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A NAVAL IMAGE CLASSIFICATION USING ORTHOGONAL FEATURE DISTRIBUTION MATRIX

V.Padmanabhan*[1], Dr.M.Prabhakaran[2]

[#]Research Scholar, Department of Computer Science, Karpagam University, Coimbatore, Tamil Nadu, India

[*]Assistant Professor, Department of Computer Science, Government Arts College, Ariyalur, Tamil Nadu, India

[1]padmanabanphd@gmail.com

Abstract

The task of image classification has been studied in many ways using variety of features like shape, color, geometric, robust and etc. but the classification process uses only the features contained in more volume in a region but missing the features distributed throughout the image. We propose a new approach for image classification, using orthogonal feature distribution matrix. The orthogonal feature distribution matrix represents set of feature points around different axes of the image spectrum where there is ineligible volume of feature presents. The proposed method splits the axes into sixteen and at each axes, feature points are identified and the features of those points are converted into orthogonal feature distribution matrix. The OFDM (Orthogonal Feature Distribution Matrix) simplifies the process of classification, where it could be executed with least processing time and avoids missing values. In earlier approaches there are situations where the algorithm misses sheared features on classification, where as in our approach the features which gets sheared also will be obtained to produce more efficient classification. The proposed method has produced efficient classification both on time and space complexity with higher rate of classification accuracy.

Key Words: Image classification, Features, OFDM, classification accuracy.

I. Introduction

Image classification is the process of obtaining similar or same image from large image data base or classifying a single image towards a group of categorical images. Whatever it is , the image classification process has certain unavoidable steps where the image will be preprocessed to remove the noise present in the image or removing the blur from the image. Then the features of the image will be extracted using which the image is classified. For classification there are many methods available, the simple one is the color based classification, where only the color values are used to classify the image over high dimensional image data set.

There are other measures or features used like shape, volume; density and etc are used for classification. However to compute the different between two pixels of the image, there are many measures used like Hamming distance, Euclidean distance, also few other matrix are used. The classification is performed by computing any form of relevancy with set of feature vectors in the literature. There are many features has been used in the literature to compute the distance for classification.
The ultimate aim of this research is to find an optimum and suitable methodology to represent the image features in least measure so that to reduce the computation time with high rate of accuracy in classification. Because of the image data base has millions of image, obtaining relevant image from the data base is a challenging one and the time complexity has to be reduced. Producing more similar and relevant image is the main aim of this research using a naval approach.

The efficiency of classification is depending on the classification accuracy and overlap, false positive results. The algorithm should produce more classification accuracy with less false positive results. Efficient indexing and retrieval of large number of color images, classification plays an important and challenging role. The main focus of this research work is devoted to finding suitable representation for images and classification generally requires comparison of images depending on the certain useful features.

II. Background

There are many approaches has been discussed in literature, we discuss few of them related to our problem statement.

Efficient HIK SVM Learning for Image Classification [1], present a new svm training method called intersection coordinate descent which is deterministic and faster than general svm solvers. Also the ICD has been extended in order to increase the efficiency of training. The proposed method has been analyzed theoretically.

A feedback based image classifier [2], is proposed which uses the histogram intersection method with user feedback. The method provides an interactive approach for image classification to satisfy the user requirements. The method iteratively accepts the user feedback and returns the results according to them. This improves the classification accuracy and works as a learning system.

Classification of Remote Sensing Image Areas Using Surf Features and Latent Dirichlet Allocation [6], we are interested in classifying the satellite images into 3 different regions as water, urban and greenland. The process involves two steps, first training the class images and second classifying the testing image which consist of all the classes based on training image. Speed up Robust Features (SURF) is used to enhance the performance over low level feature like mean and standard deviation. Topic modelling concept is used to obtain Bag of Features (BoF) with Latent Dirichlet Allocation (LDA) algorithm. Threshold value for each class is obtained from BoF and compared with testing image feature values in order to classify it.

Vector-valued images such as RGB color images [12], propose a new notion of treating vector-valued images which is based on the angle between the spatial gradients of their channels. Through minimizing a cost functional that penalizes large angles, images with parallel level sets can be obtained. After formally introducing this idea and the corresponding cost functional, we discuss their Gateaux derivatives that lead to a diffusion-like gradient descent scheme. We illustrate the properties of this cost functional by several examples in denoising and demosaicking of RGB color images. They show that parallel level sets are a suitable concept for color image enhancement. Demosaicking with parallel level sets gives visually perfect results for low noise levels. Furthermore, the proposed functional yields sharper images than the other approaches in comparison.

Image Quality Assessment for Fake Biometric Detection [13], present a novel software-based fake detection method that can be used in multiple biometric systems to detect different types of fraudulent access attempts. The objective of the proposed system is to enhance the security of biometric recognition frameworks, by adding liveness assessment in a fast, user-friendly, and non-intrusive manner, through the use of image quality assessment. The proposed approach presents a very low degree of complexity, which makes it suitable for real-time applications, using 25 general image quality features extracted from one image (i.e., the same acquired for authentication purposes) to distinguish between legitimate and impostor samples.

Coding Visual Features Extracted From Video Sequences [14], propose, for the first time, a coding architecture designed for local features (e.g., SIFT, SURF) extracted from video sequences. To achieve high coding efficiency, we exploit both spatial and temporal redundancy by means of intra frame and inter frame coding modes. In addition, we propose a coding mode decision based on rate-distortion optimization. The proposed coding scheme can be conveniently adopted to implement the analyze-then-compress (ATC) paradigm in the context of visual sensor networks. That is, sets of visual features are extracted from video frames, encoded at remote nodes, and finally transmitted to a central controller that performs visual analysis. This is in contrast to the traditional compress-then-analyze (CTA) paradigm, in which video sequences acquired at a node are compressed and then sent to a central unit for further processing. In this paper, we compare these coding paradigms using metrics that are routinely adopted to evaluate the suitability of visual features in the context of content-based retrieval, object recognition, and tracking.

The above discussed methods used different features and measures but they miss the distributed features at different orthogonal axis of the image.

III. Proposed Method

The proposed method has three stages namely; preprocessing, OFDM computation, image classification.

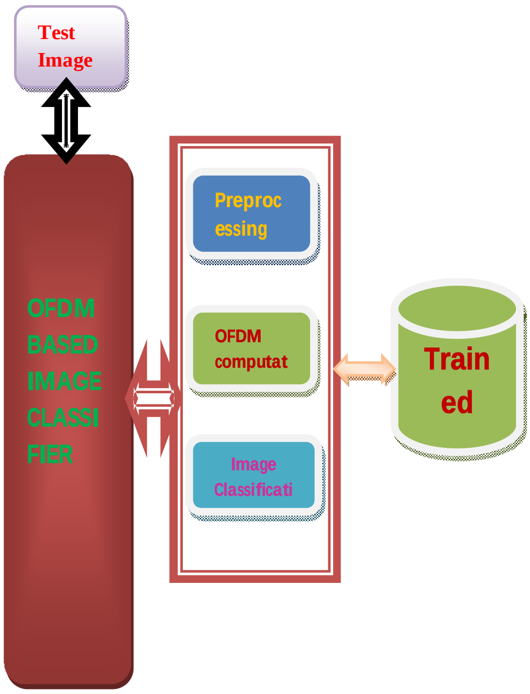


Figure1: Proposed system architecture.

A. Preprocessing:

The input image at both training and testing phase is preprocessed to enhance the image quality. We generate gray scale values are then passed to the edge detection and we used sobel edge detector for the purpose of edge detection. The output image of the edge detection process is used to increase the intensity values of the original image. We increase the intensity of the detected edges in the original image.

Algorithm:
Step1: start
Step2: read input image img.
Step3;convert image into gray scale
Compute size of image img [w,h]=size(img).
For each pixel from img
$Img_{(i)}$= 0.2989 * R + 0.5870 * G + 0.1140 * B.
end
Step4: stop.

B. OFDM Computation:

At this phase, the image geometry is split into 18 orthogonal layers and features of each layer are extracted. Each pixel values from each layer is extracted and we identify set of pixels as interest pixels which has more surrounding pixels. From identified set of pixels, we compute the distances of each pixel with more values are computed. From computed distances, we compute the area affected and store to the OFDM matrix. So that the OFDM consists of set of coverage values which represent the features of different orthogonal layers.

Input: Preprocessed image img.
Output: OFDM
Step1: initialize distance matrix Dm, Ofdm.
step2: split image region into 18 layers Ol.
step3: for each layer l from Ol extract features i.e. pixel values ps = $\int_{width}^{Height} \emptyset(Img(i) > 0)$
Randomly select set of points and compute surrounding pixel values.

RPs = $\sum_{1}^{N} \Delta(Img(i) \in P(i) > 0)$

$\Delta -$
$set\ of\ pixels\ has\ sorrounded\ with\ more\ pixel\ values.$
compute distance of pixels from selected pixel.
Dm(i) =$\int Rps - P(i)$
end.
step4: for each index of Dm compute the area
Ofdm(i) = Area(Dm(i)).
end.
Step5: stop.

C. Image Classification:

Image classification is performed using the Ofdm matrix which is computed earlier. The process of preprocessing and Ofdm computation is performed for the input image Img and with the compute Ofdm we compute the similarity measure using distance computation. Each training value has set of area of feature set and the input feature set Ofdm is compared with that. We compute the similarity value using the Euclidean measure with all the images and their feature set. Finally set of image is selected as relevant and resultant image according to the closeness value.

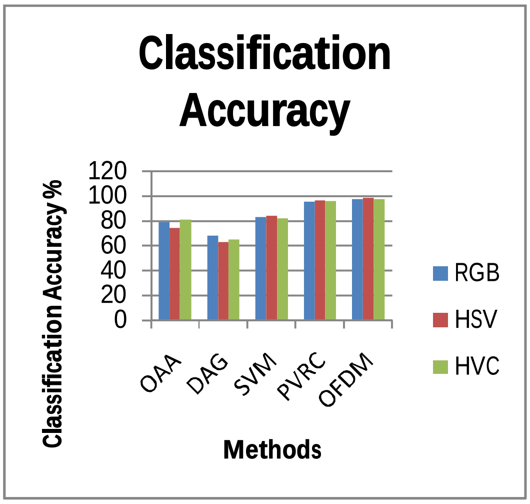
Input: Ofdm, Training set Ts.
Output : set of resultant image RIS.
step1: for each feature vector v from Ofdm
for each feature vector v1 from Ts
for each feature value U from V1
compute Euclidean distance D =
$\sum_{U}^{V1} Dist(Ts(V1, U) - Ofdm(v)$
end
end
end
Step2: Sort Ts according to D.
Step3: Select top few results RIS.
Step4: stop.

IV. Results And Discussion

The proposed orthogonal feature distribution matrix based classifier has produced efficient results than other classifier. We have evaluated the proposed algorithm with different methodologies discussed earlier.

Color Space	OAA	DAG	SVM	PVRC	OFDM
RGB	79	68	83	96	98
HSV	74	63	84	97	98.6
HVC	81	65	82	96.5	97.9

Table1: shows the accuracy of classification with different algorithms.



Graph1: Comparison of classification accuracy.

The graph 1, shows the classification accuracy achieved by different methods. It shows that the proposed OFDM approach has produced efficient classification compared to other methods. Also it produced less false positive results.

V. Conclusion

We proposed a naval orthogonal feature distribution matrix to classify the color images using feature distribution, which uses intensity and color values to generate the Ofdm matrix using which the similarity of images are computed. The computed similarity value is used to classify the images. The proposed method has produced better results than other classifier with low time and space complexity.

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