RESEARCH ARTICLE OPEN ACCESS

Camouflage Texture Assessment Method Based on WSSIM and Nature

Kiran More , S. B.Borse
PG student , Late G.N. Sapkal COE., AjaneriNashik,
Assistant Prof . Late G.N. Sapkal COE.,AjaneriNashik.

Abstract:

The human vision system finds it difficult to identify the camouflaged image on the surface the object, while examining the corresponding image. This is due to the inherent limitation of human vision system. . It is quite difficult to detect such camouflaged object because they get camouflaged in the background; they are smaller in size and also chromatically match with surrounding. The success of military weapons depends upon their ability to remain unseen by enemy. Thus camouflaging strategy is purposely employed in military applications.we will focus on the essential of the human visual system, and its relative significance of various factors affecting camouflage texture. The method detailed here develops a computational vision modelto examine the perceived differences between background image and camouflage texture background image. A dffrinet features for measuring thresholds for differentiating between small changes in naturalistic images have been studied to direct the camouflage texture designing.

Keywords — **Camouflaging, texture analysis, WSSIM, SSIM.**

1.Introduction-

Camouflaging is the process of disguising an object to blend it with its surrounding. A camouflaged object cannot be seen by the human vision system. Decamouflaging is the identification and recognition of the object which is camouflaged. For the Decamouflaging of the image, texture analysis is carried out in different part of the image. Based on the results of the analysis, camouflaged object is detected. This paper mainly focuses on application of decamouflaging in defense area, which is needed for our country to save soldiers This paper is related to weighted structural similarity index (WSSIM) which represents perceptual image quality based on the structural information .WSSIM is an objective image quality metric and is superior to traditional quantitative measures such as MSE and PSNR. In this project, we focus on the essential of the human visual system, and its relative significance of the different factors of affecting camouflage texture. The proposed method developed a computational vision model to evaluate the perceived differences between camouflage texture image and background image. And a variety of features, measuring thresholds for discriminating small changes in naturalistic images have been studied to direct the camouflage texture designing.[1]

2.TEXTURE ANALYSIS

Thereare four major issues in texture analysis:

a) Feature extraction: to compute a characteristic of a digital image able to numerically describe its texture properties;

b) Texture discrimination: to partition a textured image into regions, each corresponding to a perceptually homogeneous texture (leads to image segmentation);

c) Texture classification: to determine to which of a finite number of physically defined classes (such as normal and abnormal tissue) a homogeneous texture region belongs;

d) Shape from texture: to reconstruct 3D surface geometry from texture information.

Feature extraction is the first stage of image texture analysis. Results obtained from this stage are used for texture discrimination, texture classification or object shape determination.

Approaches to texture analysis are usually categorized into

_ structural,
_ statistical,
_ model-based and
_ transform methods.

Structural approaches represent texture by well defined primitives (micro texture) and a hierarchy of spatial arrangements (macro texture) of those primitives. To describe the texture, one must define the primitives and the placement rules. The choice of a primitive (from a set of primitives) and the probability of the chosen primitive to be placed at a particular location can be a function of location or the primitives near the location. The advantage of the structural approach is that it provides a good symbolic description of the image; however, this feature is more useful for synthesis than analysis tasks. The abstract descriptions can be ill defined for natural textures because of the variability of both micro- and macrostructure and no clear distinction between them. A powerful tool for structural texture analysis is provided by mathematical morphology. It may prove to be useful for bone image analysis, e.g. for the detection of changes in bone microstructure.[3]

In contrast to structural methods, **statistical** approaches do not attempt to understand explicitly the hierarchical structure of the texture. Instead, they represent the texture indirectly by the non-deterministic properties that govern the distributions and relationships between the grey levels of an image. Methods based on second-order statistics (i.e. statistics given by pairs of pixels) have been shown to achieve higher discrimination rates than the power spectrum (transform-based) and structural methods Human texture discrimination in terms of texture statistical properties is investigated in. Accordingly, the textures in grey-level images are discriminated spontaneously only if they differ in second order moments. Equal secondorder moments, but different third-order moments require deliberate cognitive effort. This may be an indication that also for automatic processing, statistics up to the second order may be most important. The most popular second-order statistical features for texture analysis are derived from the so-called co-occurrence matrix. They were demonstrated to feature a potential for effective texture discrimination in biomedical-images.The approach based on multidimensional co-occurrence matrices was recently shown to outperform wavelet packets (a transform-based technique) when applied to texture classification .

Model based texture analysis using fractal and stochastic models, attempt to interpret an image texture by use of, respectively, generative image model and stochastic model. The parameters of the model are estimated and then used for image analysis. In practice, the computational complexity arising in the estimation of stochastic model parameters is the primary problem. The fractal model has been shown to be useful for modelling some natural textures. It can be used also for texture analysis and discrimination however, it lacks orientation selectivity and is not suitable for describing local image structures.[4]

Transform methods of texture analysis, such as Fourier Gabor and wavelet transforms represent an image in a space whose co-ordinate system has an interpretation that is closely related to the characteristics of a texture (such as frequency or size). Methods based on the Fourier transform perform poorly in practice, due to its lack of spatial localisation. Gabor filters provide means for better spatial localisation; however, their usefulness is limited in practice because there is usually no single filter resolution at which one can localise a spatial structure in natural textures.[5] Compared with the Gabor transform, the wavelet transforms feature several advantages:

_ varying the spatial resolution allows it to represent textures at the most suitable scale,

_ there is a wide range of choices for the wavelet function, so one is able to choose wavelets best suited for texture analysis in a specific application.

They make the wavelet transform attractive for texture segmentation. The problem with wavelet transform is that it is not translation-invariant.

3.CAMOUFLAGE TEXTURE EVALUATION

A. WSSIM Texture Evalution Model

Human visual model is based on knowledge of primary visual cortex, which recognizes a visual image by processing in parallel by channels or neurons with different optimal spatial frequencies. Based on human visual model, we propose a camouflage texture assessment framework to get the differences of background image and camouflage textures. Meanwhile, human eyes do not pay an equivalent attention to different regions in an image. In the assessment framework, different attention weights are applied to different regions of image. Fig.1 illustrates the camouflage texture assessment framework based on human visual model. We provide a brief summary here.

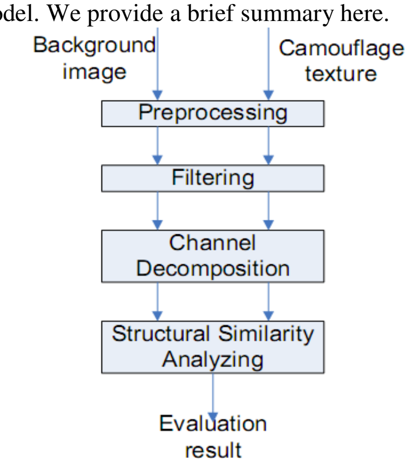

Fig. 3.1 Camouflage assessment Frame work for WSSIM.

First, a variety of basic operations is performed to eliminate distortions from background image and camouflage texture. And a low-pass filter simulating the point spread function of the eye optics may be applied. Second, the luminance of camouflage texture and background image is compared as follows:

$$l(x,y)=\frac{2\mu_x\mu_y+C_1}{\mu_X^2+\mu_Y^2+C_2}[1]$$

Where *l(x, y)* is the luminance comparison function of the mean intensity μ_x and μ_y *of the* camouflage texture x and background image y respectively. *C1* is included to avoid instability, here we choose 6.5025.

The contrast comparison function is given as follows:

$$C(x,y)=\frac{(2\sigma_{xy}+C_2)}{(\sigma_x^2+\mu_y^2+C_2)}[2]$$

Where σ_x *and* σ_y *is the stand deviation and we chooseC2 58.5225.*

We define the structure comparison function as follows:

$$S(x,y)=\frac{(2\sigma_{xy}+C_3)}{\sigma_x\sigma_y+C_3} \quad [3]$$

Where σxy is the covariance and we choose *C3 58.5225.*

At last, the structural similarity (SSIM) index between xand y can be drawn as

$$SSIM(x,y)=l(x,y)c(x,y)s(x,y) \quad [4]$$

The camouflage texture is compared with each block of the background with same size to get the whole evaluation result by Weight-SSIM as follows:

$$WSSIM(X,Y)=\frac{1}{M}\sum_{j=1}^{M} W_j\, SSIM(x_j y_j) \quad [5]$$

Where Wj is the weight of different block of backgroundand M is the sum of the blocks.

WSSIM is calculated three times on each pair of background image and camouflage texture for the red green and blue channels. The value will show the differences between the background image and the camouflage textures in RGB channels

4.Result-

4.1 Original image of beach:-

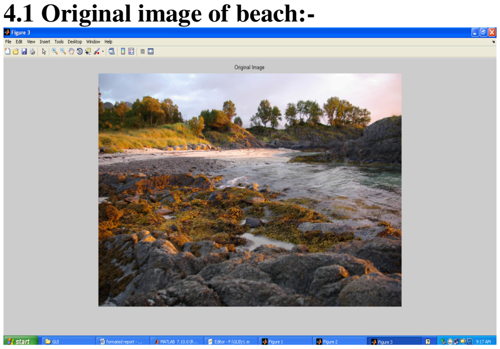

Fig:4.1 Original image of beach

By using WSSIM and nature image feature analysis test we get parameters or feature values

Like max. luminance = 1, min. luminance = 1, mean. Luminance = 1, deviation of luminance = 0, image entropy = 7.7130, correlation length = 0.9797, num. of closed areas = 3844. Index of similarity=1.

4.2Texture 1 image of beach:-

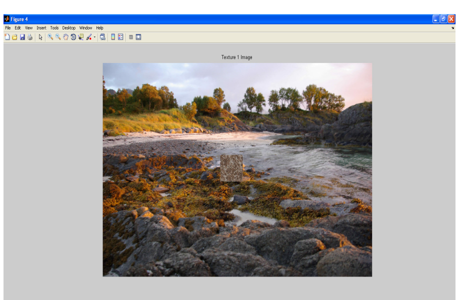

Fig:4.2Texture 1 image of beach

By using WSSIM and nature image feature analysis test we get parameters or feature values

Like max. luminance = 1, min. luminance = -0.4483, mean. Luminance = 0.9890, deviation of luminance = 0.0947, image entropy = 7.7092, correlation length = 0.9791, num. of closed areas = 3855. Index of similarity=0.9890.

4.3 Texture 2 image of beach:-

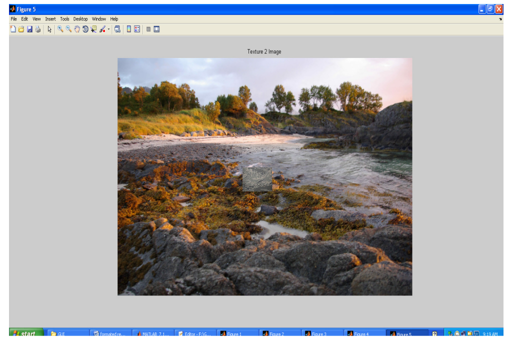

Fig:4.3Texture 2 image of beach

By using WSSIM and nature image feature analysis test we get parameters or feature values

Like max. luminance = 1, min. luminance = -0.4912, mean. Luminance = 0.9889, deviation of luminance = 0.0956, image entropy = 7.7137, correlation length = 0.9797, num. of closed areas = 3890. Index of similarity=0.9889.

4.4 Texture 3 image of beach:-

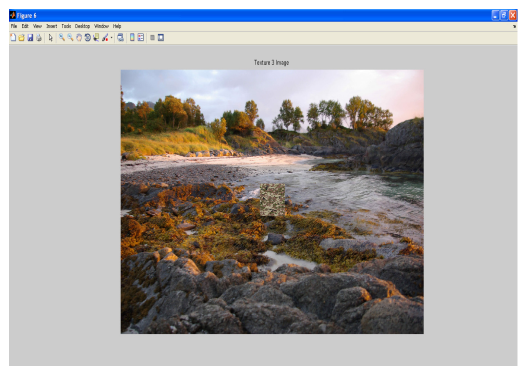

Fig:4.4 Texture 3 image of beach

By using WSSIM and nature image feature analysis test we get parameters or feature values

Like max. luminance = 1, min. luminance = -0.5824, mean. Luminance = 0.9888, deviation of luminance = 0.0978, image entropy = 7.7107, correlation length = 0.9787, num. of closed areas = 3817. Index of similarity=0.9888.

The different parameter for beach image:-

Features	Original image	Texture 1	Texture 2	Texture 3
Max. luminance	1	1	1	1
Min. luminance	1	-0.4483	-0.4912	-0.5824
Mean luminance	1	0.9890	0.9889	0.9888
Deviation of luminan.	0	0.0947	0.0956	0.0978
Image entropy	7.7130	7.7092	7.7137	7.7107
Correlation length	0.9797	0.9791	0.9797	0.9787
Num of closed areas	3844	3855	3890	3817
Index of similarity	1	0.9890	0.9889	0.9888

Complete result for beach image:-

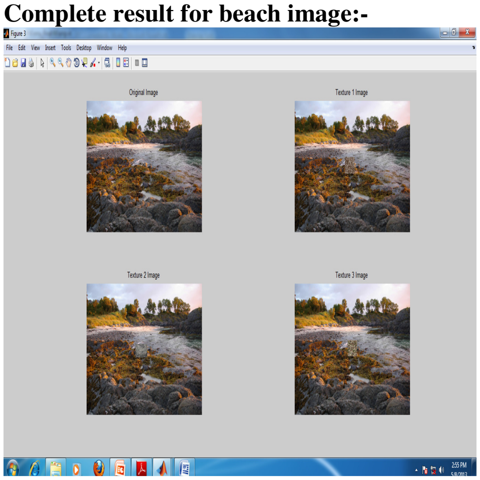

Fig: 4.5 complete result of beach image.

5.Conclusions:-

Traditional evaluation method of camouflage texture effect is subjective evaluation. It's very tedious and inconvenient to direct the texture designing. In this project, a systemic and rational method for direction and evaluation of camouflage texture designing is proposed. A camouflage texture evaluation method based on WSSIM (Weight structural similarity) is given to access the effects of camouflage texture at first. Then nature image features between the camouflage texture and the background image are calculated to help direct the designing camouflage texture. In this project, we focus on the essential of the human visual system, and its relative significance of the different factors of affecting camouflage texture. The proposed method developed a computational vision model to evaluate the perceived differences between camouflage texture image and background image. And a variety of features, measuring thresholds for discriminating small changes in naturalistic images have been studied to direct the camouflage texture designing. Primary experimental results show that the proposed method is helpful for evaluation and design of the camouflage texture.

By using weighted structural similarity index algorithm and nature image feature analysis test we calculate similarity index by applying weights three times to an image at diffrent weighted rigions so we get the knowledge of the textures that how much these textures are closure to each other in the structural similarity and nature image feature analysis test gives comparative diffrences between the textures or images. for this WSSIM and nature mage feature analysis test the knowledge of basic parameters i.e. luminanace, contrast and sructure is essential. By observing extracted texturalparamtrs of WSSIM we conclude that WSSIM algorithm has proved himself for better and approximate performance over traditional methods like PSNR AND MSE, these parameters has limitations in distorted and degraded noisy envirment because in this condition PSNR becomes zero and MSE goesto infinity which is inconsistent to human visual system. So WSSIM algorithm is best over other traditional algorithm.

6.Future scopes:-

In future WSSIM will be used for detection and tracking of camouflaged objects in video surveillance. Also for development of a procedure for camouflage pattern design for military uniform, military vehicles, tanks, missiles and airplanes to increase the survivability of soldiers by preventing visual observations and other military sensors from detecting. In motion based target tracking and identification purpose we may develop fast algorithm and also improve this algorithm by some means. This algorithm is also useful in forensic lab, for image as well as video analyzing.

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