International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 1, January - 2014

# Detection of an Object by using Principal Component Analysis

[1.] G. Nagaveni , [2.] Dr. T. Sreenivasulu Reddy
[1.] M.Tech, Department of EEE, SVUCE, Tirupathi, India.
[2.] Assoc. Professor, Department of ECE, SVUCE, Tirupathi, India.

## Abstract

This paper represents the object recognition from different categories of images by using principal component analysis. The objects are represented by internal or external descriptors. The descriptors are found by using signature and principal component analysis .The signature features are helpful to distinguish the set of objects based on their external shape but when it fails, the principal component analysis is used instead. The proposed method is implemented, trained, and tested using matlab on a set of images. The results show the effectiveness of the proposed system in recognizing the objects.

## Keywords

Template matching, PCA, signature.

## Introduction

Object recognition system are used in many application like robotics, optical character recognition, object clustering and tracking, image watermarking, image panoramas [1, 2 ,3]. Features are used to distinguish and recognize objects. This process is completed by comparing the extracted features with previously stored and known features of different objects. The above applications needs a computer program, so they can be able to recognize different types of objects as explained in [1, 2 ,4]. The work based on Gabor wavelet for object recognition consists.

(a) Salient point detection to overcome the strategy of finding the objects present in the particular part of the image.

(b) patch extraction to extract the sub square images from the original images over the salient points.

(c)Feature extraction to handle various complex images which looks different in different circumstances.

The images can be discriminated by Gabor wavelet features irrespective of their localization. The obtained features are distinguished by SVM classifier. The object recognition task that is to recognize object or non object.

## Proposed Method

The proposed system consists of extracting signature features and this method works very well in the cases, like when their is no distortion and occlusions. In this case PCA is considered as an additional feature when it fails in recognizing the object. The paper is organized as follows: In section I a definition of template matching has been presented. In section II the overall system scheme has been started. Extracting signature features has been given in section III. The principal component analysis has been given in section IV. Finally section V illustrates the discussion and results.

### *1. Template Matching*

Template matching is a process of finding the location of a sub-image (i.e. template) inside another big image. It is the main technique and an essential task in image analysis application. The features extracted from the boundary of objects are compared with the previously stored known features for recognition purpose [5]. It is also called features matching because extracted features are matched with the known features. Euclidean distance is measured between the object features and stored features and then calculate the matching between the object features and the stored features. The Euclidean distance between points p and q is the length of the line segment.

In Cartesian coordinates, if $P = (p_1,p_2,\text{------}p_n)$ ,

$$Q = (q_1,q_2,\text{-------}q_n)$$

are two points in Euclidean space, then distance from p to q or q to p is given by,

$$d(p,q) = d(q,p) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \ldots + (q_n - p_n)^2}$$

$$\therefore d(p,q) = \sqrt{\sum_{i=1}^{n} (q_i - p_i)^2}$$

When a match is found, it is deemed to be recognized.

## 2. Block Diagram of the System

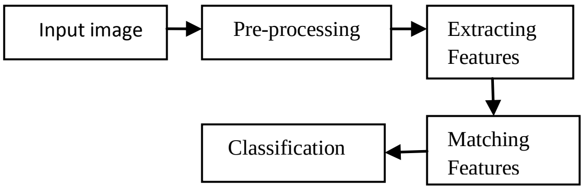


Figure1: block diagram of the system.

Here the input is an image. In pre-processing step the region of interest (ROI) is determined, then the given input image is converted from RGB to gray scale image and then to binary image. In third extracting features step, the features were extracted for all the objects that have been obtained from the previous stage. The features we have got are matched with the features of the objects. The matching between features is carried out based on Euclidean distance metric, and they are used to decide whether the object is recognized or not. Finally the system classifies the object and put a descripition according to the object types.

### An Overview

In order to classify the objects good features or a set of features are needed. To recognize the objects, the signature feature is one of the most useful features. When signature comes to the grief, the principal component analysis is used. In this case PCA [6, 7, 8] supports the signature feature when it fails in recognizing the object. Because the signature of the object is an external descriptor, which is heavily effected by the noise. PCA is an internal descriptor, so PCA is adopted, which will describe the object as a whole image.



## 3. Signature Feature Extraction

The signature is an one-dimensional function, that can extracted by several method. Here we used the distance from the centroid to the boundary of the object as a function of angle .It reduces the boundary dimensions from 2D to 1D signature function. The signature features relies on scaling and it is size and rotation variant. The signature values are normalized. These points were saved for each object as a vector feature. Further it will be used for recognition and matching.

## 4. Principal Component Analysis

Analysis of multivariate data plays a key role in data analysis. Multivariate data consists of many different attributes or variables recorded for each observation. It is hard to visualize multidimensional space. Principal component analysis (PCA) is a famous multivariate technique and is mainly used to reduce the dimensionality of multi variables to two or three dimensions.

PCA summarizes the variation in a correlated multi variables to a set of uncorrelated variables, each of which is a particular linear combination of the original variable. The extracted uncorrelated variables are called principal components (PC) [12, 13, 14]. The number of Principal components is less than or equal to the number of original variables.

Principal components are found by calculating the eigen vectors and eigen values of the data covariance matrix. Let A be an n**x**n matrix. The eigen values of A are defined as the roots of

determinant(A-λI) = |(A-λI)| = 0

Where I is an identity matrix. This equation is called characteristic equation. Let λ be an eigen value of A. Then there exists a vector x such that

$$Ax = \lambda x$$

This vector x is called an eigen vector of A associated with the eigen value λ.

The covariance values are computed using following equation:

$$S_{xy} = \frac{1}{n-1}\left(\sum_{i=1}^{n}\left(X_i - \bar{X}\right)\left(Y_i - \bar{Y}\right)\right)$$

Here n represents sample size.

The images are all of the same resolution and are all equivalently framed. Each pixel can be considered a variable thus we have a very dimensional problem, which can be simplified by PCA. The main goal of the PCA is to reduce dimensionality by extracting the smallest number of components that account for most of the variation in the original multivariate data and to summarize the data with little loss of information. To determine the most discriminating features between images of components PCA has been used. PCA has been called one of the most valuable results from applied algebra.

Formally, in image recognition an input image with n pixels can be treated as a point in an n-dimensional space called the image space. Most of the image pixels will be highly correlated. Thus we need to consider how to achieve a reduction in the number of variables. PCA helps in reducing the dimensions of the variables.

PCA can supply the user with a lower dimensional picture, a projection or shadow of this object when viewed from its most informative viewpoint. This is done by using only the first few principal components, so that the dimensionality of the transformed data is reduced.

## 5. Results and Discussion

The following algorithm has been applied on different images. The result of one sample is shown in different stages.

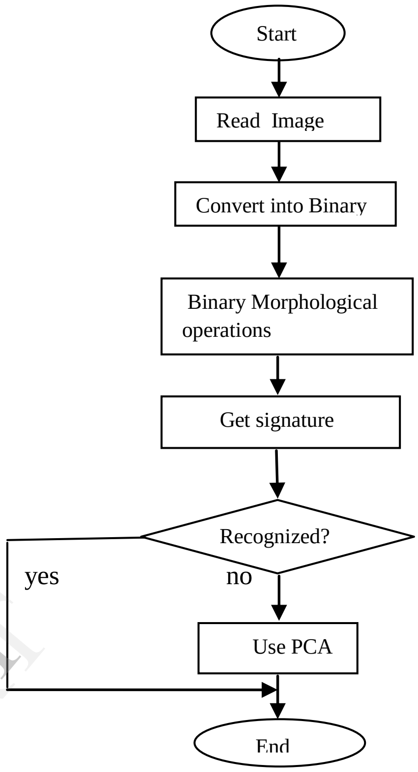


figure2: flow chart of the system.

The input RGB image was read, then, the ROI is obtained and it was converted to gray level image.

Figure3: The input image.

Figure4: The gray level of the input image.

Then the gray level image was converted to a binary image.

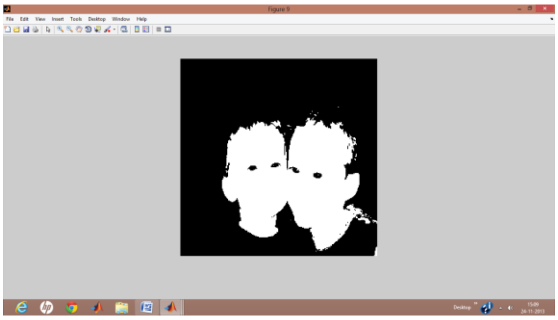

Figure5: The binary image.

The normalised set is shown in figure(6).

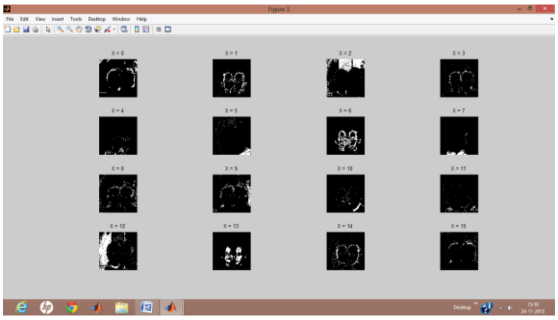

Figure6: The training set of PCA.

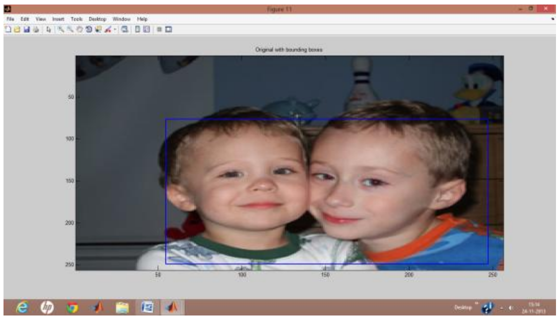

Figure7: Original image with bounding boxes.

To test the ability of the proposed method different images are taken and processed. The existing method is object recognition using Gabor wavelet features.



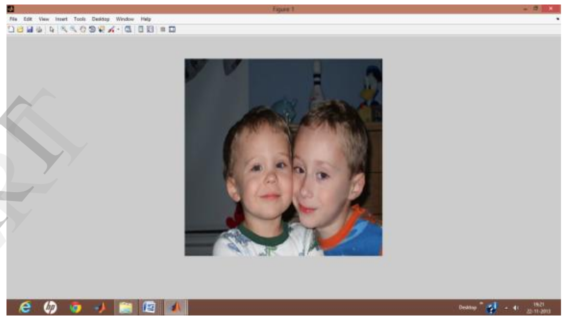

Figure8: The input image.

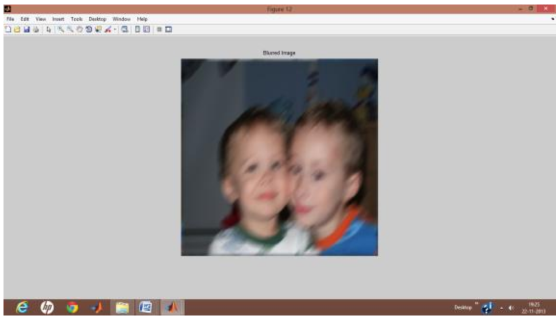

Figure9: The noise image.

At first, RGB image is taken as an input shown in figure(8). The Gaussian noise is added to the input image and is shown in the figure(9). SNR is calculated between original and noisy image. Similarly the noise level is increased and SNR is calculated between original and noisy image.

**Table 1**

| Noise(db) | SNR for Existing method | SNR for Proposed method |
|---|---|---|
| 0.3 | 1.0806 | 1.8850 |
| 0.5 | 2.2435 | 5.1074 |
| 0.7 | 6.9638 | 9.6936 |
| 0.8 | 11.1027 | 11.6365 |
| 0.9 | 16.7368 | 17.2218 |
| 1 | 24.3680 | 25.8584 |

The above table gives the comparison between existing method and proposed method. From this we can say proposed method is better.

## Conclusions

An algorithm for recognition of an object is implemented in this paper. Here mainly the objects are recognized by using template matching, signature values and PCA. The proposed system can recognize multiple objects based on the features extracted. In this we find the location of a sub-image(i.e. template) inside another big image for recognition purpose. The proposed method increases the stability and gives the better results compare to the existing method. It recognizes the objects with greater accuracy and with good recognition rate.



## References

[1]. Neufeld J.E., Hall T.S: Probabilistic Location of a Populated Chessboard using Computer vision. Circuits and systems(MWSCAS),2010 53rd IEEE International Midwest Symposium on Circuits and Systems,pp.586-591,IEEE,(1991).

[2]. Blunsden S.: chess Recognition. Ph.D. Dissertation, University of Plymouth.BSc(Hons)Computing and informatics.(2003).

[3]. Tam K.,Lay J., Levy D.: Automatic Grid Segmentation Of Populated Chessboard Taken at A Lower Angle View. Computing Techniques and Applications,2008. DICTA'08.Digital Image,pp.294-299,(2008).

[4]. Turk M., Pentland A.: Face Recognition using Eigen-Faces. Proceedings of Computer Vision and pattern Recognition,pp.586-591,IEEE(1991).

[5]. Yang Z.: Fast Template Matching Based on Normalised Cross Correlation with Centroid Bounding. Proceedings of the 2010 International Conference on Measuring Technology and Mechnacis Automation – Vol. 02(ICMTMA '10), Vol. 2. IEEE Computer Society, Washington, DC, USA, pp.224-227(2010).

[6]. Swets D.L., Weng J.: Using Discriminant Eigen Features for Image Retrieval. IEEE Trans. Pattern Analysis and Machine Intelligence, vol.18, no.8, pp.891- 896,(1996).

[7]. De la Torre F.,Black M.J.:Robust Principal Component Analysis for Computer Vision. ICCV 2001. Proceedings of Eighth IEEE International Conference on Computer Vision, vol.1,pp.362-369,(2001).

[8]. Jolliffe I. T.: Principal Component Analysis , Second Edition. Springer Series in Statistics. Springer-Verlag New York,(2002).