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Past, Present and Future Research Direction For Camouflage Image Detection

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Abstract : The camouflage image detection is one of the processing technique in which we want to extract a foreground object from the image, the foreground object is disguised in the image in a such way that it is neither visible nor identifiable through human vision. The concept of hiding foreground object into background surrounding is called camouflage and detecting hidden object from background is referred to as camouflage detection or camouflage breaking or decamouflaging. In this research work we will focus on previous outlined work, present ongoing research, future scope and research directions in camouflage detection.

Keywords : Camouflage, Decamouflage, Camouflage Image Detection

1. INTRODUCTION

Many creatures have got a natural gift with respect to the surroundings and environments to change their body patterns, body texture, colors so that they could survive from their enemies. This concept of changing creature's body color, pattern, texture and hide into the surroundings, environments is called camouflage, like the Lizard, snake, frog, zebra, etc. The beginning of camouflage predates about 20 million years, when to match the background certain cephalopods varied their pigmentation. Change of Color in cephalopods is unequaled in the animal kingdom. In biological camouflage the appearance of body outline is visually determined by background image variables, such as contrast, brightness, edge, size of objects, etc. The concept of Camouflage is an effort to obscure the object and disguised it into background image frame [1]. Concept of camouflage used in following areas: to blend objects from visual surveillance or inspection during quality check, to hide soldier and their weapons at the battlefields and to mix up duplicate product in the original during logistics. Camouflage detection is to reveal the target object which is disguised in a given image.

Camouflage assessment, design and camouflage detections are the two major areas in the camouflage related work. Work of assessment and design the camouflage is easy as compare to identifying the camouflage portion in the given image even more literatures are available in the assessment and design of the camouflage and in camouflage detection also many methods have been proposed with certain condition.Camouflage image detection methods are available in the literature based upon variety of criteria, like motion camouflage, camouflage in a static image, Detecting camouflaged image an unsupervised way [1]. Here at Past, present and future directions of camouflage detection, focus shall be on camouflage detection, means identifying camouflaged portion in given image frame.Application areas would be military, defects in manufacturing product and finding duplicity during logistics. Second section of this paper shall discuss previous work in camouflage image detection, Third section is to present and existing camouflage image detection method and ongoing work, Fourth section is for future scope and direction of camouflage image detection, Fifth section we have a proposed approach suitable with the future directions and conclusion is in the sixth section

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2. PAST OF CAMOUFLAGE IMAGE DETECTION

In this section previous work of camouflage image detections is discussed.

An American artist Abbott Thayer has detected how most of the animals used to be dark on their back to white on their front part of the body and he concluded that this deception makes animal conceal in the background and this is happened because of making variations in the body color pattern,texture . There are three categories of color variation in animals : (*i*) mottle, (*ii*) Disruptive and (*iii*) Uniform [3]. In mottle it is marked with spots or smears of colour on animal body , in the disruptive it is keep changing the coloration of body of animal and in uniformity it does not allow for varying the coloration. So these variations are basically used by animal kingdom to hide themselves from predators and this is the origin of the concept of camouflage. Same concept of camouflage is employed in the battle field, for military camouflage is a technique to conceal them in the background texture so that enemies could not easily detect them and camouflage detection is a technique to find the enemies those are hidden in the battle field or being camouflaged in the texture.

The previous work of camouflage image detection is summarized as follows with method and application areas.

Motion camouflage first suggested by Srinivasan & Davey in the year 1995 here one moving object is to get blended with another moving object and authors discussed planar motion camouflage with respect to a fixed background object. Continuing the work of Srinivasan, et al, Andrew James submitted a thesis on artificial motion camouflage in the Department of Computer Science, University of London.in the year 2003. He stated the basis of motion camouflage that is the object maintains a trajectory such that its image projected onto the predator‘s retina emulates that of a fixed point object. This requires the shadows to be always remaining in between the predator and fixed point and on the constant line connecting the position of the fixed point to the present position of the predator [4].

Nagappa et al described camouflage image detection with the help of Co-Occurrence matrix based texture features.Here first they split the entire image into LXL disjoint blocks (where L could be 2, 4, 8 or 16) and compute invariant central moments up to Kth order (K could be 2, 3, 4….. 10^{th} order is sufficient) for each block and extract texture features of each block, then apply segmentation method to get the camouflaged portion of the image[1] [10].

P. Sengottuvelan et al have proposed a model to detect camouflaged image portion of the background image in an unsupervised way. Means in this model we do not have any knowledge about either the normal background image or the camouflaged image portion. In this model P. Sengottuvelan et al has converted the input image into a grayscale image, then split image into sixteen equal blocks and calculate Gray Level Coouccrenec Matrices value for each block, then mean value is calculated for each Gray Level Coouccrenec Matrix block of the image, then dendrogram is plotted for mean values, then we received the largest individual block and combine the adjacent blocks [5][10].

In wood texture classification, defects and dissimilarity P. A Bautista et al have discussed about Co-occurrence matrices and they focused on the Co-occurrence matrices features which has derived the group of classification of dipterocarpaceae woods. They used domain Linear Vector Quantization as a classifier and very good performance is achieved at the rate of 80% as a classification of camouflaged image. Asymmetric normalized Gray level Co occurrence matrix is used to find the featured parameters. The featured parameters which they used are Entropy, Interia, Cluster Shade, Total energy, Local homogeneity, Maximum Probability, Cluster Prominence and information measure of correlation [6]. Based upon extracts features wood texture discrimination has been carried out.

A mathematical model is suggested by Ariel Trunks’ and Yehezkel Yeshurun in that possible explanation of visual camouflage breaking is described. In this paper they described how some animals prevent their detection from predators by the use of counter-shading, countershading is the texture pattern and coloration of the animal in which

3. PRESENT ONGOING WORK

A first section describes the present status of work in terms of the limitations of existing work, then in the second section we will discuss ongoing work in camouflage identification.

3.1. Limitation of Previous Work

In the previous section we have found the intended work in the identification of the camouflage portion in the image and now we have observed following points as an outcome to enhance and improve the previous camouflage related work.

- It is assume that camouflaged portion is very small means it does not work when large amounts of camouflaged image present in the input image frame.
- Camouflaged object and extraction from the background efficiently in an unsupervised way, which means we do not have any knowledge about either the normal background or the camouflaged object.
- It is also not able to discriminate defective part if more than one type of defect is present in one image frame.
- Researchers assume that camouflage is present in a close neighborhood of the blocks if it is spread in all blocks then cluster analysis would not work.

3.2. Current ongoing research work in camouflage image detection –

In the camouflage related research work, most of the work has been focused on the assessment of the environment and accordingly design the camouflage pattern, but opposed to this research work of detection of camouflage pattern from given image is very less [13].

In 2011, BAE Systems Inc. announced their adaptive infrared camouflage technology, it uses about 1000 hexagonal panels to cover the sides of a tank to disguise in the surrounding. The panels are rapidly heated and cooled to match either the temperature of the vehicle's surroundings, or one of the objects in the thermal cloaking system's "library" such as a truck, car or large rock and making the vehicle invisible [11].

In United States's air force research program they introduced counter illumination camouflage by placing low intensity blue lights on aircraft. As night skies are not pitch black, a 100 percent black-colored aircraft might be rendered visible. By emitting a small amount of blue light, the aircraft blends more effectively into the night sky [12].

In India Nagappa Bhajantri and P Nagabhushan are working on Camouflage image detection methods. They have taken many application areas like finding the duplicity of product, detecting hidden object, camouflage in military etc to identify camouflage portion, but improvement is still needed in many cases. In their recent paper on camouflage "multiple camouflage breaking by Co occurrence and Canny" they describe a frequency domain method would be more efficient to identify small camouflage portions of the target image [15].

In daily science recently published in scientific Reports that how camouflage is helpful to reduce the chance of nesting ground bird's egg being eaten by predators by Jolyon Troscianko and Martin Stevens [18].

4. FUTURE SCOPE OF CAMOUFLAGE IMAGE DETECTION

Camouflage image detection has rich application areas like in Military tactics, in detecting defective product during manufacturing and in detecting duplicate products during logistics. In the future scope previous limitations should be minimized to improve and enhance the camouflage image detection method. In the camouflage image detection artificial and natural camouflaged images are taken for research, which are as follows:

- Natural camouflage in animal or insects, which are naturally used to prevent attacks from predator's like lizard, zebra, from and various insects fig 1 [10].
- To detect a camouflaged image portion and to extract that from the background efficiently in an unsupervised way, which means we do not have any knowledge about either the normal background or the camouflaged object [1].

- Visual image camouflaged (Motion camouflaged), it means hiding foreground objects in the visual background object. In visual surveillance applications camouflaged occurred when texture and color of a moving object is same as the background.
- In artificial Camouflage, texture patterns are used in battlefield to hide soldiers and weapons. Means first camouflage textures are evaluated from the environment and then camouflaged textures are used to design, texture and coloration of military dresses , weapons, armament ,tank vehicle etc. In fig 2 one soldier is having a close textured appearance as the background [10].
- During logistics mixing up of duplicate product in the original set of product, in such way that duplicate product is disguised into the original. In the set of medicine one of medicine is duplicated, but it is difficult to identify which one is duplicate. This is also an example of artificial camouflage.
- Any small defect may appear at the time of manufacturing of any item is also a kind of camouflage because it is not recognized by current quality control system or human vision.

Camouflage image detection requires a robust and consistent object detection method to either confirm or revealing the target object. In the literature, researchers have developed many techniques to detect, prevent and protect the object being camouflaged. However, there are some limitations and assumptions in any technique mechanism.

A critical step in camouflage detection is to detect automatically and reliably extract features from the input camouflaged images.The performance of feature extraction algorithm depends on the quality of the image. In order to achieve this it is essential to incorporate an image enhancement algorithm in the feature extraction module and introduce a new algorithm to improve efficiency in new application areas.

Fig. 1. This figure shows the coloration and texture of insect with surrounding which escapes it from predators [10].

Fig. 2. In above picture one soldier is disguised in the background is also an example of camouflage

5. PROPOSED METHODOLOGY

Texture analysis has been studied and used in various approaches of image processing like performing texture analysis directly upon the gray levels in an image, these include gray level co-occurrence matrix , autocorrelation function analysis, generalized co occurrence matrices, second order spatial averages, and two-dimensional filtering in the spatial and frequency domain. Other approaches texture analysis operates at a symbolic level where a textured image is organized or represented in terms of primitives [17].

Our approach to finding the camouflage in the future perspective shall be based on analysis of texture. Analysis of texture requires the identification of proper attributes or features that differentiate the textures in the image for segmentation, classification and recognition. Previously texture analysis was based on the first or second order statistics of texture then other models were proposed like Gaussian Markov random field and Gibbs random field to illustrate textures. The above approach is best suited when the analysis of small texture is very less. Wavelet transform and Gabor filter can be used to detect camouflaged portion in a larger image frame which will overcome the method suggested by Gaussian Markov random Field and Gibbs Random Field [16].

Wavelet transform and Gabor filter methods based on multiresolution analysis proved to be good and satisfactory in texture analysis. Again in case Gabor filter output with this method for texture analysis are not mutually orthogonal which affects texture features and that reduce the applicability of this method in texture synthesis. Wavelet transform can be used to reduce the problem of Gabor filter, because it gives a precise framework for the analysis of texture. One more benefit of wavelet transforms over Gabor filter is that low and high pass filters remain same between consecutive scales. Thus wavelet statistical attributes and the wavelet Co occurrence attribute can be used for the texture classification and characterization.

In our methodology we want study of image segmentation which is based on study of texture segmentation and this we can achieve through a thorough study of texture analysis, then require to employ image decomposition methods which consist of camouflage portion now it is turn to combine these similar camouflage portions with the help of clustering techniques in this way we can identify the camouflage portion in given image\object. In this way we proposed wavelet transform for the texture segmentation in the given image frame to detect camouflaged portion by comparing Co occurrence matrix derived from discrete wavelet transform.

5. CONCLUSION

In this way we have seen previous work, present ongoing and future direction in the field of camouflage image detection. We have found different methods and application areas and we also discussed their limitations based upon this now it is time to have new robust and enhance camouflage breaking method which can overcome the limitations discussed in the past.Here in this paper authors have proposed wavelet based method to decompose and analyze the image to get the better result.

6. REFERENCES

1. Smith, T.F., Waterman, M.S.: Identification of Common Molecular Subsequences. J. Mol. Biol. 147, 195—197 (1981)
2. P. Nagbhusan, Nagappa U. Bhajantri: Identification of camouflaged defects through central moments and hierarchical segmentation. International Journal of Tomography & Statistics issue winter (2008)
3. Nagappa U. Bhajantri and P Nagabhusan "Camouflage Defect Identification: A Novel Approach" 9th International Conference on Information Technology (ICIT'06) 0-7695-2635-7/06 (2006)
4. Lydia M. Mother, Chuan Chin Chiao, Alexandria Barbosa, Roger T. Hanlon: Color Matching on Natural substrates in Cuttlefish, Sepia Officinalis. J. Comp Physiol (A) 2008: 194 577-585 published online Springer Verlog (2008)
5. Andrew James Anderson: Sensorimotor neural systems for a predatory stealth behavior ca camouflaging motion. ISSN 1470-5559 Dec (2003).
6. P. Sengottuvelan, Amitabh Wahi and A. Shanmugam: Performance of Decamouflaging Through Exploratory Image Analysis. IEEE ICETET (2008).
7. P. A. Bautista and M.A. Lambino: Co Occurrence Matrices for wood texture Classification. The samahang Pisika Visayas at Mindanao SPVM Iligan (2001).
8. Ariel Trunks' and Yehezkel Yeshurun: Convexity based Visual Camouflage Breaking. School of Computer Science, Tel-Aviv University, Tel-Aviv 69978, Israel. (2003).
9. Song Liming and Geng Weidong: A new camouflage Texture Evaluation Method Based on WSSIM and nature Image features. IEEE 978-1-4244-7874-3 (2010).

10. Sujit K Singh, Chitra Dhawale and Sanjay Misra: Survey of Object detection methods in camouflage image. IERI Procedure 4 351-357 (2013).

11. Kent W. McKee and David W. Tack: Active Camouflage for Infantry Headwear Applications. Human Systems. Pp. 10–11 (2007).

12. Perry, Dominic. : DSE BAE eyes Adaptive camouflage to cloak helicopters. Flightglobal. Retrieved 18 June (2012).

13. Amy Whicker Camouflage Breaking A Review of Contemporary Techniques CSCE 867.

14. Jiri F. Urbanek, Jiri Barta, Jozef Heretik, Josef Navratil and Jaroslav Prucha Cybernetic Camouflage on Human Recipient - Visual Illusion INTERFACE ISBN:978-960-474-262-2 Recent Researches in Circuits, Systems, Electronics, Control & Signal Processing.

15. P. Nagbhushan, Nagappa U Bhajantri: Multiple Camouflage Breaking by Co Occurrence and Canny. DOS Computer Science, University of Mysore Digital Repository of Research Innovation and scholarship Eprint.uni-maysore.ac.in 13665 (2013).

16. Nicu Sebe and Michael S. Lew Wavelet Based Texture Classification Leiden Institute of Advanced Computer Science. Netherlands.

17. M. Tuceryan: Moment Based Texture Segmentation. In Pattern Recognition Letters, vol. 15, pp. 659-668, Elsevier, July (1994).

18. Jolyon Troscianko and Martin Stevens Daily Science University of Exeter (2016).