DETECTION OF FOREGROUND OBJECT USING CONVENTIONAL METHOD FOR CAMOUFLAGE IMAGES

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ABSTRACT

Detection of a camouflaged object is a continuous research problem in many computer vision applications where similar intensity information among foreground and background regions. In camouflage image foreground will be hidden in the background image. Camouflage images can be natural and artificial. Detection of such hidden objects become difficult for a machine vision system and takes much time to detect and recognize whereas it is not difficult for Human Perception. Detection of object having similar color as background structure is called as camouflage, which is another big challenge. The method of detecting camouflage object is known as Decamouflaging.

KEYWORDS: Bayesian, Camouflage, Color, Dendrogram, GLCM moving object detection, video surveillance

I. INTRODUCTION

Camouflage word has derived from the French term called 'camoufler' which means conceal. Camouflage IS the concept of hiding foreground objects into background surroundings. It is referred as hidden images or as an instance of recreational art. In camouflage, any combination of materials is used for concealment, making objects hard to identify. It is also called as cryptic coloration as it is used to alter its appearance usually to match with its surroundings. Camouflage is used to mask their identity or location. Camouflage is also used by some predators as a tool for hunting. For them, being able to blend in with their environment gives them success m obtaining food. Natural camouflage occurs in animals, insects or humans (Fig.1) to hide from their predators. In motion camouflages, the object gets hide into the similar color visual background. A texture pattern used on the battlefield by the soldiers to hide weapons and themselves is an example of artificial camouflage (Fig.2).

Types of camouflage: The camouflage Images are classified into two categories, i.e., natural and artificial. The concept of natural and artificial camouflaging is as explained as below.

Fig. 1. Natural Camouflage

Fig. 2. Artificial camouflage

Several features are used for detection of moving object for different challenges. The color features are mainly used with RGB color space as it is directly available from the camera. Though color features are often very discriminative features of objects, they have several limitations in the presence of challenges such as illumination changes, camouflage and shadows. Other features like edge, texture, stereo etc. are used in addition to color feature. Thus some of the camouflaged moving object detection methods using different feature combinations are surveyed.

II. CAMOUFLAGED MOVING OBJECT DETECTION METHODS

A. Visual Camouflage Breaking:

Thayer's Countershading is a type of camouflage in which the object color is black on the upper and light on the lower side of the body. This camouflage type is mostly observed in insect, reptiles, fishes, Aves and mammals. Countershading makes it difficult to detect predators and prey because the effects of self-shadowing are counterbalanced. When the light is incident on the 3-dimentional uniformity colored objects, it makes the lighter upper side and darker lower side.

Visual camouflage breaking is used to detect Thayer's countershading effectively. This can be implemented by using a pre-defined operator that can be applied to the intensity image and detect 3D smooth convex (or concave) objects. The operator used is invariant under any difference or transformation of the intensity function, which makes it suitable for camouflage breaking, even for an object that cannot be properly seen by a human viewer. This method overcomes all the difficulties experienced in another similar representative edge-based method called radial symmetry

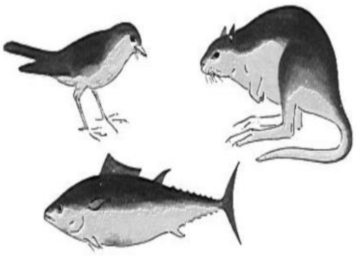


Fig. 3. Examples of counter-shaded animals

B. Adaptive Kernel density-based camouflage moving object detection:

Nikos Paragios et al. used a combination of optical flow and color to detect the camouflage moving object. As most of the dynamic scenes exhibit motion characteristics, their behavior is modeled via optical. Optical flow is used as a feature for change detection.

Density estimation is performed in high dimensional space by considering motion and intensity pixels for modeling the background. Variable bandwidth is used for density estimation. Normalized RGB color features are used; as such transformations are not affected by changes in illuminations. Then both the optical flow and color features are combined to detect moving object having same visual properties as background due to different motion characteristics.

C. Camouflage detection Using GLCM and Dendrogram:

A technique to detect camouflaged object from a given image and to extract it from background frame is given by P. Sengottuvelan et al. GLCM estimate the properties of the image that are related to second order statistics. Initially, the input image (Fig.4.) is converted to a grayscale image. Then the image is divided into the number of equal blocks and finally, GLCM value for each block of the image frame is calculated and also the mean is computed for each block. Dendrogram plot of the hierarchical, binary cluster tree is represented by Z. Z is an (m-1) x 3 linkage function matrix where, m are the number of objects in the real data set. Finally, dendrogram is plotted for previously obtained mean values of each block and among them; the largest individual block is marked. Now combine the adjacent blocks of the individual largest block to get the full camouflaged object. This technique is inappropriate for an image which contains intense shadow effect. The success rate of this technique to identify camouflage part is 70%.

Fig. 4. Original image

Neighbor Pixel Value / Ref pixel Value	0	1	2	3
0	(0,0)	(0,1)	(0,2)	(0,3)
1	(1,0)	(1,1)	(1,2)	(1,3)
2	(2,0)	(2,1)	(2,2)	(2,3)
3	(3,0)	(3,1)	(3,2)	(3,3)

Fig. 5. GLCM table

D. Bayesian modeling for camouflaged moving object detection:

Xiang Zhang et al. proposed a strategy to identify camouflaged foreground pixels using camouflage modeling whereas discriminative modeling is used to detect noncamouflaged pixels of the moving object. Discriminative feature-based modeling enhances the performance to distinguish foreground from the background with discriminative features but, it fails in case of camouflage moving object detection. A global model is developed for the background and an integration of global and local models is developed for the foreground.

In discriminative modeling (DM) YUV color features and Spatio-temporal derivatives are used for background modeling. The background is modeled as a global GMM in the case of camouflage modeling (CM). Different from the DM; sophisticated discriminative features are not required in the CM. For camouflage object detection, foreground likelihoods of the pixels are compared with background likelihoods. Both DM and CM are fused together in a Bayesian framework to detect the whole moving object. (Fig.6)

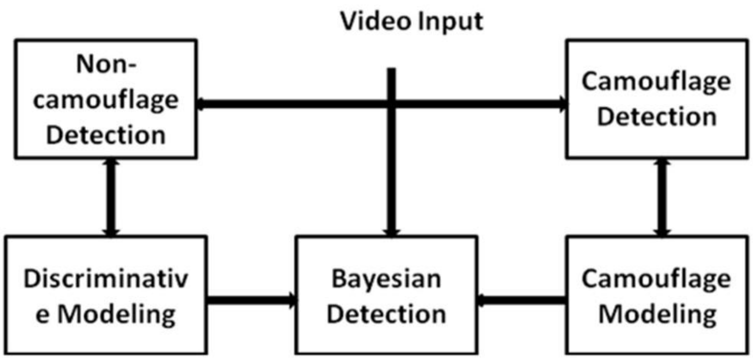


Fig. 6 Block Diagram of Bayesian modeling-based camouflage moving object detection

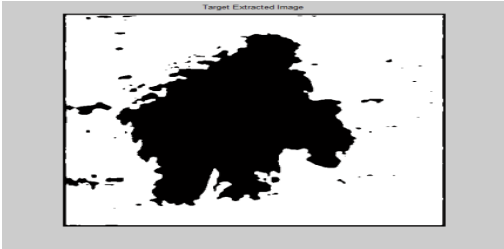
III. ANALYSIS OF OBJECT DETECTION

A. The analysis of object detection using Method

(a)

(b)

B. The analysis of object detection using Method



(c)

Figure 7:

*(*a) camouflage soldier in desert environment detection using statistical features from method A and detection by smoothing texture measures from method B

(b)camouflage Aero Plane detection using statistical features from method A and detection by smoothing texture measures from method B.

(c)camouflage soldier in grass fields detection using statistical features from method A and detection by smoothing texture measures from method B.

The performance analysis of these two methods to detect camouflaged objects assessed by regular metrics for image segmentation like precession and recall from true positives, true negatives, false positives and false negatives [6,7,8,9] in target extracted outputs shown in figure (4). The test images corresponding statistical features using method A and method B are listed in tabular representation in table (1)

Image	Seed Block	Seed Point	Contrast	Cluster shade	Cluster prominence
Camouflaged soldiers in desert	107	(209, 337)	750	1.287e+0 11	1.436e+0 14
Camouflaged soldier in fields	122	(299, 38)	387	1.279e+0 11	3.039e+0 14

The constructive approach on different environments shows the result

Aeroplane	113	(113,115)	87	2.9077e +011	1.4506 e+014
Bird	113	(119, 205)	302	1.480e+ 011	3.6802 e+011
Statue	203	(237, 205)	209	1.4434e +011	2.0414 e+014
Ship	117	(233, 373)	335	3.336e+ 010	8.6129 e+012

Table 1: Statistical features of different kinds of camouflage images

Performance analysis:

The image segmentation of object detection approach performance can be analyzed in many ways like standard measures, distance measures and similarity measures. Standard measures are the best suitable ones in comparison with similarity and distance in case of camouflaged approach because foreground and background pixels are of same characteristic entities (like: intensity colour and texture e.t.c). To access the performance here considered three indices from standard measures are Precision Recall and F-Measure which are depending on confusion matrix entries.

Precision (P) = True positives/(True Positive+ False positives)
Recall (R) = True positives/ (True Positive+ False Negatives)
F-measure=2*P*R/(P+R)

The problem of camouflage is sporadicin image or sequence of image here we considered specific frames where the rate of camouflage is more while detecting objects using statistical features set (Method A) and constructive one of both statistical features in smoothed characteristic entities (Method B).

Input and Performance (Standard measure)	Input image (a) Camouflage Soldier in war environments	Input image (b) Camouflage Aero Plane	Input image(c) Camouflage Soldier in Grass Fields
Precision	0.902	0.878	0.976
Recall	0.924	0.761	0.573
F Measure	0.90	0.815	0.74

Table 2: Performance evaluation on three kinds of images

The performance analysis of method A and method B defines that it is necessary that smoothing of characteristic entity and statistics of smoothed entity gives better detection than that of method A. Both of the methods gives satisfactory results on several kinds of images but if the intermittent is more in camouflaged image, then method B is better compared with method A.

IV. RESULTS AND DISCUSSION

The experimental process was carried out in a southern suburb of Nanjing in 2018, and continuous aerial imaging acquisition was performed on a certain simulate export target. The altitude of the aircraft is about 50 meters, and the flight conditions are selected in the morning, noon, afternoon, sunny, rainy days and other time periods. The data collected after the masquerading is completed is used as a training sample, as shown in Figure 8. The image in the full camouflage state is used as the test data of the original camouflage state; the image in the partial camouflage state is used as the test data of the better camouflage state; the image in the non-camouflage state is used as the test data of the failed camouflage state, and the three types of data are separately collected 25 frames.

(a) Completely camouflage

(b) Partially camouflage

(c) Not camouflage

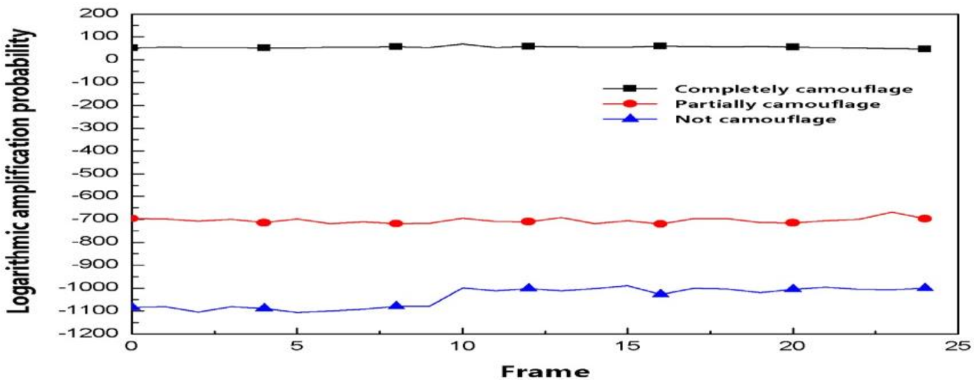


Figure 8: Three camouflage states in the experimental data

The probability density graph shown in Figure 8 is calculated by separately calculating the three types of data to be detected shown in Figure 8. The abscissa represents the number of frames of the data to be detected, and the ordinate represents the logarithmic amplification probability density value. Mathematical statistics on these three curves yield the results shown in Table 3. It can be concluded from the figure and the table that in the state of complete camouflage, the mean value of the curve is 58.2364, which is in accordance with the original camouflage state; in the state of partial camouflage, the mean value of the curve is -727.6583, which is in accordance with the better camouflage state; in the state of not camouflage, the curve The average value is -1005.2298, which is in compliance with the failure camouflage state. The mean data of the curve reflects its camouflage state very well. The fluctuation of the curve is relatively stable, and the variance and the extreme difference are relatively stable, indicating that the model can run smoothly during the dynamic detection process. From the full camouflage state to the partial camouflage state, the arrangement orientation of the camouflage net is changed and the ornaments arranged above are removed, but the curve is already close to the threshold of the failed camouflage state. This indicates that the sample data is not sufficiently expressed for the data space, and the next step should be to supplement the sample data reasonably. Overall, the model provides an accurate reflection of changes in the target camouflage state.

Table 3. Statistical data of three camouflage state probability density curves

Three camouflage states	Statistical data		
	Mean	Variance	range
Completely camouflage	58.2364	5.8953	21.5698
Partially camouflage	-727.6583	6.9555	29.0336
Not camouflage	-1005.2298	8.1569	22.8956

V. CONCLUSION

Camouflage detection is applicable in areas such as visual surveillance, to identify hidden enemies in the Warfield, defective material detection etc. Thus different methods of camouflaged moving object detection in different applications were reviewed. Each method is having its own advantages and disadvantages. Some techniques are cost effective or some are not efficient to detect camouflage moving object. Hence the development of new efficient techniques is necessary for camouflage moving object detection.

VI. AKNOWLEDGMENT

Firstly, Author's would like to pay special thanks to TEQIP CELL, VTU, Belagavi. For their support to carry out Research Project under "Competitive Research Grant", for encouragement

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