks. Eight blocks positionedon the surface oftongue tocharacterize the textureoftongue images. The Texture Feature Extraction is specified in Figure 7.

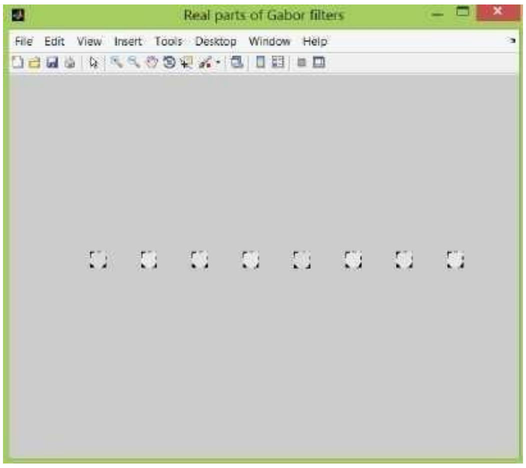

Figure 7: Texture Feature Extraction

3.4.3. TONGUE GEOMETRYFEATURES

In the subsequent section, the geometry features extracted from tongue images have been defined. Those features are depending on measurements, areas, distances, and theirproportions.

Triangle area ratio: Triangle area ratio (tar) is the proportion of ta to a:

Tar=ta/a ——————(1)

Triangle area: Triangle area (ta) is the area of a triangle characterized within the fore-ground of tongue.

Square area ratio: Square area ratio (sar) is the proportion of sa to a: sar =

sa/a —————(2)

Square area: Square area (sa) is the area of a square characterized within the foregroundof tongue utilizing reduced half-distance z:

$sa = 4z^2$ —————(3)

Circle area ratio: Circle area ratio (car) is the proportion of ca to a

Car=ca/a————(4)

Circle area: Circle area(ca) is the areaof acircle within the foreground of tongue utilizingless significant half-distance z, Where r = z

$ca = nr^2$ sar = sa/a————(5)

Area: The area (a) of a tongue is characterized as the number of pixels in the tongueforeground.

Center distance ratio: Center distance ratio (cdr) is proportion of cd to l:Cdr=cd/l ————

———(6)

Length-Width Ratio: The length-width ratio lw is the proportion of a length of tongueto its width

Iw = l/w——————-(7)

3.5. HYBRID CLASSIFIER

In this study, a hybrid classifier has been formed by combining three classifiers such as minimum distance classifier and Bayes classifier, support vector machine. The class projections of those classifiers have been merged to enhance the classification precision of the forecasted method.

- The class were classified by minimum distance classifier which is based on the image features and forecast the relations among class and features.
- Bayes classifier is utilized to determine the subsequent possibility for every class. Theclass with the maximum posterior probability is the result of forecast.
- Using Support vector machine image features are segregated into classed by applyingthe hyper plane on the data points.

In this study, three classifiers are utilized exclusively to forecast category in which the feature belongs to. The hybrid classifier findings demonstrate the taken image is unhealthy and hence confirms the oral cancer. when all the classifiers define a feature to an unhealthyclass, When the two classifiers define that the feature of captured image belongs to healthy category therefore the captured image is healthy.

4. IMPLEMENTATION TOOLS

4.1. MATLAB

In this study, MATLAB 13.0 package is utilized which is a high-performance language for technical data processing. It incorporates calculation, vision and software developmentin an easy to utilize environment where difficulties and the solutions are articulated in recognizable statistical notation. It also comprises mathematical and calculation algorithms for the growth of the data collection.

Simulation, modeling and preproduction data evaluation, exploration and visualization technical, industrial graphics and developing applications. It also incorporates a graphical user interface structure to resolve many specialized data processing problems. Toolboxes are comprehension compilation of MATLAB functions which expand that are available willincorporate signal handling, wavelets modelling, fuzzy logic, neural networks, management systems, and several others issues like the solution of initial value difficulties for a normaldifferential equation.

MATLAB is an interactive environment and high-level language that allows you to con- duct computing intensive tasks more quickly than with standard programming languages like FORTRAN, C++ and C.

MATLAB is an interactive package for mathematical calculations and illustrations. MATLAB is specifically created for matrix calculations: a solution to the linear equations, calculating Eigen vectors and Eigen values, factorization matrices and so on. Additionally, it has a range of graphics functionality, and can be expanded through programs that are written in its own programming languages. Several such systems arrive with the structure a certain number of the following are extend MATLAB capacities to non-linear

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5. EXPERIMENT RESULTS

In this paper, the existing and proposed work detect Oral Cancer Lesions on tongue featuresusing Bi-Elliptical Deformable Contour (BEDC), Support Vector Machine and Gra- dient Vector Flow (GVF), Hybrid Classifier. The Procedure of proposed and existing workincludes the subsequent steps:

Step 1: Data is gathered from BioMed Central in Chinese Medicine Repository.

Step 2: BEDC (Bi-Elliptical Deformable Contour) have been utilized to segment tongueimages in existing work. Italso distinguishes the boththebackground imageand foreground pixels. Oral Cancer Lesions affected patient image is taken as input. Figure 8 demonstratesthe segmented image utilizing BEDC method.

Step3: Following segmentation, the features like geometry, texture and color are ex- tracted. Then by utilizing standard deviation and mean, the values of feature are computed. The mean geometry, texture and colors of Healthy and ORAL CANCER are showed in Table 1, Table 2 and Table 3 along with their standard deviation.

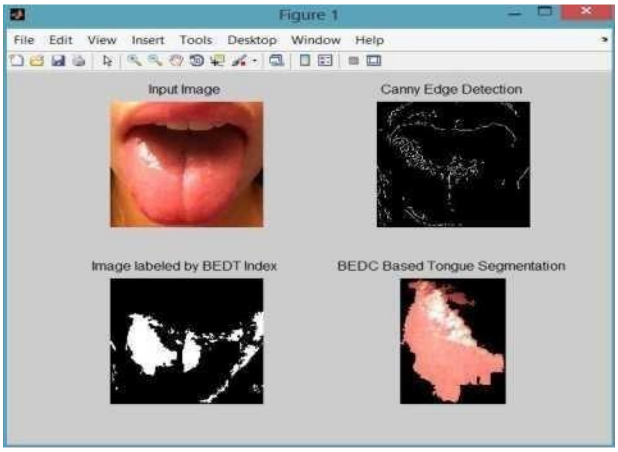

Figure 8: BEDC Segmented Image

Table 1: Geometry Features for Oral Cancer Lesionsand Healthy Images (BEDC)

FEATURES	Area	Center distance	Center distance ratio	Circle area	Circle area ratio	Length	Length-width ratio	MEAN	Smaller half-distance
Oral Lesions	1234	89	1.2	23456	3.456	190	2.3456	76564	87
HEALTHY	32456	134	1.4	39990	2.456	134	1.235	39055	156.9

Table 2: Color Features for Oral Cancer Lesions andHealthy Images (BEDC)

COL-ORS’	CR	DR	LR LP	LB BK GY	W Y MEANSTD
Oral	0.04510.006 50	0 0	0.758 0	0.17550.48990	0.205 0.00010.9999 0.147
Lesions					

H 0 0.00060 0 0 0.49660.00230.02960.27780 0.19320 0.083340.1591

Table 3: Texture Features forOral cancer Lesions and Healthy Images (BEDC

LOCKS	Oral	Lesions	H
B-1	4.345	5.24	4.23
B-2	4.321	2.43	5.34
B-3	3.234	5.23	5.22
B-4	5.32	6.32	1.24
B-5	6.134	7.23	7.346
B-6	3.1345	2.34	7.242
B-7	4.2453	4.23	7.242
B-8	3.213	5.24	6.345
MEAN	4.234	3.45	7.244
STD	2.123	6.34	1.245

The extracted structures are now supplied as input for SVM (Support Vector Machine) classification. The features are linked to the training features, and the result is produced. The result is then classified as ORAL CANCER or healthy using SVM.

Step 4: In projected work, the segmentation process is utilized to segment the image bymeans of GVF (Gradient Vector Flow). The entire tongue image is segmented by GVF fromthe given input. Figure 9 demonstrates the original tongue image utilized for segmentation and Figure 10 demonstrates the GVF Snake segmented image.

Step 5: From the segmented tongue image, features such as geometry, texture, and colour are extracted. Then, using standard deviation and mean, the values of the feature are calculated. Tables 4, 5, and 6 demonstrate the mean geometry, texture, and hues of ORAL CANCER and

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Healthy, as well as their standard deviations.

Figure 9: Original Image

Table 4: Color Features for Oral Cancer Lesions andHealthy Images (GVF)

COL-ORS	C	R	DR	LR	LP	LB	BK	GY	W	Y	MEANSTD
Oral Lesions	0.00940.13580		0	0.11710.31120		0..04990.23110.00010.07550.06980.9999					0.101
Healthy	0	0.02980	0	0.00140.48540.0020.01960.18840					0.27250.00090.083330.1547		

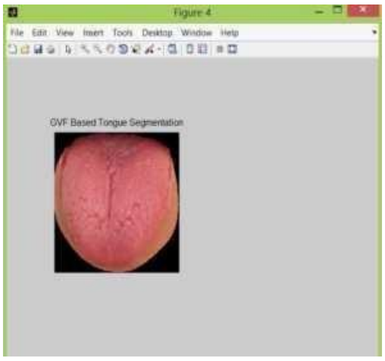

Figure 10: GVF Segmented Image

Table 5: Texture Features for Oral Cancer Lesionsand Healthy Images (GVF)

BLOCKS	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	MEAN	STD
Oral	3.234	4.24	4.24	3.12	3.45	3.23	3.23	3.56	3.23	0.2345
Lesions										
Healthy	3.21	3.24	3.45	3.56	4.245	4.235	2.456	2.345	2.455	0.3455

Step 6: The classification is performed for both proposed and existing data set which istrained and tested.

Step 7: Finally, Specificity and Sensitivity values are computed to calculate the accuracy.

6. PERFORMANCE EVALUATION

The several evaluation metrics are utilized to determine and examine our proposed method Gradient Vector Flow to identify Oral Cancer Lesions utilizing tongue characteris-tics. The metric values like Average accuracy (AC), Specificity (SP) and Sensitivity (SE) areutilized to calculate the overall performance of the hybrid classifier. Table 7 lists the formu-las. Specificity is proportion of the negative cases that are well detected by the test and the sensitivity is a fraction of positive instances that are well exposed by the test. Classificationaccuracy is determined by the number of experiments properly categorized.

Table 7: EvaluationMeasures

Measures	Formula
Average Accuracy	(SE+SP)/2
Specificity	SP=TN/(TN+FP)
Sensitivity	SE=TP/(TP+FN)

6.1. EVALUTION METRICS

In order to assess the accuracy in classification, sensitivity and specificity values are calculated for Bi-Elliptical Deformable Contour and Gradient Vector Flow.

Sensitivity is the quality or condition of being sensitive. Specificity is the ability of thetest to correctly identify those without the disease. Specificity is the quantity or state of being specific. Sensitivity is the ability of a test to properly identify those with the disease. In simple terms, high sensitivity implies that an algorithm returned more relevant results.

6.2. CONFUSION METRICS

Confusion matrix is assessed to make decision which could be produced by classifier. Aconfusion matrix showed in Table 8.

Where,

- TN (True Negative) is the number of healthy properly categorized.
- FP (False Positive) states the number of Oral Cancer Lesions misclassified as healthy
- FN (False Negative) describes the number of healthy misclassified as Oral Cancer Lesions,

Table 8: Confusion Matrix

Types		Predicted	
		Healthy	Oral Cancer Lesions
Types	Healthy	TP	FP
	Oral Cancer Lesions	FN	TN

- TP (True Positive) signifies the number of Oral Cancer Lesions accurately categorized The

confusion matrix for the existing algorithms (BEDC, Feature Extraction (Color, Texture and Geometry) and SVM) and proposed algorithm (GVF Snake Technique, Feature Extraction (Geometry, Texture and Color) and Hybrid Classifier (SVM, Minimum Distance and Bayes Classifier) are given below. For 10 images, based on the Predicted records and True records, the FN, FP, TN, TP values are calculated. Table 9 depicts the confusion matrix for the proposed work, using GVF snake technique.

Table 9: confusion matrix for theproposed work, using the GVF snake technique.

Method	Actual	Predicted	
		DM(Positive)	Healthy(Negative)

Deep Learning	Oral lesions (Positive)	9(TP)	1(FP)
	Healthy (Negative)	3(FN)	7(TN)

Table 10: Confusion Matrix for BEDC

Technique	Actual	Predicted	
		DM(Positive)	Healthy(Negative)
Hybrid Classifier	Oral lesions (Positive)	7(TP)	3(FP)
	Healthy (Negative)	2(FN)	8(TN)

6.3. RESULT ANALYSIS

The table 11 illustrates the contrast of identifying Oral Cancer Lesions in proposed andexisting system. The table contains Accuracy, Specificity and Sensitivity of the proposed and existing system.

Table 11: Result Analysis of GFV Snake And BEDC

Test Image	Methods	Sensitivity	Specificity	Accuracy
10 Healthy 10 orallesions	Deep Learning Hybrid	46% 89%	73% 82%	60% 85.5%

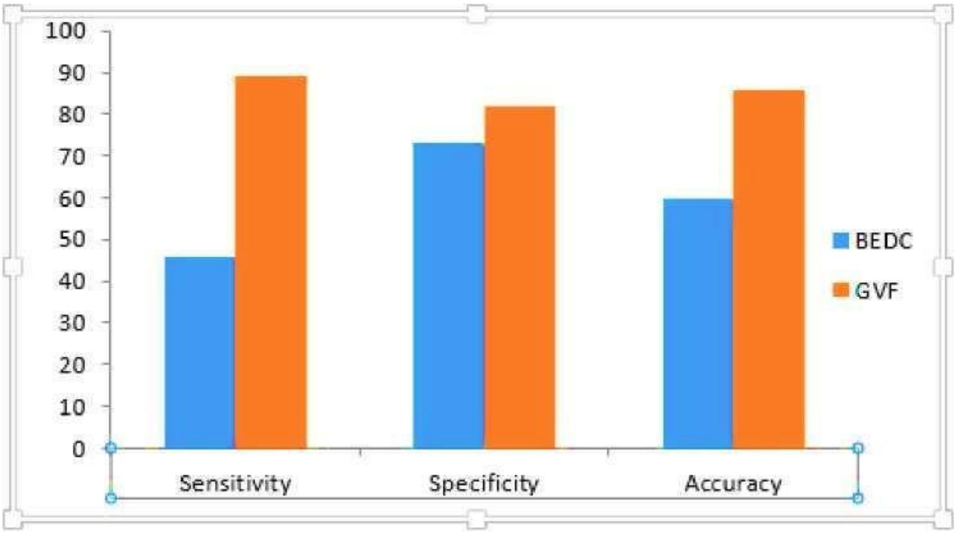

Figure 11: GraphicalEvaluation of BEDC and GVF Snake

Graphical Analysis of GVF Snake and BEDC Method are plotted based on Table 5 in Figure 11. Values are placed on the Y-axis, while suggested and current methods (Accuracy, Specificity, and Sensitivity) are mapped on the X-axis. Using assessment metrics of 85.5 percent, 82 percent, and 89 percent, the proposed system GVF Snake Method algorithm has improved the superior outcome. In the current BEDC algorithm, the Evaluation metrics have obtained results such as 60%, 73 percent, and 46%.

7. CONCLUSION

The main purpose in performing this analysis is to identify the Oral Cancer Lesions affected region in the tongue images. Image processing is a safe and time-consuming tool to detect Oral Cancer Lesions in effective and precise manner. In this research Oral Cancer Lesions is noticed by means of advanced methods of image processing like Hybrid classi-fier, Feature ex-traction and Gradient vector flow algorithm which select the images in partly. The current work utilized GVF algorithm to detect Oral Cancer Lesions using features involved in tongue images. Feature extraction and hybrid classifier methods are involved in this research for detecting Oral Cancer Lesions. The main work of this re-search is to detect Oral Cancer Lesions accurately using tongue features. By using hybrid classifier all the tongue images are get classified and provide the result appropriately.

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