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RESEARCH PAPER

Vehicle Tracking System Using Discrete Wavelet Transformation

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ABSTRACT

Given the significance of speed in the realm of the Internet and the large number of cyberattacks, verification systems that are fast, accurate, and convenient are required. Although it is possible to manipulate Image Recognition verification, it can still be of some help against any form of fraudulent scheme. The present study proposes a model of pixel-wise operations for identifying a location point. The computer vision is not limited to pixel-wise operations. It can be more complicated than image processing. First, unstructured image segmentation is taken via K-Means Clustering Algorithm. Then, after completing the preprocessing step, the segmented image is extracted from the surveillance cameras to identify expressions and vehicle images. Raw images of the surveillance camera comprise the images of individuals and vehicles that are classified by means of DWT. Further, the images that represent the appearances are taken by Smart Selfie Click (SSC). These two features are extracted in order to identify whether or not a vehicle should be permitted into the campus, thus making the verification possible. These two images are nothing but reliable objects extracted and used for location identification.

KEYWORDS: *Discrete wavelet transform; Image segmentation; K-Means clustering; Smart selfie click.*

1. Introduction

Image Processing and Computer Vision are the two most essential techniques in Vehicle Tracking Systems. Computer Vision utilizes the basic Image Processing Algorithm (IPA) as its active backbone from which the vehicle tracking application is developed and then, is pushed onward as a product or service. Computer Vision interprets two-dimensional images to typically identify or track single or multiple objects. To this end, Artificial Intelligence methods, such as pattern recognition and machine learning, used to predict their motion or behavior are frequently utilized. Image Processing is a systematic transformation of the input image into an output image. Besides, other specific information that might be of help in transformation is extracted from the image. Image processing incorporates rotation, color, scale changes, crop, filter effects, etc. Computer vision is the procedure for investigating image processing and machine learning methods are used to mine information from any image other than its properties. For instance, the number of windows in a structure can be detected by computer vision. Of note, the output of a computer vision method is not limited to merely a transformed image. The functionality of computer vision is partly similar to human intelligence; in other words, similar to a person who stores visual information such as facial expression and features of others, computer vision can also store and extract such similar information from images. Computer vision algorithm can be trained to decode meanings from images or other already existing information. Similar to human intelligence that can recognize people by their face, computer vision algorithms can be trained to recognize outlines and differentiate one object from another. Therefore, image processing takes an image as an input and outputs an image as a result of some defined transformations. However, computer vision takes an input image and outputs the desired information in which machine learning algorithm is accomplished.

The rest of the present paper is structured as follows: First, a general introduction is given. Section 1 deals with Unstructured Image Segmentation by means of K-Means Clustering Algorithm. Section 2 discusses Discrete Wavelet

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Transformation. Section 3 introduces the features of image extraction using Discrete Wavelet Transformation. Section 4 shows experimental result. Finally, Section 5 concludes the study.

2. Unstructured Image Segmentation via K-Means Clustering Algorithm

Image Segmentation is a method of subdividing an unstructured image into many slices. It is used to facilitate and/or alter the representation of an image into a tiny part, whose importance lies in the feasibility of applying analysis again in the future. In addition, it is mainly used to add objects or limits to images. In the exact sense of a word, image segmentation is the process of assigning a tag to each pixel in an image and those pixels with similar tags share certain characteristics. Image segmentation results in a set of segments that generates a complete image or a whole shape extracted from the image. Each pixel in a region shares some similarities with several features or determines some possessions such as color, intensity, or texture. By applying K-Means clustering algorithm, similar P clusters were partitioned into C clusters in which each pixel belongs to the cluster with almost the same mean as other clusters. The mentioned method produces exact P clusters, unlike those clusters that are widely distant from each other. The optimum number of P clusters with a considerable distance from each other remains unknown and it can be determined using unstructured image data. The present study utilizes K-Means clustering and aims to minimize the whole intra-cluster variance or squared error function.

K-Means Clustering Function K is given below:

$$\sum_{k=1}^{c}\sum_{i=1}^{p}\left\| \boldsymbol{l}_i^{(k)} - \boldsymbol{m}_k \right\|^2$$

where

c is the number of clusters, p the number of instances, m the centroid cluster for j, and l the instance i.

The algorithm of K-Means Clustering is given as follows:

1. Cluster the image pixel data p_i into C groups, where C is predefined.
2. Select c points randomly as cluster centers.
3. Assign each pixel to its neighboring cluster center according to the Euclidean distance function.
4. Evaluate the centroid or mean of all image pixel substances in each cluster.
5. Iterate Steps 2, 3, and 4 up to a point when each cluster would contain the same opinions as others in successive iterations.

3. Discrete Wavelet Transformation

Wavelet is more beneficial than any other transforms such as DFT and DCT. Discrete wavelet is frequently used as an image processing technique and has the capacity to provide roomy and frequent representations of the image. It is also used for feature extraction. This feature is a classification of the input data into numerous types of division into space and frequency. It allows separating the frequency component familiarization by means of intrinsic deformations due to illuminations into certain sub-bands. While using the discrete wavelet, the DWT [4] is pillared on the facial features extracted from Wavelet Transform. Wavelets can be used to correctly develop image registration by considering both special and spectral information. As shown in Figure 1, at each level of the wavelet classification, four new images are discovered from the original N x N pixel image. The size of the new image is reducible to ¼ of the whole size. The new size is N/2 x N/2. The new images are LL, LH, HL, and HH. The LL image considered as a reducible image retains most details. The LH image has horizontal edge feature, while the HL has the vertical edge feature. The HH image contains only high-frequency information so that it is not suitable for registration. In wavelet transform, only the LL image is used.

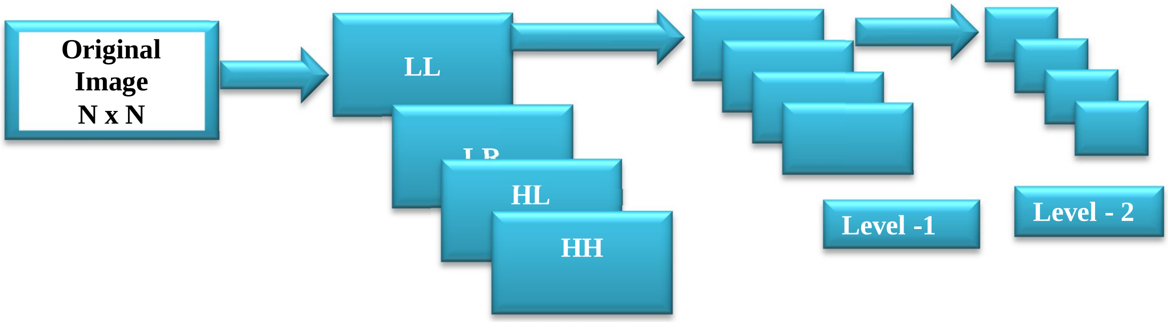

Fig. 1. Discrete wavelet transformation

The above picture indicates the segmentation process by applying the 2D wavelet transform to a face image. The image is divided into four sub-bands of images. Accordingly, the two levels of the wavelet decomposition can be obtained by means of the wavelet transform with low frequency. In the sub-band, LL corresponds to the low-frequency components in both vertical and horizontal directions of the original image. Therefore, it is the low-frequency sub-band of the original image.

The sub-band LH corresponds to the low-frequency component in the horizontal direction and high-frequency components in vertical directions, respectively. Therefore, to technically change the image, the sub-band LH maintains the details of the vertical edge. Therefore, the sub-band LL will be the most stable one if wavelet transforms are applied to separate features of images.

4. Features of Image Extraction Using DWT

The present study aims to find solutions to the problems that a majority of crowded cities, organizations, and malls are facing. This problem is generally observed in organizations with inadequate space in their parking lots while unauthorized vehicles are parked in a parking lot and there is no room left for valid ones to park. To carefully study the problem, a database which consists of valid vehicles that belong to the organizations' employees is taken into consideration. In order to avoid unnecessary parking in no-parking zones, security guards manually take images of the vehicles and identify the vehicle and its owner. Manual identification is a quite tedious and time-consuming process with the least desired results. Furthermore, new problems may arise since a large number of images are captured by unconstrained conditions taken by nonprofessional users. These images taken by nonprofessional individuals can be considered as unstructured images. These unstructured images must be passed to a phase called noise reduction where they become structured to be used for feature extraction. Here, the methodology is applied in two approaches for identifying the vehicles: a segmentation of the vehicle image for feature extraction and a text-based segmentation for identifying the vehicle registration plats. To avoid this manual tedious problem, a feature extraction algorithm is considered and the images of bikes or cars are regarded as raw inputs. As shown in Figure 4.1, there are four images that are nothing but features. One of these four images is taken and checked with the database. The images in the database and the extracted images are checked for resemblance and similarity. If any resemblance between the images is observed, the vehicle is treated valid, and vice versa. In the second approach, a separate set of characters/pixels is directly identified from the text region and classified to determine the performance of text segmentation. Conducting a minor analysis is required to calculate whether the pixel identified is a pixel/character or of an image. SIFT [1] (Scale-Invariant Feature Transform) and SURF [2] (Speeded up Robust Features) can also be employed. To achieve the best results, multiple feature extraction is performed in order to retrieve the characteristics from the text/background. The text-background differences must be identified. To this end, that computer vision algorithms are used to ensure real-time monitoring of an organization. In addition, it can be programmed to transmit live video streaming over the Internet that can be remotely viewed and identified. The image from the surveillance cameras are considered as the inputs. The image is divided into different sub slices. Since each slice is unstructured, it may not be utilized. In addition, any noise must be removed. Therefore, to avoid this noise, a new way of identifying the face in the image called face recognition is proposed. Once a human face is identified, the required image is captured and sent for verification to specify whether the image belongs to a valid user or not. The process of capturing the image is also known as Smart Selfie Click (SSC). The SSC is compared with the images of the database and verified for a valid user.

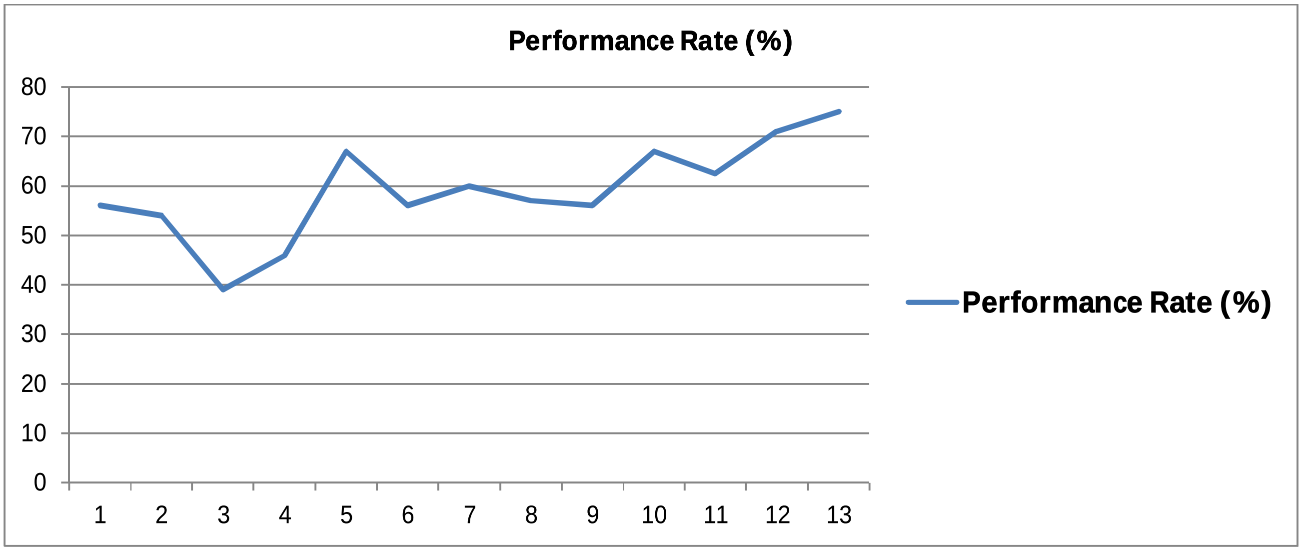

Fig. 2. Performance rate of object identification

A feature is only small unique part of the data extracted from a specific object. This small part of data can be an image, another image segment, or a specific shape such as a line, edge, etc. As shown in the Figure below, the raw image of a bike is given as an input to the feature extraction algorithm. The extraction procedure will output a vector which contains a list of features called feature vectors. The features are extraction-procedure one-dimensional array that draws a strong depiction of objects.

As shown in Figure 3.1, a raw image of the bike is given as an input to the feature extraction algorithm and it generates a vector of images, which includes different parts of the bike. These different images are merely features.

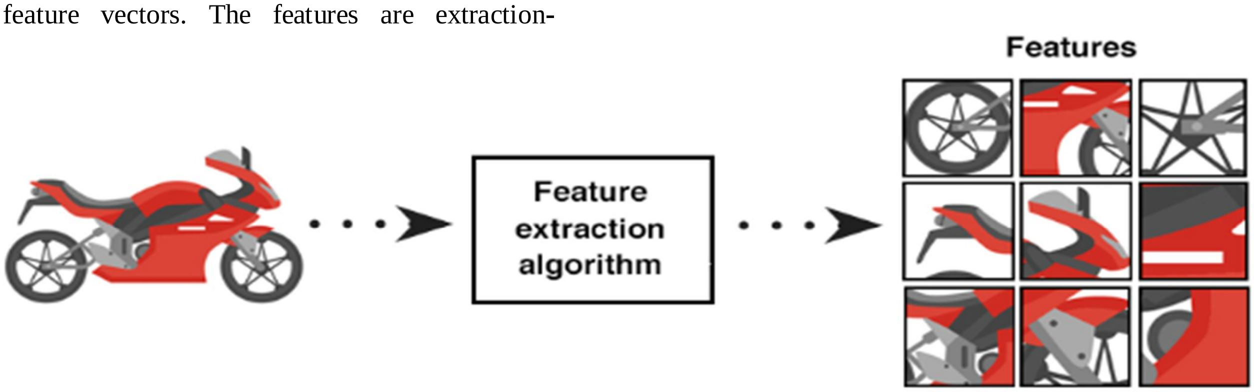

Fig. 3. Illustration of feature extraction

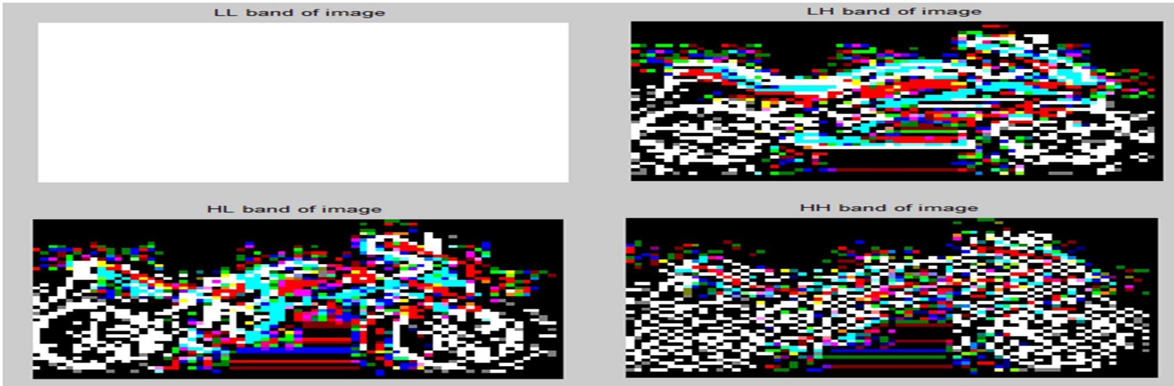

Fig. 4. Motor cycle image using discrete wavelet transformation

5. Experimental Result

The phenomenon of feature extraction of motor cycle image reliability is the probability that image segmentation would work properly in a certain partition of the image and for a specific amount of time. The following formula is used to the success rate of testing a sample of all available input segmented images.

$$\textbf{Probability} = \frac{\textit{Number of segmentation erros}}{\textit{Total number of cases under consideration}}$$

A space with a set of all the possible input image segments is called the input image space. Also, the reliability of image segmentation needs to be determined. This study finds output segmentation images space from the given input image segmentation space using segmentation technique.

Tab. 1. Performance rate of object identification

S. No.	Segmentation of Input Images for Features Extractions	Recognition of the Required Object Identification	Performance Rate (%)
1	9	5	56
2	11	6	54
3	13	5	39
4	15	7	46
5	12	8	67
6	16	9	56
7	10	6	60
8	14	8	57
9	18	10	56
10	6	4	67
11	8	5	62.5
12	7	5	71
13	4	3	75
14	5	4	80

6. Conclusion and Future Perspectives

The present study aimed to extract the feature of a given input from the surveillance cameras. The method of feature extraction is of importance in the artificial intelligence domain. This model can be used for extracting the required image from a captured image. In future, we will try to develop more efficient methods for reducing noise. This model eliminates the drawbacks of traditional image processing. A pixel-wise operation is required to identify the location point extraction. Other major fields that can benefit from digital image processing are medical field, remote sensing, pattern recognition, color processing, etc.

References

[1] Karami, E., Shehata, M., Smith, A.: Image identification using SIFT algorithm: performance analysis against different image deformations, (2017).

[2] Bay, H., Tuytelaars, T., Van Gool, L: SURF: speeded up robust features,. Springer, Heidelberg, (2006), pp. 404-417.

[3] Shaveta Thakral, Pratima Manhas, Image processing by using different types of discrete wavelet transform. Conference: ICAICR-2018(shimla), Shimla, (2018).

[4] Ahmed A. Abdelwahab and Lobna A. Hassaan, A DISCRETE WAVELET TRANSFORM BASED TECHNIQUE FOR IMAGE DATA HIDING, 25th NATIONAL RADIO SCIENCE CONFERENCE (NRSC 2008) C01 1 March 18□20, Faculty of Engineering, Tanta Univ., Egypt (2008).

[5] Q. Zang, Wavelet Network in Nonparametric Estimation. IEEE Trans.

Neural Networks, Vol. 8, No. 2, (1997), pp. 227- 236.

[6] R. Ashraf and M. Akbar, “Absolutely lossless compression of medical images”, 27th Annual Conference Proceedings of the 2005 IEEE Engineering in Medicine and Biology, IEEE, (2005), pp. 4006-4009.

[7] S. Murali Mohan and P. Sathyanarayana, “FPGA Implementation of Hybrid Architecture for Image Compression Optimized for Low Power and High Speed applications”, International Journal of Scientific & Engineering Research, Vol. 4, No. 5, (2013).

[8] Z. Ye, H. Mohamadian and Y. Ye, “Information Measures for Biometric Identification via 2D Discrete Wavelet Transform”, Proceedings of the 3rd Annual IEEE Conference on Automation Science and Engineering, CASE’, (2007), pp. 835-840.

[9] S. Osowski, R. Waszczuk, P. Bojarczak, “Image compression using feed forward neural networks — Hierarchical approach” Lecture Notes in Computer Science, Book Chapter, Springer-Verlag, Vol. 3497, (2006), pp. 1009- 1015.

[10] Wen-Bing Tao Jin-Wen Tian Jian Liu "Image segmentation by three-level threshold based on maximum fuzzy entropy and genetic algorithm [J]" Pattern Recognition Letters Vol. 24, (2003), pp. 3069-3078.

[11] Lu Ming, 3rd International Conference on Advanced Computer Theory and Engineering (ICACTE), 10.1109/ICACTE.2010.5579114, IEEE, (2010).

[12] Yi Yang, Sam Hallman, Deva Ramanan, Charless C. Fowlkes. "Layered object Models for Image Segmentation" (2009-2010).

[13] DR.S.V. Kasmir Raja, A. SHaik Abdul KHadir, DR.S.S. Riaz Ahamed. "Moving Toward Region-Based Image Segmentation Techniques: A Study". Journal of Theoretical and Applied Information Technology, (2005-2009).

[14] K. H. Talukder and K. Harada, “Haar Wavelet Based Approach for Image Compression and Quality Assessment of Compressed Image”, IAENG International Journal of Applied Mathematics, (2007).

[15] Krishna Kant Singh, Akansha Singh. "A study of Image Segmentation Algorithms for Different Types of Images". IJCSI International Journal of Computer Science Issues. Vol. 7, No. 5. pp. 1694-0784.

[16] Suphakit Niwattanakul, Jatsada Singthongchai, Ekkachai Naenudorn, Supachanun Wanapu, IAENG International Conference on Internet Computing and Web Services (ICICWS'13) At: Hong Kong, (2013).

[17] https://machinelearningmastery.com/object-recognition-with-deep-learning/

[18] F. C. Monteiro and A. Campilho, "Watershed framework to region-based image segmentation," in Proc. International Conference on Pattern Recognition, ICPR 19th, (2008), pp. 1-4.

[19] M. J. Islam, S. Basalamah, M. Ahmadi, and M. A. S. hmed,"Capsul image segmentation in pharmaceutical applications using edge-based procedures," IEEE International Conference on Electro/Information Technology (EIT), (2011), pp. 1-5.

[20] M. Sharif, S. Mohsin, M. J. Jamal, and M. Raza, "Illumination normalization preprocessing for face recognition," in Proc. International Conference on Environmental Science and Information Application Technology (ESIAT), (2010), pp. 44-47.

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