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Thyroid Nodules Classification Of Segmented Image Using Geometric And Moment Features

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Abstract

Ultrasound image is one of the most inexpensive modalities because of its low cost and safety. This research focuses on classification of thyroid nodules by using deep learning segmentation approach. Semantic segmentation plays on important role in today's robotics connected applications. Most of the research nowadays on semantic segmentation fulfilled the way of increasing accuracy of all the models of segmentation with highly computation cost. The US image is segmented using U-Net segmentation and it is coupled with Mobile net deep learning segmentation for high accurate and sensitive feature extraction based upon Geometric features and Moment features. This selected feature is used for further classification. The classifiers used in this research work are Support vector machine and Random forest classifiers and the performance and the parameters are considered for future comparison.

Keywords: *ultrasound, semantic, segmentation, u-net, mobile net, svm.*

1. INTRODUCTION

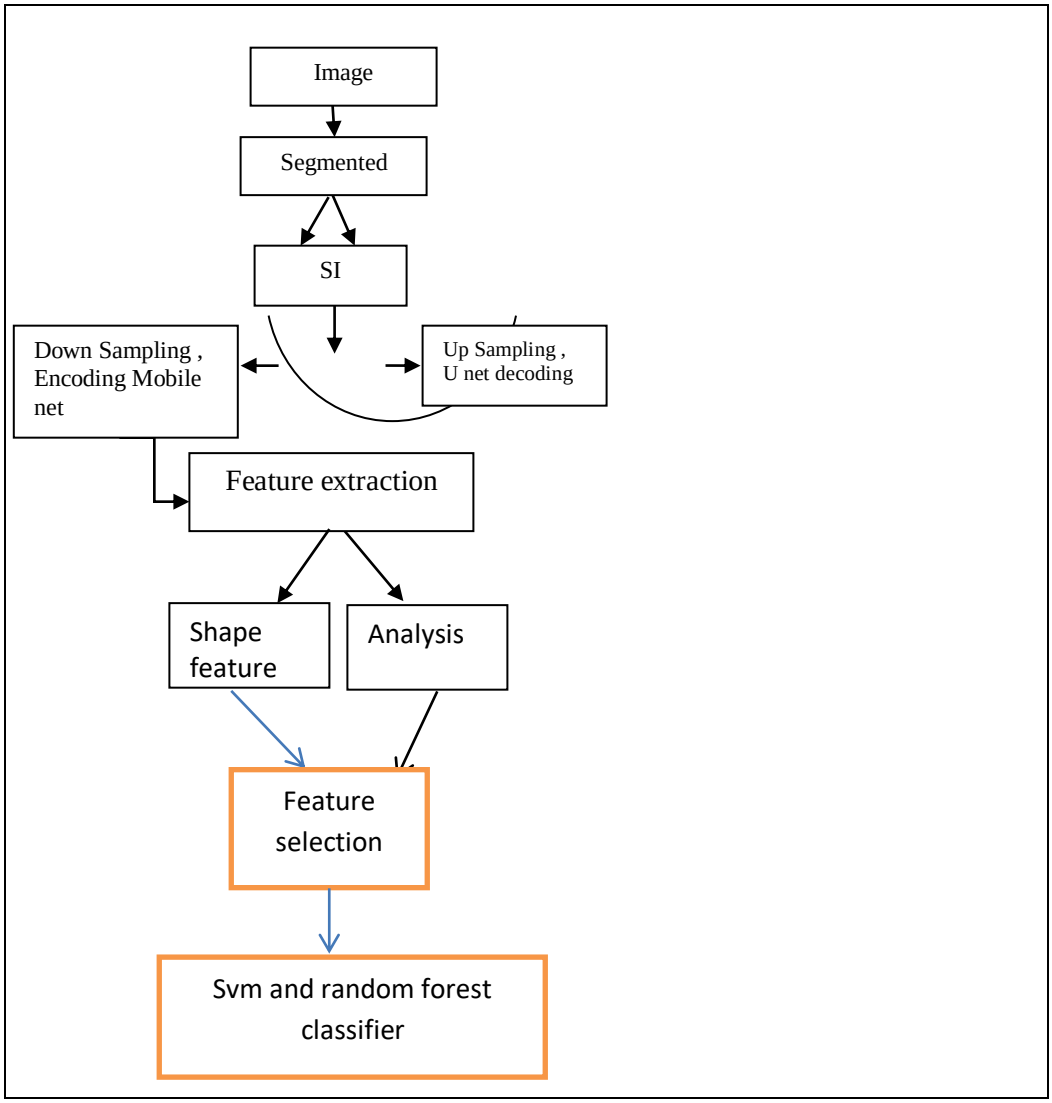
Semantic segmentation had made high progression in past years with deep learning. This architecture based on using encoders and decoders which was known as semantic pixel wise segmentation.[1] It is done by encoding the input image into low level dimensions and then illustrate it with positioning invariance ability in the decoder. This helpful in generating segmented Image at the decoder and the most commonly used techniques for semantic segmentation was FCN &Skip net architecture. Both the methods were refined the output of segmentation[3]. These two methods only proved a high contribution towards accuracy only a very little level of attention was given to the computation efficiency. In this paper we proposed a framework towards standard real time architecturein segmentation. The work focused on

i) By a modular developing technique used in segmentation architecture for feature extraction and decoding method is known as meta-architecture .This approach was most commonly used to understand the separation between the various part of the network for achieving high performance.

ii) A detailed study was made in the relevant area by considering accuracy and computational efficiency.

iii) The framework based upon the most compatible design by the emergence of two deep learning segmentation architectures using mobile net and UNet with multiple decoding methods.

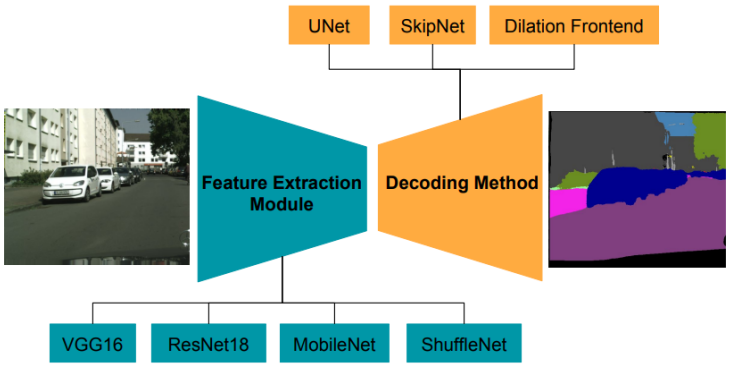
OVERALL DIAGRAMMATIC REPRESENTATION



2. RESEARCH WORK:-

The ultra sound thyroid image is collected from the database. The image is segmented to remove the unwanted noise present in the orginal image. The image is segmented in more versatile manner. The U net segmentation is more senstive and accurate when compared with all other deep learning segmentation approach. The U net segmentation which consists of Down sampling and upsampling path[1].

In down sampling side the encoding takes places in which it done by using mobile net which was an feature extraction module.



a) **U-net architecture**:-

U-Net architecture is used for decoding an image using convolution network for corresponding down sampling stage by an encoder . The upsampled images are fused withthe corresponding feature extraction module withsame resolution.The 8X8 up sampling is done at each convolution layer for better accuracy. This method is based upon an fussion method which provide an framework for element wise addition. The segmentation is followed by an concatenation fussion method which result in an high accuracy and it is used to learn the network by using weighed features that are in the networks. The resultant of this which increases the computational cost. So in this work U-Net architucture using mobile net as a feature extraction network.

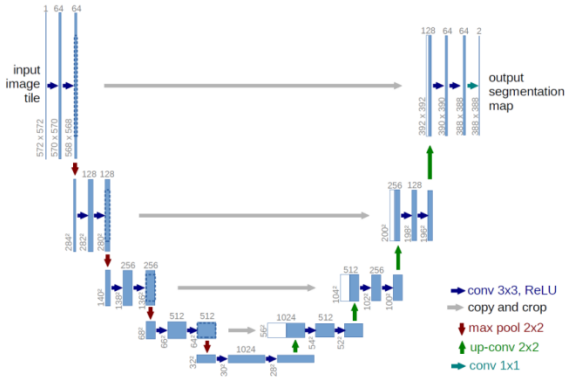
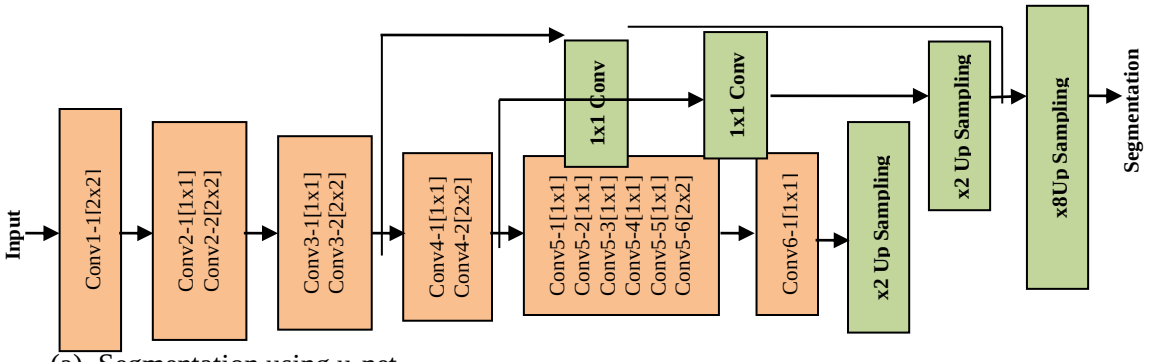


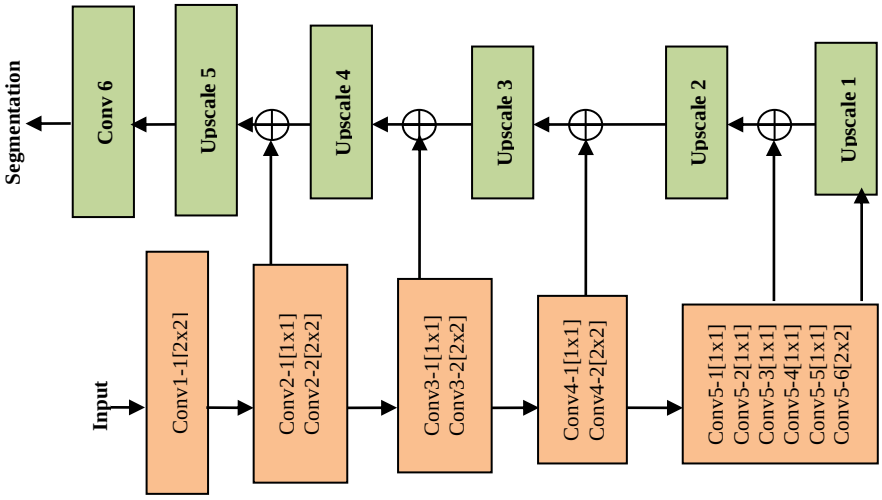
Fig 1.1:U-net architecture

b)Mobile net :-

The mobile net architecture followed an convolution based upon depthwise seperation technique. In the inception module it is indicated as an extreme case for each channel and it is applied which was known as depth wise convolutions. The point wise calculations is used in all the channels of 1X1 convolutions to fuse the output. The point wise and depth wise calculations that are used in each convolutions network as a result there is a continuous improvement in the computational efficiency.It also increase the accuracy incase of cross channel and mapping that are done as spatial correlation.



(a) Segmentation using u-net



(b)segmentation using mobile-net classificatio

Fig:orginal ultrasound image

Fig:Segmented image

3.FEATURE EXTRACTION

1.GEOMETRIC FEATURES :-

i) Compactness:

It is formulated as an irregularity index of an given image which Y represents the area of the object.

$$C=1-4\frac{\prod y}{\text{perimeter}^2}$$

ii) Convexity :-

The perimeter and the parameter for object reference is based upon the measurement of edges of the given object as

$$Cy=\frac{\text{perimeter of convex area}}{\text{perimeter of given object}}$$

iii) Circularity :-

The calculation of how the same object in a circle, in which the standard deviation and the ratio of mean in an object is measured from distance of centroid($\ddot{a}_2 \ddot{b}_2$) to the edge of object ($x2y_2$) as

$$b_h = \frac{1}{M}\sum_{i=1}^{y}(y_2x_2) - (\bar{a}_2\, b_2)$$

$$\frac{1}{N}((y_2z_2) - (\bar{a}_2\, b_2) - \frac{1}{N}\sum_{y=1}^{x}(y_2x_2) - (\bar{a}_2\, b_2))^2$$

iv)Solidity

It is defined as the measurement of an object based upon the concavity measurement andresultant is the ratio of the area of an object and area of convex hull as

$$T=\frac{\text{area of object}}{}$$

convex area

v)Rectangularity:

The rectangular measurement of the object is based upon their similarities.

$$Z = \frac{\text{Area of object}}{\text{area of rectangularity in object}}$$

vi)Tortuosity:

It is defined as the level of an object inaccrodrance with curve tortuous.

$$S = \frac{2*\text{Length of major Axis}}{\text{perimeter of object}}$$

vii)Ratio,Height and width

It is based upon the measurement and comparision between height and width of an object is formulated as

$$Zhw == \frac{\text{object area}}{Y_{max}\, y_{min} * X_{max}\, x_{min}}$$

2) **MOMENT FEATURES:**

a) Hu's moment Invariant

For scaling and rotation of an object the moments that are generated and used to handle the translation occurs . The normalized central moment concept was used in this invariant. It consist of 7 features

$Z1=\eta_{20}+\eta_{02}\, 2\eta_{11}+2\eta_{11}$

$Z2=(\eta_{20}+\eta_{02})^2+4\eta_{11}^2$

$Z3=(\eta_{30}+3\eta_{12})^2+(3\eta_{21}-\eta_{03})^2$

$Z4=(\eta_{30}+\eta_{12})^2+(\eta_{21}-\eta_{03})^2$

$Z5=(\eta_{30}-3\eta_{12})(\eta_{30}+\eta_{12})^2-3(\eta_{21}+\eta_{03})^2+(3\eta_{21}-\eta_{03})(\eta_{21}+\eta_{03})(3(\eta_{30}+\eta_{12})^2+(\eta_{21}-\eta_{03})^2)$

$Z6=(\eta_{20}-\eta_{02})(\eta_{30}+\eta_{12})^2-(\eta_{21}+\eta_{03})^2+4\,\eta_{11}\,(\eta_{30}+\eta_{12})(\eta_{21}+\eta_{03})$

$Z7=(3\eta_{21}-\eta_{03})(\eta_{30}+\eta_{12})\,((\eta_{30}+\eta_{12})^2-3(\eta_{21}+\eta_{03})^2)-(\eta_{30}+3\eta_{12})(\eta_{21}+\eta_{03})(3(\eta_{30}+\eta_{12})^2-(\eta_{21}+\eta_{03})^2)$

b)Zernike moments

The shape descriptors of this method is region based and evaluation is based upon Zernike polynomials (Vmn)and the orthogonal area to the circle as a2+b2<=1

$$V_{mn}(a,b)=V_{mn}(r\cos\theta, r\sin\theta)=R_{mn}\,,\ \exp(m,n,\boldsymbol{\theta})$$

r=radius of coordinate(a,b)to the center of mass $\boldsymbol{\theta}$ is the angle between r, the radial orthogonal polynomial

4.FEATURE SELECTION:

It is used to improve the accuracy and reducing the training time for computation for the given dataset. The main goal of feature selection is to find the apart subset of attribute. The most commonly used feature selection algorithm is correlation based feature selection algorithm is correlation based feature selection because it is used to find the correct subset from the given attribute based on the heuristic evaluation.The resultant is based upon the features of highly correlated class of a given subset with the class which are the low corealted object with each other.

$$r_{za} = \frac{K^{ra1}}{\sqrt{K + k(k-1)}r_{11}}$$

r_{za} = The summation of correlation between attribute and other variable

K = indicates the total number of attribute

$r_{a\bar{T}}$ = the correlation and average between attribute class

r_{11} = The correlation of average of attribute.

The classification is done by means of using

1)SVM(Support Vector Machine)

2)Random Forest Classifier

1.SUPPORT VECTOR MACHINE

Support vector machine are used to analyze the data for classification by using supervised learning models inassociated with learning algorithms[19].The fature selection is applied by means of SVMto obtain more discriminative feature set off different categories of thyroid nodules.SVM trained by shifted

Features of corresponding category .It is used to perform non linear classification using kernel tricks and map their inputs for high dimensional feature spaces.

2)RANDOM FOREST CLASSIFIER

The random forest classifier used an machine learning algorithm for the classification of training data[17].It consists of many number of individual decision trees.The individual tree in random forest will take a class prediction and class with number of positive votes will becomes our prediction result.

5.RESULT AND ANALYSIS

The data was collected from publicly available database[7] in which 347 data was used to testing and 138 data was used for training. The segmented image with geometric and moment features further used for classification by using the classifer support vector machine and random forest.The considered parameters are accuracy,precision,recall and F1 score .

Accuracy

It is based upon the ratio of no of predictions to the total number of input values

A=Corrected predictions/total no of predictions

Precision

The given corrected positive results divided by the classifier positive results

P=True positives/true positives+false positives

Recall

The ratio between the no of true positives to the total number of true positives and true negatives

R=True positives/false negatives+true negatives

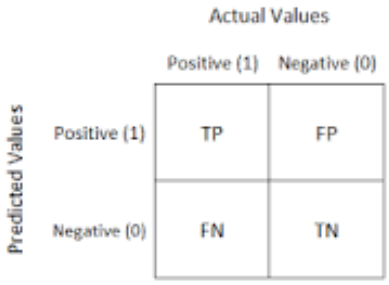
F1 score

It is used to measure the accurateness and it is derived from the mean between recall and precision.

F1=2*((precision*recall)/(precision+recall)).

The training data 138 which was arranged as an confusion matrix as truepositive as 14 false positive as 10 false negative as 22 and true negative as 90 these values are by using the classifier to classify the benign and malignant nodules.

a) Image represents the original confusion matrix



14	10
22	90

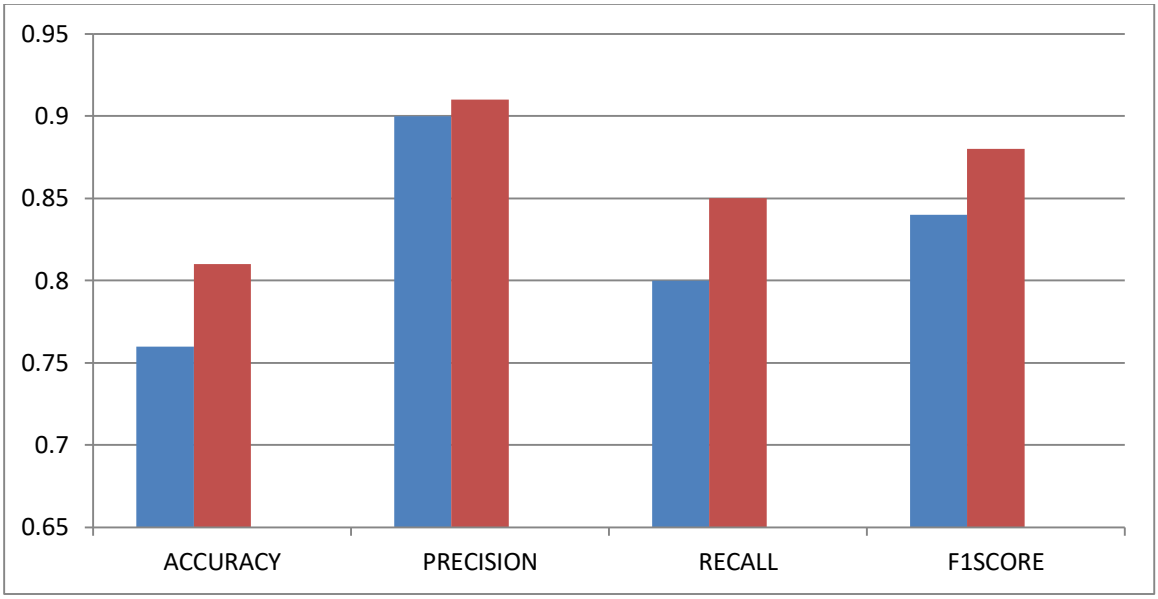
b)c Values for classification as an confusion matrix

The true positive,false positive,false negative and true negative values after classification by using the classifiers

	benings	malignants
benings	15	9
malignants	16	98

Comparision Between Support Vector Machine (SVM)AND Random Forest Classifier(RF)

	SVM	RF
accuracy	0.76	0.81
precision	0.90	0.91
recall	0.80	0.85
F1 score	0.84	0.88



SVM

RF

6. CONCLUSION

The classification of thyroid nodules based upon the geometric and moment features had been described very well in this research paper and also the features are extracted after segmentation by using coupled segmentation approaches using u net and mobile net .The proposed work is then classified by using machine learning classifiers such as SVM and Random forest classifiers.

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