Novel Error Acceptance Gabor Filter Algorithm for Reduction of Noise issue on Noisy image

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ABSTRACT: In present era as we know there is need of fast system which are able to reduce the time complexity issue, because time complexity sis main challenge for any system if time is high so it automatically increase the cost of the entire project. Similar gabor filter is very important filter for many application like texture segmentation, bio metric etc. Now if we are talking about the noisy images which are responsible for reduction in quality for those application. So here we need fast and noise reduction approach for the gabor filter which is able able to reduce all issue like quality and time complexity. Basically In this paper we proposed a new technique which use the error acceptance logic using that logic we are able to achieve time complexity issue. Now for quality level analysis we use PSNR, SSIM, FSIM, RFSIM, GMSD, Similarity (%) parameters. This paper is basically based on MATLAB codes required in computing these parameters are produced. Here calculation is decaying by utilizing of Matlab.

Keywords ***Gabor filter, Gabor energy, image quality assessment, Gabor features***

I. INTRODUCTION

Introduction to Gabor Filter:

In picture preparing, a Gabor channel, named after Dennis Gabor, is a straight channel utilized for surface investigation, which implies that it fundamentally examinations whether there are a particular recurrence content in the picture in particular headings in a limited locale around the point or district of examination. Recurrence and introduction portrayals of Gabor channels are asserted by numerous contemporary vision researchers to be like those of the human visual framework, however there is no observational proof and no practical basis to help the thought. They have been observed to be especially proper for surface portrayal and separation. In the spatial area, a 2D Gabor channel is a Gaussian part work balanced by a sinusoidal plane wave. A few creators assert that basic cells in the visual cortex of mammalian brains can be displayed by Gabor functions.[1][2] Thus, picture examination with Gabor channels is thought by some to be like discernment in the human visual framework.

1.1 Applications of 2-D Gabor filters in image processing

In archive picture handling, Gabor highlights are perfect for recognizing the content of a word in a multilingual document.[9] Gabor channels with various frequencies and with introductions in various ways have been utilized to restrict and separate content just areas from complex record pictures (both dark and shading), since content is rich in high recurrence segments, though pictures are generally smooth in nature.[10][11][12] It has additionally been connected for outward appearance acknowledgment [13] Gabor channels have likewise been broadly utilized as a part of example investigation applications. For instance, it has been utilized to contemplate the directionality conveyance inside the permeable elastic trabecular bone in the spine.[14] The Gabor space is exceptionally helpful in picture preparing applications, for example, optical character acknowledgment, iris acknowledgment ,unique mark acknowledgment and texture segmentation. Relations between enactments for a particular spatial area are extremely unmistakable between objects in a picture. Besides, essential enactments can be extricated from the Gabor space with a specific end goal to make a scanty protest portrayal.

1.2 Role of Gabor filter on Texture Segmentation:

Texture Segmentation is the way toward parceling a picture into locales in light of their surface. Roused by the multi-channel task of the Human Visual System for translating surface, investigate has been centered around utilizing a multi-channel approach in view of Gabor separating to mirror the activity of HVS for recognizing diverse surface locales. In this paper we utilize this multi-channel way to deal with the issue to pick up understanding into the capacity of this procedure in taking care of the Texture Segmentation issue.

II. LITRECTURE REVIEW

Literature study is basically done to understand the gabor filter and different parameter we used to compare different gabor filter we implement in this thesis. Literature study suggest some algorithm which can be implemented to improve the efficiency of gabor filter.

Perona et al. (1990), [1] They proposed a model of human preattentive texture perception. Their model have 3 stage, the first one is convolution of image with linear filter(even symmetric) along with half wave rectification then second one is inhibition

localized in space, along with neural response then third one is detection of texture boundary by odd symmetric mechanism. These hypothesis have commonly been built for highly contrasting spot or line designs and are not straight forwardly relevant to dark scale pictures. Exploratory outcomes depicting marvels that are not all around clarified by this hypothesis has been accounted for. An option way to deal with surface discernment depends on the reactions of the direct instruments that have been utilized to clarify a scope of wonders in early spatial vision. While these endeavors have shown that a separating methodology can clarify a few wonders that are not predictable.

Grigorescu et al.(2002), [3] Different elements identified with the neighborhood control range of pictures have been proposed in the writing and utilized as a part of somehow for surface examination, order, as well as division. In the majority of these reviews the connection to the nearby range is set up through (halfway) highlights that are gotten by sifting the information picture with an arrangement of two-dimensional (2-D) Gabor channels. Such a channel is direct and nearby. Its convolution part is a result of a Gaussian and a cosine work. The channel is portrayed by a favored introduction and a favored spatial recurrence. Generally, a 2-D Gabor channel goes about as a neighborhood band-pass channel with certain ideal joint confinement properties in the spatial space and in the spatial recurrence area. Regularly, a picture is sifted with an arrangement of Gabor channels of various favored introductions and spatial frequencies that cover properly the spatial recurrence area ,and the components acquired from an element vector field that is additionally utilized for investigation, characterization, or division .Gabor include vectors can be utilized straightforwardly as contribution to a grouping or a division administrator or they can first be changed into new element vectors that are then utilized all things considered an information.

Onizawa et al.(2015), [14] has proposed a Gabor filter that is based on stochastic calculation. By using stochastic calculation they use sine function in gabor filter which is approximated by several stochastic tanh function designed according to a state machine. They design stochastic gabor filter using stochastic sine function and stochastic exponential function then they compare it with the conventional gabor filter. Their filter shows almost equivalent result with different frequencies and variances, with root mean square error of 0.043. Their filter achieves approximately 78% area reduction compared to conventional Gabor filter.

Sheridan et al. 2016, [15] They worked on Memristor network that extracts feature from thw image. They proposed a method in which crossbar array of memristive element is used for implementation of dictionary learning and features of Natural images. Their dictionary is in conjunction with Oja's rule that is mainly used to learn a dictionary that resembles features of Gabor filter. They then use this dictionary for locally competitive algorithm for a sparse representation of input images. They have shown that in which way crossbar arrays of memristive devices can implement the locally competitive algorithm developed for image feature decomposition.

Lee et al.(2008), [8] On this paper author gives us idea about human eyes. According to paper the human eye can tolerate an error upto 10%. So we can easily apply approximation on image processing system. Through this small error there is tremendous saving in hardware complexity.

Wang et al. (2004), [10] According to this paper natural image signals are highly structured their pixels exhibit strong dependencies, especially when they are spatially proximate, and these dependencies carry important information about the structure of the objects in the visual scene. In this paper, they have shown the traditional method of image quality assessment based on error sensitivity, they use the property of structural similarity for design of image quality measures. To demonstrate their structural similarity concept, they developed an SSIM index. Although most quality measures based on error sensitivity decompose image signals using linear transformations, these do not remove the strong dependencies.

Gabor Filter

A core of Gabor filter based feature extraction is the 2D Gabor filter function expressed as,

$$g_{\lambda,\theta,\varphi,\sigma,\gamma}(x,y) = \exp\left(-\frac{x'^2+\gamma^2 y'^2}{2\sigma^2}\right)\cos\left(2\pi\frac{x'}{\lambda}+\varphi\right) \quad (1)$$

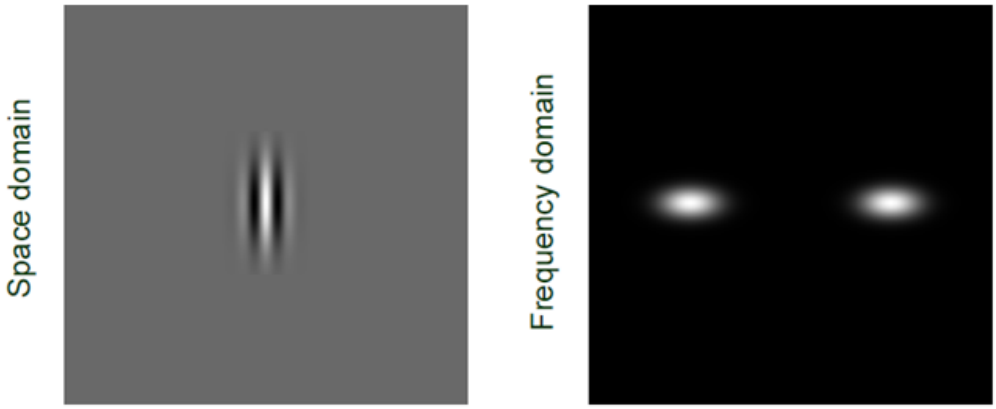


Fig. 1 Space and Frequency Domain

$$x' = x\cos\theta + y\sin\theta$$
$$y' = -x\sin\theta + y\cos\theta \quad .$$

In the spatial domain (Eq. (1)) the Gabor filter is a complex plane wave (a 2D Fourier basis function) multiplied by an origin-centred Gaussian (Fig. 1). f is the central frequency of the filter, θ rotation angle, λ sharpness (bandwidth) along the Gaussian major axis, and η sharpness along the minor axis (perpendicular to the wave).

2.2 Outcome from literature survey: Here some author talk about the texture segmentation process. Some author discuss about the feature extraction process. Some author discuss about the different type of filtering process but according to all previous existing approaches we can find that all approaches are focus on quality only no one is targeting to minimize the time complexity issue as we know system cost will increase due to increment in time. Also some approaches are not upto the mark in terms of quality level. So we can simply say that most of the process are not useful for many application where we need fast simulation result with good quality.

III. METHADOLOGY & IMPLIMENTATION DETAILS

In this work basically we are focusing on new algorithm of Gabor filter which is useful for various applications. Basically we are targeting two parameters which are quality and speed. As we know in current era there is need of fast system which are able to reduce the cost issue from any application. We also know if system require huge time so automatically entire application cost will increase which is not acceptable in this competitive era. So here we proposed a gabor filter which require less time and also able to mutation the quality level of generated output. Here we know texture segmentation application needs gabor filter so here first we did the comparative analysis between existing gabor filter and proposed gabor filter after that we pass our proposed gabor filter with texture segmentation application.

As per our proposed approach here we are try to use error acceptance logic which is resize the input image in to the smaller size so automatically it require less time for calculation and here we also try to optimize the Xp and Yp gabor equation , we also proposed a new equation for gabor coefficient analysis which is combination of both cosine and sine factor due to that we are able to get good quality output with fast process. Here you can see in fig. 2 we present the block diagram of our proposed system:

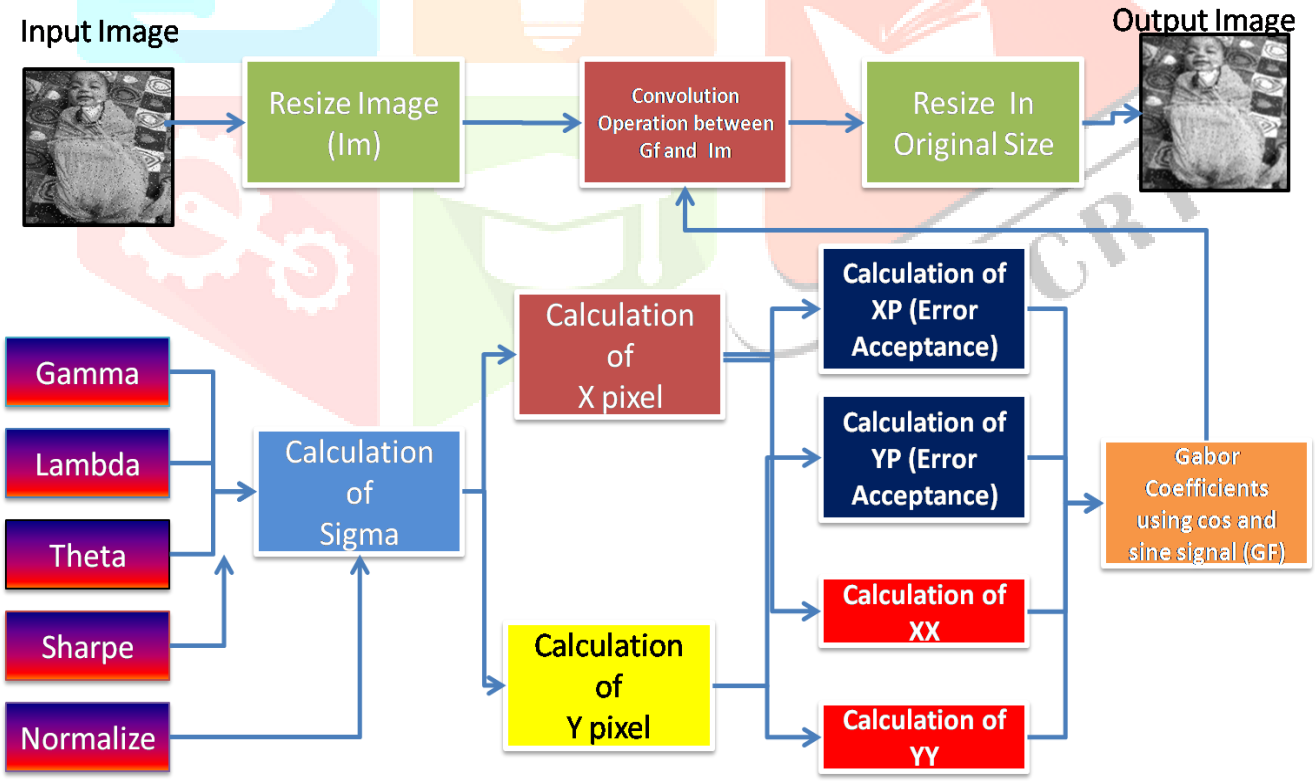


Fig. 2 Block diagram of Proposed Model

Proposed Gabor Filter Algorithm:

Require: (Image(N X M), gamma, lambda, b, theta, phi, shape) ;

Begin
//Read image
H1=ReadImage(N X M)

//Step1: Resize Inage
V1=Resize(H1, [200 200])

//Step2: Calculation of horizontal and vertical pixel

Xp = y * sin(theta);
Yp = x * cos(theta);
YY = fix(sigma)+y+1;
XX = fix(sigma)+x+1;

On step two we applied approximation logic and exchange the x pixel with y and y pixel with x.

// Step3: Calculation of Gabor coefficient which contains cos and sine both factor which will help us to improve the quality
GF(yy,xx) = exp(-.5*(xp^2+gamma^2*yp^2)/sigma^2) * ((cos(2*pi*yp)+ sin(2*pi*xp)));*y=y1+y2+y3;*

// Step4: Convolution of GF with input image
GO = Conv(V1, GF, shape);

// Step5: Resize the output image in to original size and save it
Out=Resize((D),[256 256]);

end

So this is our proposed algorithm which is able to solve time complexity and quality complexity issue. Here we also apply our proosed approach in to the texture segmentation application where inout image is with paper and salt noise and using our proposed gabor filter we got good result as a output.

IV. RESULT & ANALYSIS

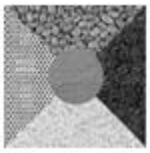
In this section basically we did complete analysis in terms of two main parameters which are:

1. Quality level analysis
2. Image level analysis

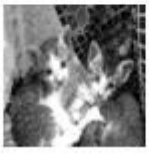
So for this analysis we use 6 different types of images which are combination of standard image and real time mobile images:

1. Lena 
2. Data 
3. Baby 
4. Cat 
5. Home 
6. Babynew 

Noisy Images:

1. NoisyLena 
2. NoisyData 
3. NoisyBaby 
4. NoisyCat 
5. NoisyHome 
6. NoisyBabynew 

Proposed Filter Output Images:

1. FilterData 
2. FilterLena 
3. FilterBaby 
4. FilterCat 
5. FilterHome 
6. FilterBabynew 

Now here we use all those parameters which will validate our proposed approach with exsisting approaches so for that we use some of the scientific parameters which are:

1. PSNR 2. SSIM 3. FSIM 4. RFSIM 5. GMSD 6. Similarity (%)

We contrast our proposed calculation and past approach. For calculation usage we utilized MATLAB apparatus.

Here we are presenting the comparative analysis of different approaches with all parameters:

		Time			PSNR			SSIM			FSIM			GMSD			RFSIM			Simiarity(%)		
Images	Cos	Sin	PROPOSED	Cos	Sin	PROPOSED	Cos	Sin	PROPOSED	Cos	Sin	PROPOSED	Cos	Sin	PROPOSED	Cos	Sin	PROPOSED	Cos	Sin	PROPOSED
LEENA	0.298025	0.295	0.184179	15.64	18.51	20.48	0.2016	0.2825	0.6622	0.574	0.6862	0.8457	0.7556	0.7887	0.8647	0.006	0.022	0.1101	73.84	82.41	79.37
DATA	0.303565	0.298237	0.175598	11.19	13.15	14.58	0.3089	0.2989	0.5373	0.691	0.7382	0.7487	0.7953	0.8142	0.8347	0.018	0.063	0.2612	51.59	62.02	64.94
CAT	0.284983	0.26701	0.148274	12.76	15.16	19.71	0.2436	0.3225	0.5422	0.689	0.7412	0.7923	0.762	0.7922	0.8213	0.012	0.053	0.2312	60.42	72.07	77.89
BABY	0.300247	0.26352	0.176571	12.95	15.47	18.16	0.2216	0.2825	0.6722	0.588	0.7123	0.8211	0.7712	0.823	0.8623	0.019	0.031	0.1922	59.44	71.95	73.22
HOME	0.276386	0.258505	0.166614	12.2	14.23	17.69	0.1616	0.2225	0.4622	0.612	0.7312	0.7612	0.7816	0.8312	0.8622	0.009	0.043	0.2515	55.41	66.33	73.19
BABYNEW	0.284995	0.261787	0.165426	13.27	15.75	20.28	0.2316	0.2925	0.6122	0.635	0.7612	0.7755	0.7025	0.7823	0.8432	0.021	0.023	0.2236	64.65	75.24	79.28

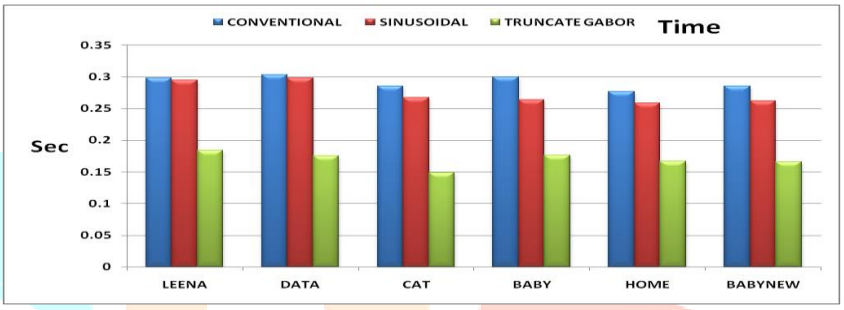


Fig. 3 Comparative analysis in terms of Time Complexity

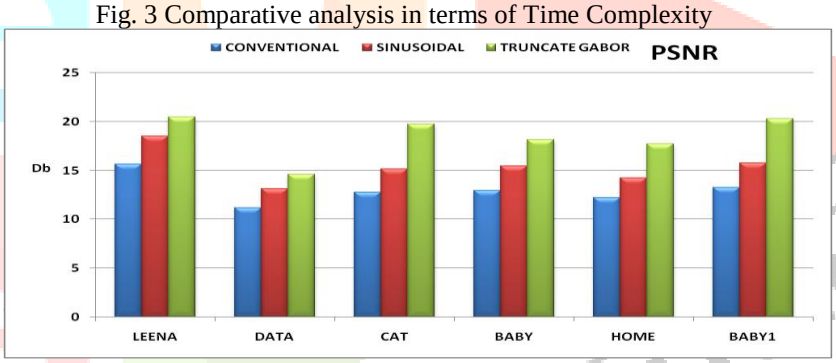


Fig. 4 Comparative analysis in terms of PSNR

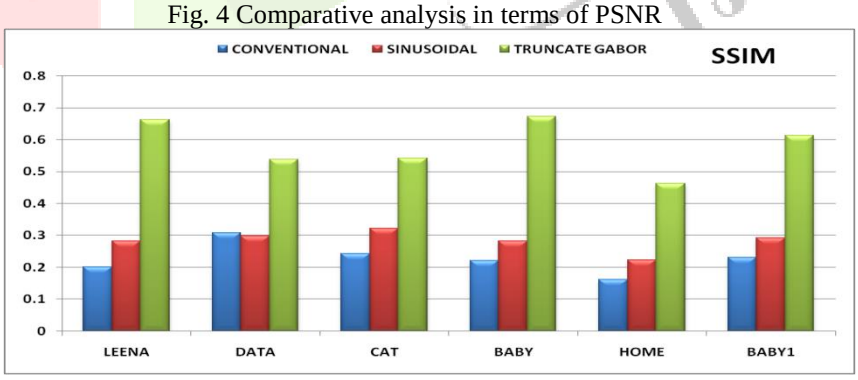


Fig. 5 Comparative analysis in terms of SSIM

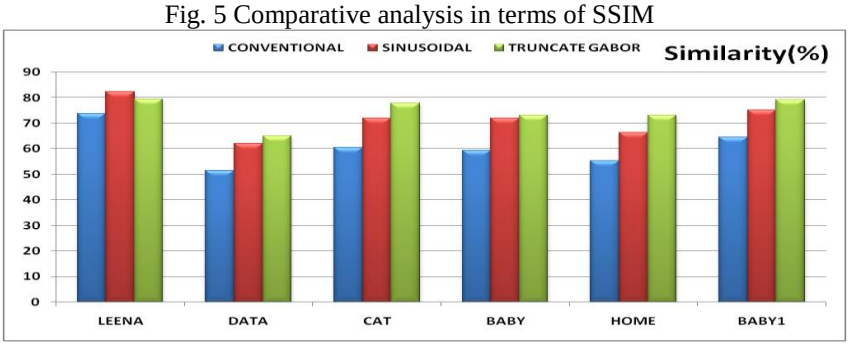


Fig. 6 Comparative analysis in terms of Similarity (%)

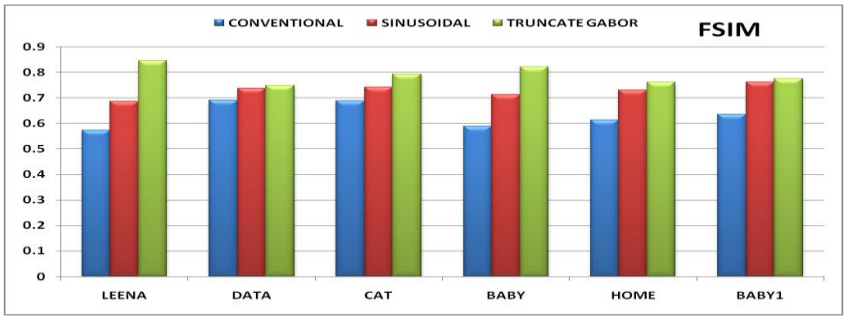


Fig. 7 Comparative analysis in terms of FSIM

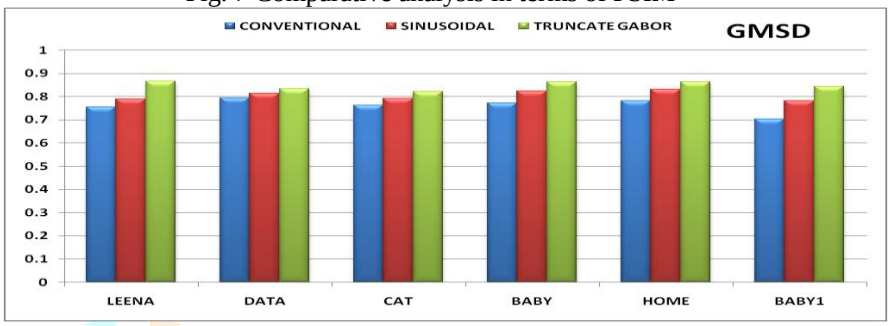


Fig. 8 Comparative analysis in terms of GMSD

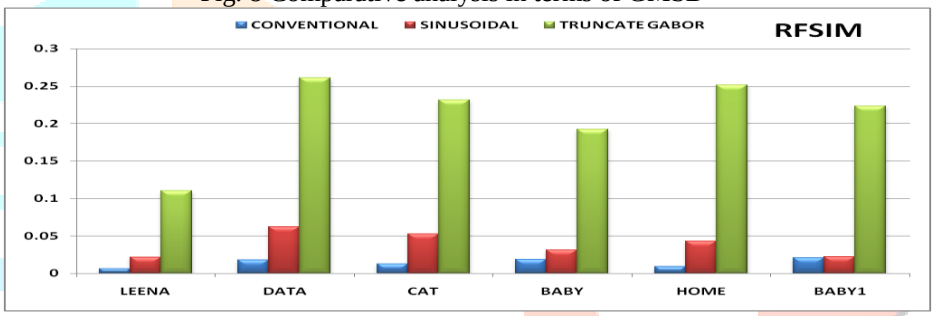
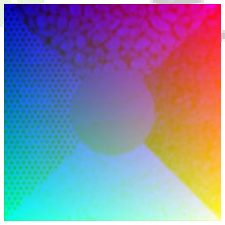


Fig. 9 Comparative analysis in terms of RFSIM

Now after the validation of our proposed approach now we apply our proposed gabor filter for Texture segmentation application and here are the output of that application:

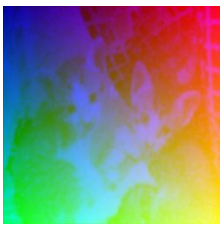
Texture Segmentation Using Proposed Filter Output Images:

1. Lena 



2.Data

3.Baby 

4. Cat 

5.Home 

6.Babynew 

V. CONCLUSION

In this paper basically we focus on the previous existing issues which are time complexity and quality complexity there is no any approach which makes justice with both parameters. Conventional gabor filter is good in quality but require time is huge now if we are talking about the sine based gabor filter so that filter is able to reduce the time issue with very small improvement in quality. Here we present a novel algorithm which follows the error acceptance logic and due to that logic we are able to improve the quality if generated output image in very less time. For quality estimation we use six images which are combination of standard and real time mobile images. We perform the quality check analysis on those images using some

parameters like PSNR, SSIM, FSIM, RFSIM, GMSD. Here we got improvement in quality of 20-30% and also reduction in time complexity by 40-50% as compared to previous existing approaches.

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