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Designing Medical Content Based Image Retrieval System With Edge Density Criterion

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Abstract: *The Medical Image Can Be Understood By Its Visual Features Also Known As Image Signatures. These Features When Modified Or Enhanced Under Certain Geometrical Functions, It Improves The Resultant Retrieval By The Increase Of 94% In The Performance With The Comparison Of 85% In The Case Of The Nearest Neighbor And In The Case Of Normal Image Retrieval It Comes Out To Be 75 %. This Research Includes The Approach Of Calculating Edge Density Is Applicable For The Five Human Body Parts- Hands, Pelvis, Breast, Brain And Chest And Is Cam Parable To The System In The Previous Work In Literatures. The Result Acquired For The Proposed System Comprises Of Edge Density Concepts.*

Keywords*:-Medical Images, Edge Density, Geometric Feature Vector, Content Based Image Retrieval,*

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I. Introduction

Content-Based Image Retrieval Has Its Deep Roots In Medical Organization In Such A Way That It Is Regarded As Best Way To Retrieve Information From Medical Images That Comes Out As Output Of The System .Medical Images Has Become Backbone Of Medical Organization Giving Growth To The New Field Known As Medical Imaging Diagnosis [1]. Accepting The Challenge Of The Access To The More Relevant Images For The Users Give The Options Of Easy And Improve Search Of The Image [3]. Generally, CBIR System Working Approaches Include The Drawing Out Of Feature Vectors That Also Named As Image Signature [4].And Its Comparison With The Similarities Of The Visual Query Image So That Relevance Features And Same Proportion Can Be Achieved. Also, Neural Networks Are The Modern Trends Of CBIR Adopted Methods For Latest And Fastest Techniques For Retrieval With Very Less Time Consuming. Generally, CBIR Get Categorized Into Two Classes When User Involvement Is Concerned. One Is Relevance Feedback For The Active Learning Strategies [11] And Other Is Processing Of Image Databases Through Different Classification [5]. This Research Work Involves Second Task Which Has Been Enhanced In The Classification, Comparison And In The Retrieval Of Advanced Images Features. The Proposed Research Is Designed Into Different Sections As Section

II. Previous Related Work

Medical Images Have Become Vital Resources In Organizing And Searching Of Many Treatments And Diseases Through The Content Based Image Retrieval System [1]. Extracting The Features Of The Medical Images Has Approaches Differently For Medical Images [8]. Characterization Of The Features Is Admittance In The System By Andoloussi Et Al. [2] By The Bi-Dimensional Empirical Mode Decomposition With Generalized Density Function. Feature Vectors Are Determined For The Feature Extended Version Of Extraction And Can Be Based On Any Feature Of Image Like Color In [3] By Discrete Cosine Transform Method. Feature Shape Is In Consideration For The System Like Redial Basis Functions With Relevance Feedback [11]. In Particular, MRI Images Are Used In System Proposed By N.Kumaran Et Al. For Texture Feature Extraction By Using Texture Spectrum, Edge Spectrum [12]And Gray Level Co-Occurrence Matrix For Texture Features In [14]. Furthermore, Features Have Been Also Extracted With The Help Of Descriptors Also Such As Vector Descriptor [9] Fuzzy Descriptor [10] In The System For The Medical Images. They Can Be Low-Level Descriptors, Hidden Level Descriptors For Neural Networks [14][16].These System Work On The Specified Feature To Achieve Exact Image In Lesser Time Span.

Edges Make The Essential Information Of The Image Very Conveying [15].Edge Detections Are One Of The Specified Feature Which Has Worked Very Well With Neural Network In Giving Relevant Outputs For The Input Query Images. Statistic Texture Feature Are Used In [17] For The Edge Density Calculation. Developing Sub Regions Along With The Edge Density Is Involvement By System Proposed By Phung Et

Al.[18]. These Sub Regions Can Be Analyzed More For Getting Feature Vectors Is Shown By [19]. Medical Images Have Their Unique Characteristics Which Should Measure Uniquely [13]. The Similarity Measured Has Been Measured By Various Methods. Some Formations Are Done By Euclidean Distance In [6], Graph Edit Distance [7].

III. Workflow Of The System

The Research Work Has Proposed System With An Idea From [20].The Diagram Shows The Particular Flow Of The Process From Point The Query Image To The Finally Retrieved Image. The System Flow Can Be Broadly Categorized As:-1. Database And Extraction-System Has One General Database That Stores The Medical Images Of Every Format In It, And System's Other Database Stores The Feature Vectors Extracted From The System During The Process Of Extraction. 2. Image Retrieval- It Is The Last Comparison Phase Finished With The Categorization Of The Image.

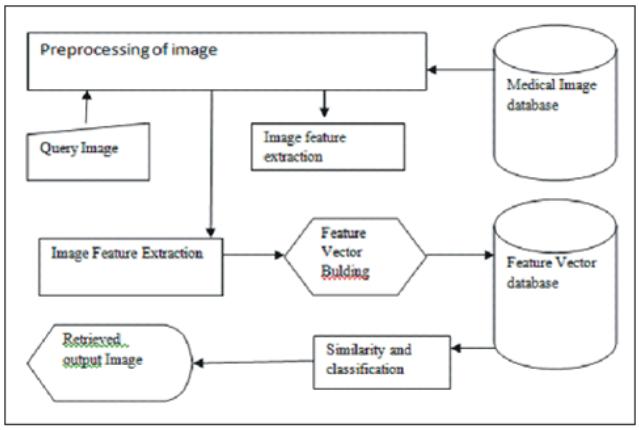

Figure 1

Figure 1 Content Based Image Retrieval System

The System Shown In Figure 1 Has Been Designed To Retrieve The Image Most Relevant To The Query Image. Its Working Can Be Elaborated Into Two Phases As:-

A) Preprocessing & Extraction Phase

Database Having Number Of Medical Images Along With Them Noisy Data Different Formats Redundant Information. Whole The Proposed Process Work On Specified Format For Which All Images Has To Redefine In Accordance To The System Required Image Format. Preprocessing Is The Procedure To Alter The Existing Images To Formulate A New Image By Formatting It This Is Done For Avoiding The Unrealistic Data Involved In The Image. The Formatted Image Pass Through The Procedure Of Deep Analysis On Its Shape So That Collaborated Pixels Which Has Form Each Edge Of The Image Can Be Extracted.

1) Reforming The Image:-

Major Aspect For The Process Of Reforming The Medical Image Is To Make The Image Clearer For The System So That It Can Have Sharp Visible Edges And The Noisy Data Can Be Eliminated. Laplace Filter Operator Has Been Performing For Two Dimensional Images In The System Shown In (1).

$$D^L = D_m^L + D_n^L = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} \quad (1)$$

Next Prior Task To The Enhancement, Is Converting The Image Into The Binary Format. Grayscale Image Pixels Are Computed For Their Threshold Values To Calculate The Spread Of Each Class Of Variance Given In (2). Using Threshold Variance It Is Given In (4).After Certifying The Image Formation From Only White And Black Pixels The Image Is Ready For The Feature Extraction Phase.

$$\alpha^2 = f_1\alpha_1^2 + f_2\alpha_2^2 \quad (2)$$

In General It Can Be Given As $f_x = \sum_a^b p(i)$ (3)

$$\alpha^2 = f_1 f_2 (\mu_1 - \mu_2)^2 \quad (4)$$

And Here A Is The Spread Of Each Class Of Variance Known As Otsu Value, f_x Is The Weighting Of The Class With Probability $p(i)$ Of The Class And μ Is The Interclass Variance. The Sample Of The Image Whole Transformation Is Shown In Figure 2

2) Division Of Images By Geometrical Functions:

The Functionality Of The System For The Extracting The Features Of The Medical Images Is Two Geometrical Parameters. One Is The Rectangular And Other Is Circular Parameter Namely Rectangular Segments And Circular Radii Respectively. In Each Parameter Point Of The Images Are Taken In Small Rectangle Or In Circle To Draw A Window Or Circle Around The Image As Many Times As It Can Cover The Whole Image.

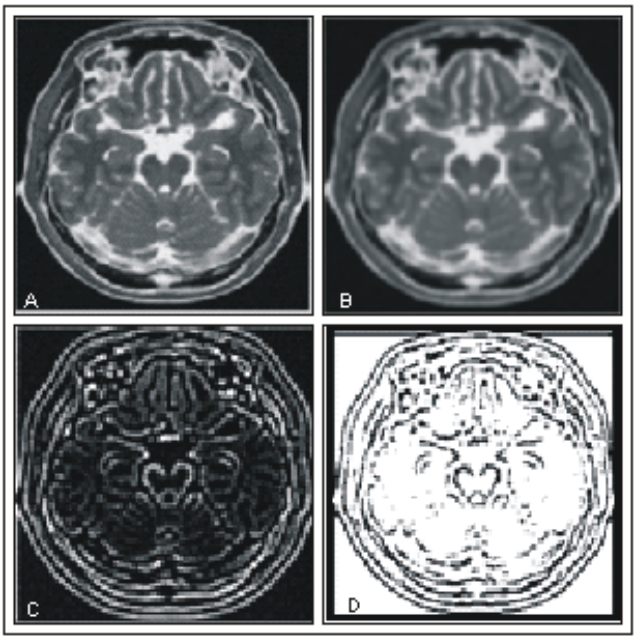

Figure 2

Figure 2 The Actual Image Is Shown In 2(A) Is The Original Image And 2(B), 2(C) Are The After The Adaptive Threshold Figure 2(D) Is The Binary Image

A) Rectangular Segments:-Division Of Images Into Segments Are Started From The Left Side Of The Image The Vertical And Horizontal Points Of The Images Are Defined By (x_0, y_0) And(x_1, y_1). Moving With These Points The 7 Segments Of Local Edge Feature Of The Image And Eighth Is Global Image Are Made Shown In Figure 3(A)-3(H) And The Points Defined On The Extreme Left Elevated L_e And Extreme Right LoweredR_l With Width w And Height h Of The Image Can Be Given Under Each Segment From (5) - (12) Below:-

$L_{e0} = (0, 0), \quad R_{l0} = (w, h)$ (5)

$L_{e1} = (0, 0), \quad R_{l1} = \left(\frac{w}{2}, \frac{h}{2}\right)$ (6)

$L_{e2} = \left(0, \frac{h}{2}\right), \quad R_{l2} = \left(\frac{w}{2}, h\right)$ (7)

$L_{e3} = \left(\frac{w}{2}, 0\right), \quad R_{l3} = \left(w, \frac{h}{2}\right)$ (8)

$L_{e4} = \left(\frac{w}{2}, \frac{h}{2}\right), \quad R_{l4} = (w, h)$ (9)

$L_{e5} = \left(\frac{w}{4}, \frac{h}{4}\right), \quad R_{l5} = \left(\frac{3w}{4}, \frac{3h}{4}\right)$ (10)

$L_{e6} = \left(0, \frac{h}{4}\right), \quad R_{l6} = \left(\frac{w}{2}, \frac{3h}{4}\right)$ (11)

$L_{e7} = \left(\frac{w}{2}, \frac{h}{4}\right), \quad R_{l7} = \left(w, \frac{3h}{4}\right)$ (12)

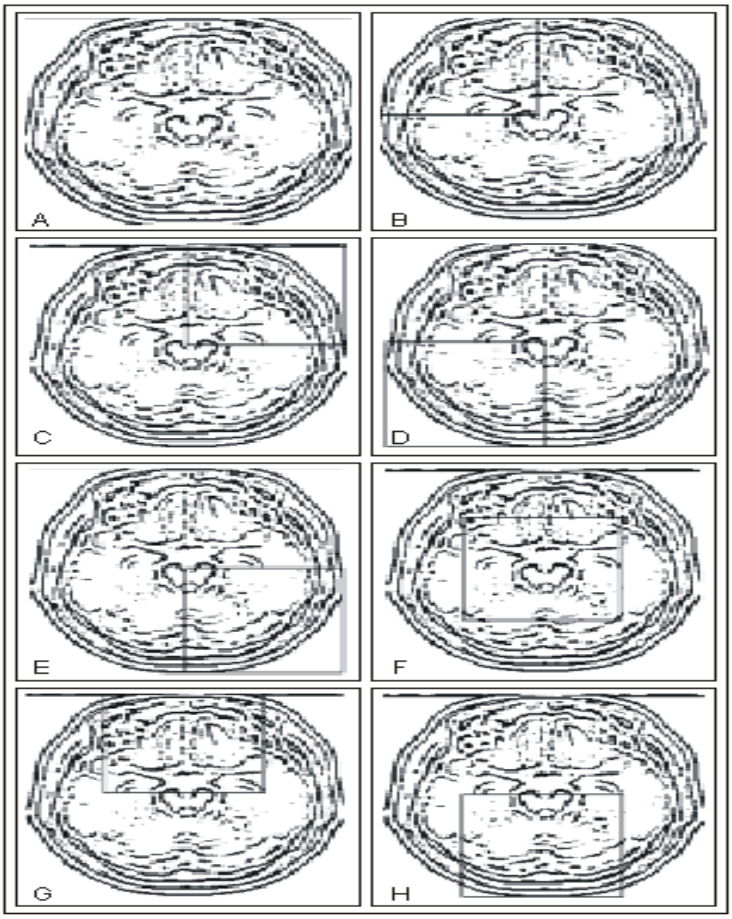

Figure 3

Figure 3 Shows The Rectangular Segments For The Scan Of The Skull.

B) Circular Radii:-Division Of Images Into Segments Is Started From The Centre Of The Image To Increasing Radius Of The Circle Moving Outwards Of The Images. Each Circular Region Produced By Varying Radius Of The Image Will Contain Different Feature Of The Same Image. There Will Be Five Circular Regions Obtained For One Single Image. Each Circular Region Here Is Given ByC_r, With Maximum Value $C_{(rmax)}$ With Height H_c And Width W_c Of The Image With Radius

Of Centre R With (R,c_o) Extracted Edges. So, $C_{(rmax)} = \max\{H_c, W_c\}$.They Can Be Shown As

C_{r0} =1 (13)

C_{r1}= C_{r0} + (R) (14)

C_{r2} = C_{r0}+ 2(R) (15)

C_{r3} = C_{r0} + 3(R) (16)

C_{r4} = C_{r0} + 4(R) (17)

C_{r5} = C_{r0} + 5(R) (18)

Each Region Represented In (13) –(18) Has Its Pictorial Presentation In Figure…..With General Expression As:- C_{rN} = C_{r0} + N(R) …(19)

And R = $\frac{C_{r_n} - C_{r_0}}{n-1}$ (20)

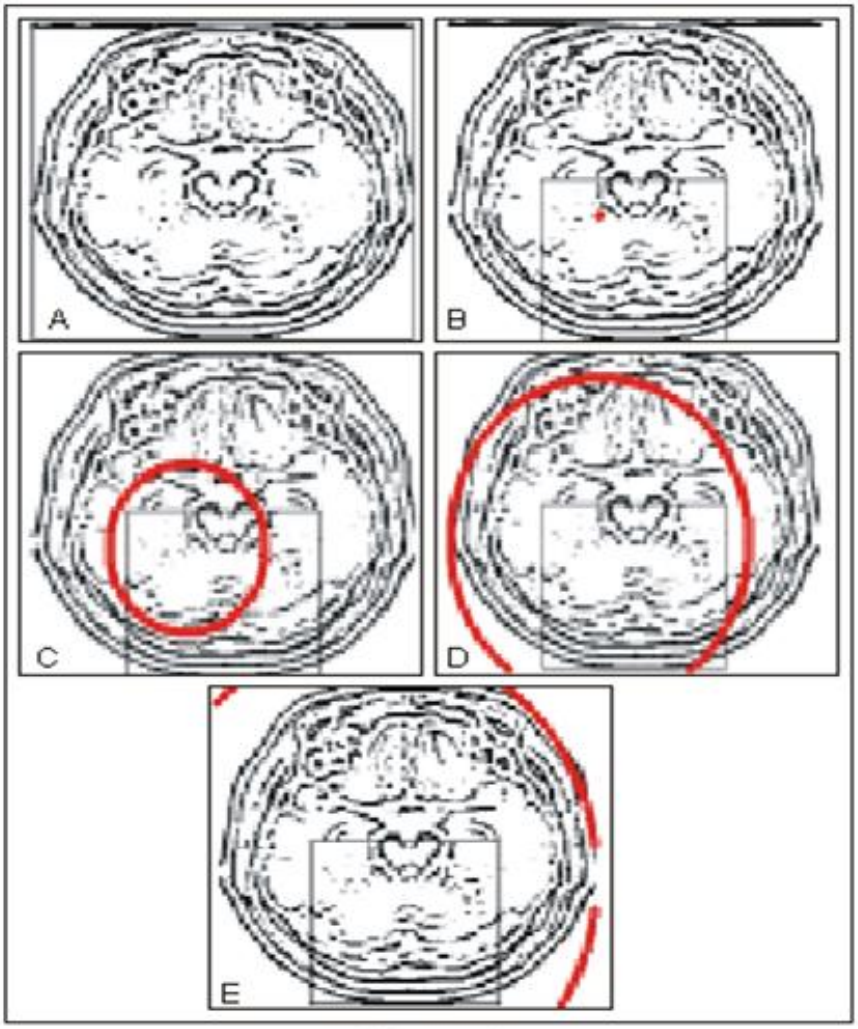

Figure 4

Figure 4 Shows The Medical Image With The Feature Vector With Circular Radii.

The Images Shown Is The Figure (4) Is The Feature Vector Collection With Geometrical Radii. The Medical Images Are Of Varying Sizes So The Geometrical Parameters Adjust The Center Of The Images By Composing The Virtual Height And Width Of The Images. Figure 5 Shows The Image Of Chest With Different Size With Full Circle. The Working Of Circular Radii Remains Same For Both The Images Even For Every Varying Image Size. Figure 5 Shows The Scans Of Lungs In Which Whole Medical Image Are Concerned With Increasing Radii With Full Defined Dimensions.

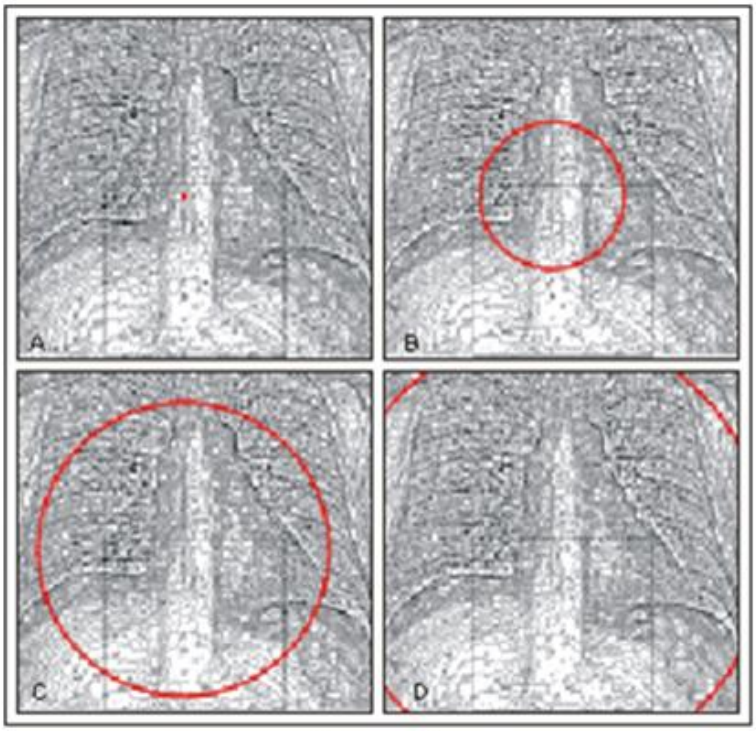

Figure 5

Figure 5 Shows The Image With Circular Radii In Whole Image With Feature Vector

3) Computing Edge Density And Feature Vectors

The Features Created In Each Segment Or Region Has Collection Of Edges From Different Parts Of Images. The Total Calculated Part Of Each Region Is Given Edge Density. In The Case Of Rectangular Segment Edge Density Is Denoted By P In (21),Including R_a And E_r Where R_a Is The Area And Edge Magnitude Is Given By E_r.

$$P = \frac{1}{R_a}\sum_{m=x_0}^{x_1}\sum_{n=y_0}^{y_1} E_r(m,n) \qquad (21)$$

WhereR_a=$(x_1 - x_0 + 1)(y_1 - y_0 + 1)$ (22)

Compromising Total Eight Feature Vector Of These Segments Are:-

$V_{r1}, V_{r2}, V_{r3}, V_{r4}, V_{r5}, V_{r6}, V_{r7} V_{r8}$.And In The Case Of The Circular Radii It Is Given In The Form Of Pseudo Code As:-

For A=1 To A=N-1
Num=1;
For B=1 To B=R
If $\sqrt{(R_b - \frac{W_c}{2})^2 + (c_0 - \frac{H_c}{2})^2} > C_{r0}$ And
$\sqrt{(R_b - \frac{W_c}{2})^2 + (c_j - \frac{H_c}{2})^2} < C_{r0}$ A+1.
Num=Num +1;
Else
Num=Num+0;
End If;
F{A}=Num;
END For;

The Five Vectors Are These Segments Are $V_{c1}, V_{c2}, V_{c3}, V_{c4}, V_{c5}$ Giving The Total Features Of 13 Features. The Total Thirteen Features Of Each Image Are Taken In Consideration Before Going To Next Phase. Hence, Improving The Retrieval Process Of The Image From Ordinary Retrieval System Of Medical Image.

B) Retrieval Phase

The Retrieval System Works Upon The Query Image Taken From The Database And The Image Gathered From The Feature Vector Database With Their New Feature Vector That Has Been Extracted From The Image During Its Extraction Phase. Here, Neural Network Gets Trained With The Collaborated Images From Both The Databases And Thus Resulting The Most Relevant Image For The Query Image. Figure 6 Shows The Overflow Common Structure And Working Of Neural Network.

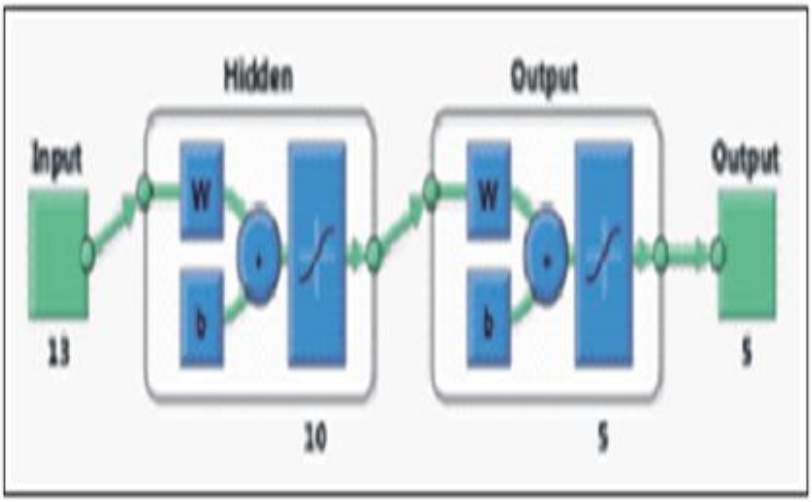

Figure 6

Figure 6 Neural Network Performance Flow

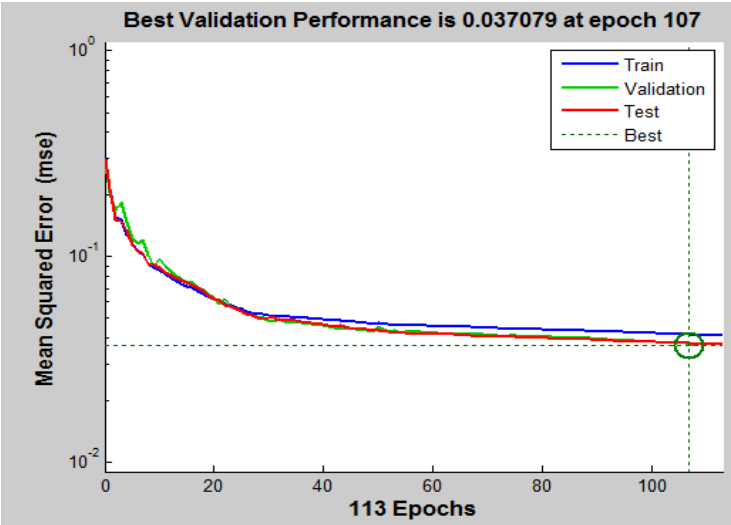

Figure7 Performance Graph For The System During Training

The Tested Images Are Repossess From The Analysis Of The Euclidean Distance Among All The Trained And Tested Images And Forming The Category Of The Image Resulting Classification. Parameter Over Which Classification Is Done Is The Five Nearest Neighbor Resulting A Category Which Holds Five Relevant Images That Are Much Closer To The Query Images. Thus Retrieving The Image Among The Cluster Which Has Least Distance From The Similarity Features Of Query Image Is Finally Retrieved As An Output Against The Query Image.

IV. Results And Discussion

Understanding An Image To Retrieve The Right Output Is The Most Important Aspect Of The Proposed System. It Access To The Testing Of The Performance Of The System And Its Comparison Checks Are Done By The Total Thirteen New Feature Vector In Addition Of The Basic Image Signature Of The Image. The Importance Of This Extraction Can Be Seen In The Performance Of The System That Has Been Used To

Retrieve The Image Using These Extracted Features. The Performance Can Be Shown Through The Graphs Of The Retrieval Image And Confusion Matrix. Calculated Precision Is Shown As:-

$$\mathbf{P} = \frac{no.of\ applicable\ images\ Retrieved}{total\ no.of\ images\ retved} \qquad (23)$$

Where Is The Precision Rate In (23). The Tabular Form Of The Precision Rate During The Retrieval Of The Medical Images Is Shown In Table 1.Closer Analysis Of The Tables Shows That System Works On The Five Types Of The X-Rays Of Parts Of Human Body Namely Hands, Pelvis, Breast, Skulls And Chest. For Each Part There Have Been Five Query Images For The Precision Rate Of 25 Images At The End Of The Run. Similarly This Is Done For Four More Runs. The Collaborated Precision For All Four Runs And Comparison With The Five Nearest Neighbor For 125 Images Are Given In Table 2 With Distinguished Feature Vector For Retrieval System With Its Combined Two Geometric Parameters And The Graphical Notation For The Same Is Given In Figure (8)-(9). Overall Testing Performance Is Shown In The Form Of Confusion Matrix In Figure (10).

Table 1 Showing The Retrieval Rate With Its Two Feature Extraction Functions.

Query Image	Databases				
	Hands	Pelvis	Breast	Skulls	Chest
	Precision Rate of Retrieving image				
1	90	70	70	100	80
2	100	60	80	100	70
3	100	90	80	100	70
4	100	80	90	100	80
5	100	80	100	100	80

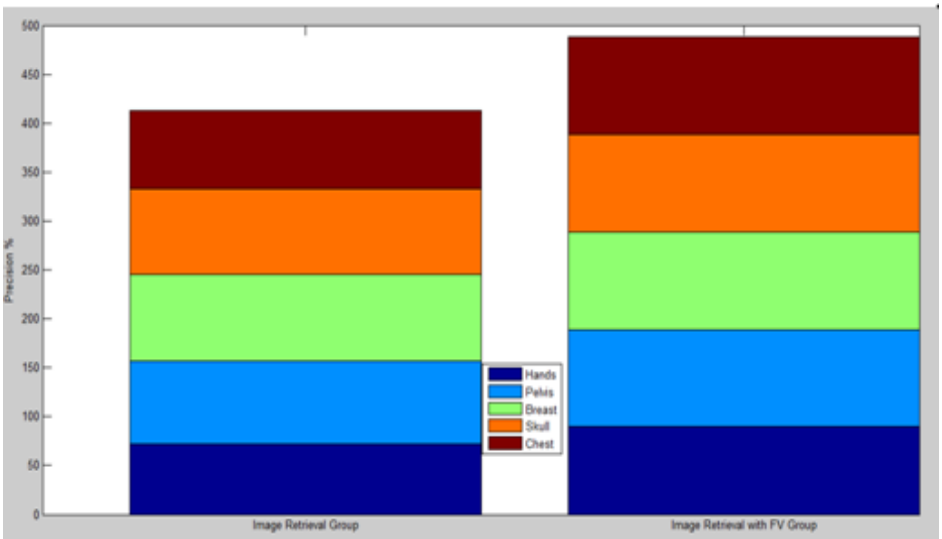

Figure 8 Showing The Result For The Two Different Body Parts Group.

Table 2 Collaborated Result Of All Runs With Different Query Images.

Run No	5-NN Precision (%)	Image Retrieval Precision (%)	ImageRetrieval with Fv vector
1	80	80	97
2	80	61	90
3	90	86	95
4	90	76	94
5	88	80	98

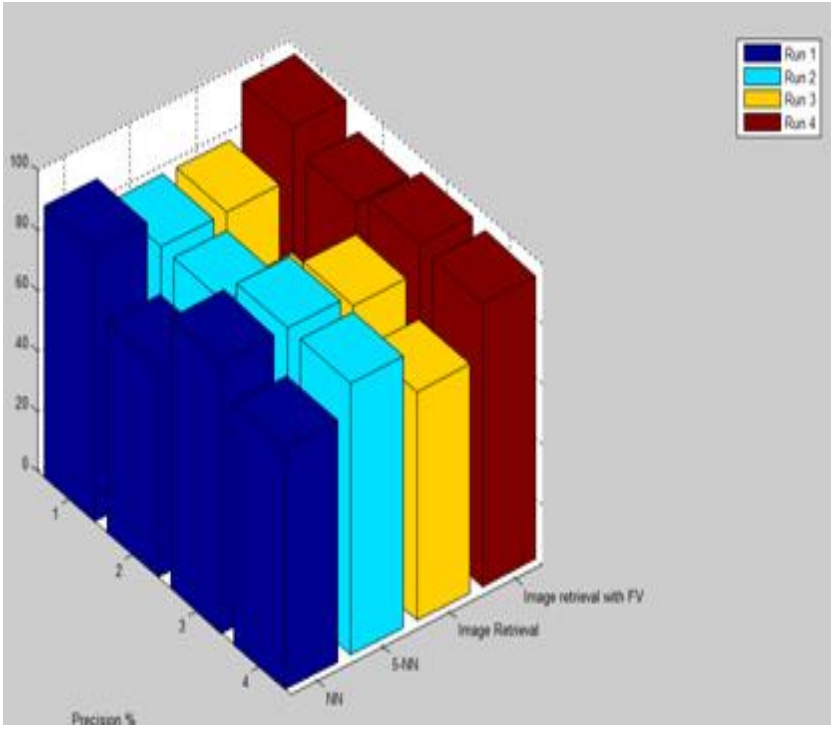

Figure 9 Showing The Graph Result For The Different Retrievals.

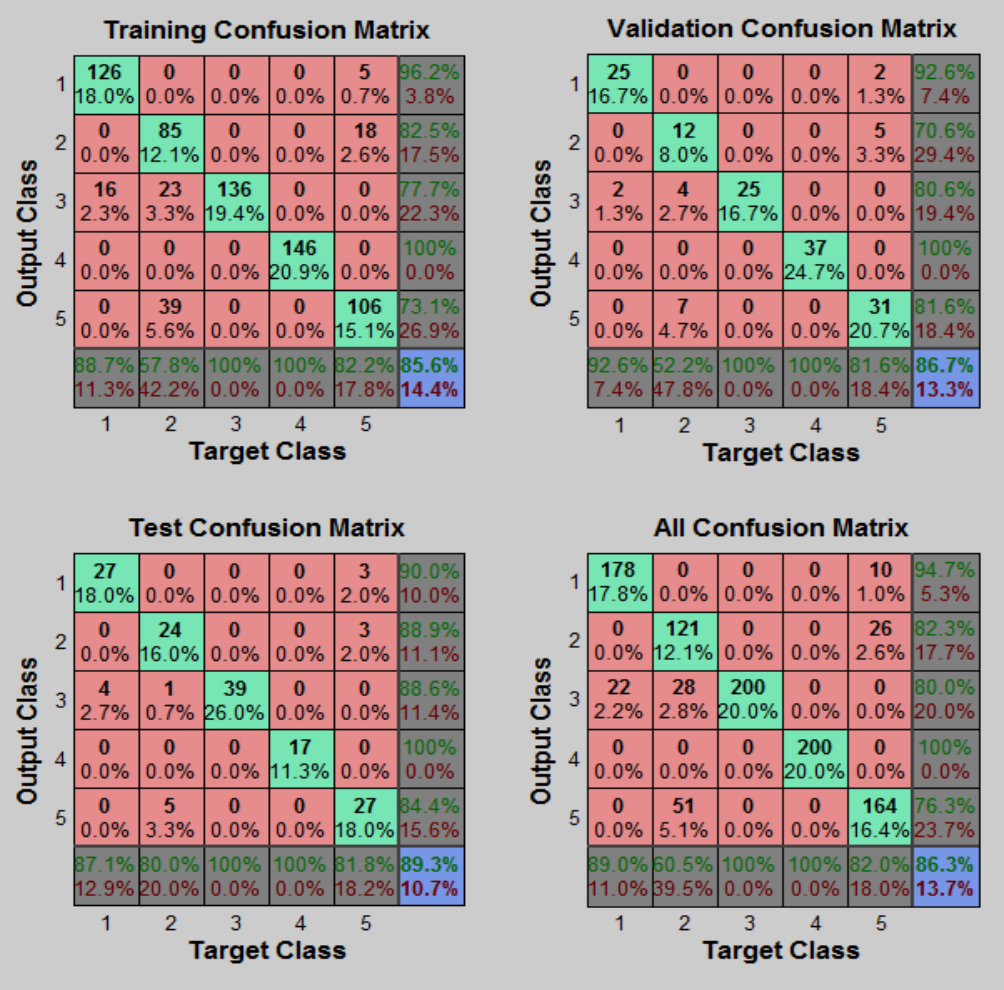

Figure 10 Confusion Matrixes Showing The Result For The Retrieval System.

V. Conclusion

The Research Work Have Been Structured On The Basis Of Features Of The Medical Image Which Are Analyzed Under Geometrical Functions With The Performance Of 76.6 %, 85.6 %, 94.8% For Image Retrieval, Five Nearest Neighbor And Retrieval With Feature Vectors. Edge Density Here With New Developed Feature Vector Has Proven Its Impact In The Improve Precision Which Has Been Working Well In The Considerably Previous Work Of Image Retrieval. The Classification And The New Features Related To The Basic Parameters Of The Image Can Be Improved Or Developed Respectively.

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