SYMCOMP 2017
Guimarães, 6-7 April 2017

AUTOMATION INSPECTION DIMENSIONAL AND PARTS OF RECOGNITION AND INDUSTRIAL MATERIALS

Almir K. Junior[1]*, Charles Luiz S. de Melo[1] and Moises P. Bastos[2]

1: Manaus Institute of Technology – MIT
69088-130
e-mail: akimurajr@gmail.com, web: http:// http://www.mit-am.org.br/

2: University of the State of Amazonas – UEA
Control engineering and automation
69020-000
e-mail: cluiz@uea.edu.br web: http://www.uea.edu.br

Keywords: System of computer vision, design of industrial parts, digital image processing techniques

Abstract *Most industrial visual inspection systems still dealing with a low variety of object classes. This is because even the most recognition techniques and representation scheme are not flexible enough to support major changes in the field of objects to recognize and scale. To avoid this type of restriction, our system incorporates digital processing techniques of image, a software able to do all sorts of for recognition and sizing and a fully compatible hardware with all the operational requirem ents of the software. From the analysis of the captured images, our system is able to choose, in a learning phase, the representation scheme best suited for each of the pieces, which facilitates and speeds up the identification and subsequent location of the same in the recognition phase. The advantages of applying these techniques representation were observed i n several experiments, both with simulated real images as real-time images. The objective of this article is to describe the implementation of a computer vision system, able to choose the best strategy to recognize measure and locate planar objects, aiming at industrial applications.*

1. INTRODUCTION

According to [1], vision system is a computational system that uses computer vision techniques for various purposes, including inspection in industry usually intended to assurance and quality control. According to [5], consists but vision have automatic equipment composed of cameras, optical elements, appropriate lights on beyond the hardware and processing image software. The goal is to simulate human vision in inspection processes in facture lines. Images are processed and provide information for the system to make decisions and control manufacturing processes or other teammates, such as robots and product separation mechanisms with defects. In Brazil, this technology was introduced in the 80s, using image matching techniques, getting reasonable results, but with little accuracy. Subsequently, in the 90s, processing techniques of feature extraction based images were made by extracting characteristic numerical data existing in the image (e.g. the area of a play, circumference, etc.). There are many applications of vision systems, among which are the inspection of pharmaceutical products, cosmetic, automotive, food and beverage, electronics, graphic, among others. Typically used to control the production and statistical inventory of items produced, allowing identify any items manufactured with some(s) fail(s). Furthermore, the system information can be used to block production, enable correction processes, etc.

In a recent work [6], all this allows managing a line production in real time, facilitating the implementation of a statistical analysis and the automatic storage. As the work of employees who inspect products on a production line, this technology enables, preserving the human activity, to great advantage by not to lose performance in function due to fatigue or distraction. Therefore, it has become essential tool in the production processes by being able to inspect the lines production with high precision, speed, repeatability and consistency.

In a work [8], this technology creates competitive advantages for ensuring quality, increased productivity, preventing recalls, and significant gains in productivity and elimination of waste in the production process, thus reducing costs and improving the image from the company.

According to [9], it noted that the vision systems do not "see" the same Nature's Way as humans. According to [4], vision systems processing pixel images to extract attributes and make decisions based on information provided by human on the quality of the product concerned. Not we intend match the vision systems adaptability and human understanding, although much FAST and accurate. It is essential to be in mind that vision systems are applied where accepts or product failure is not based on subjective or non measurable attributes. In the system we describe below, we focus on their application and functionality on flat parts where the third dimension has not interference in the adoption of part quality. The objective of this article is to describe the implementation of a computer vision system, able to choose the best strategy to recognize, to dimension and locate planar objects, aiming at industrial applications

2. METHODS

As the needs of application and functionality offered in our system, which is State for the design of industrial parts, the scene to be captured will consist of pieces placed in arbitrary position in the visual field of two video cameras. These parts must be of planar and because we are dealing with a theme that does not take into account, for recognition, the three-dimensional shape of the part, but only its silhouette. Image acquisition is made at various levels of colors, making up one after binarization in order to work only two levels of intensity (HSI INTENSITY) used for us to process the image, in Figure 1 shows this picture.

Figure 1. Sample Image Acquisition

For the project development we used the Labview tool for the development of the techniques of digital image processing. For the conversion of image acquisition used if the command shown in Figure 2, as in Figure 3 presents the result of this operation.

Figure 2. 8 bit Binarization step

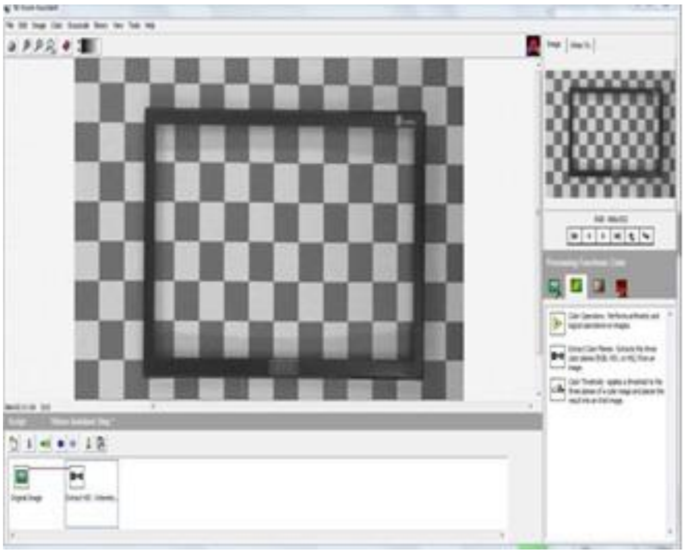

Figure 3. Binarized Image

According to [3], filtering techniques are transformations of pixel by pixel image, which does not depend only on the gray level of a given pixel, but also the value of the gray levels of neighboring pixels.

The filtering process is done using matrix called masks (Figure 4), which are applied on the image.

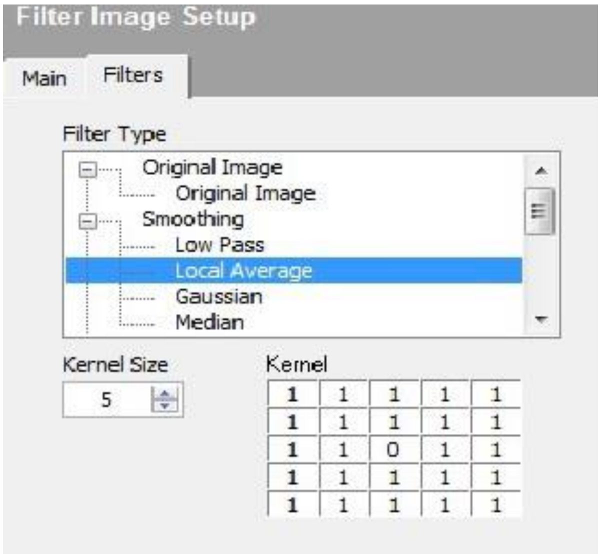

Figure 4. Application of Local Average Filter

So that we can recognize the board, we used scientific and academic techniques of digital processing images, which were the most common, the Gaussian filters, medium location, etc., as shown in Figure 4. According to [1], the local average filter application using a 5x5 matrix, it is necessary for the template material. It was used to remove the salt and pepper, creating the image sharpness.

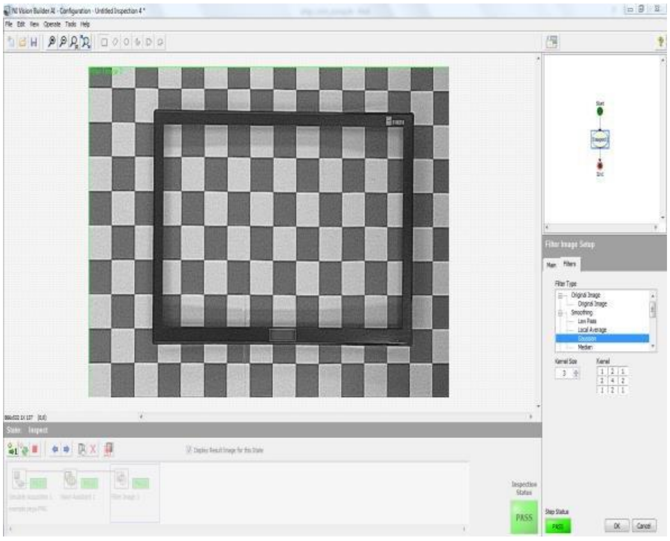

Figure 5. Application of Gaussian Filter

According to [7], the effect of the Gaussian filter is to smooth (smoothing, blur) picture, in much the

same way that the median filter (mean filter). The result will be smoother as the higher the standard deviation (standard deviation) of used Gaussian, as in Figure 5 presents the result of this operation.
HighLight filter - according [3], used to enhance the detail and edge of images, to have done the recognition and dimensioning of the material (Figure 6).

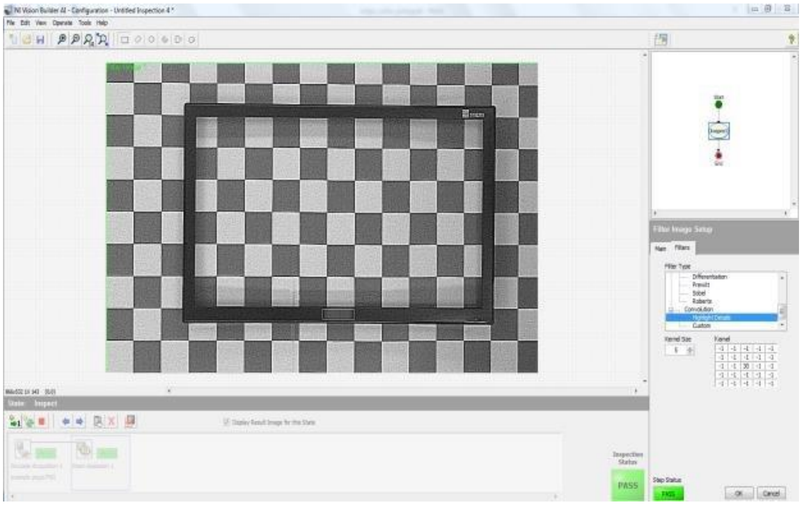

Figure 6. Application of HighLight filter

In general, the recognize patterns comes vision systems with their respective limits, which are entered by the user in the customization. In system operation, beyond the customization step - parameter setting step - are distinguished two phases: a learning phase and a recognition phase.
The learning phase is used to create the internal representation of parts to be recognized, creating the bank system parts. In the phase of reknowledge, observed each piece undergoes treatment similar to that of the learning phase, in order to determine their representation; then a search is made in the system of the bank, confront an up of part characteristics in question with those of stored parts, under the same representation, in the learning.
In both phases of operation, one manager selects the technique most appropriate for treating each piece, aiming to maximize process efficiency.
One of the strategies that our saw are computer system used for the recognition and measurement of parts, as already mentioned, is based on contours. In this strategy, after drawn the contours of the image through to using digital processing image, captured generate up chains vectors elementary corresponding to each of them, and from the elementary vectors lists, the manager gets the values of global attributes correct the piece observed, and also the segments, protruding segments are those whose key feature the ability to identify unequivocally a part, its position and orientation. After the treatments done, the next step is the recognition, in which the following will be shown. For the Recognize step used if the command shown in Figure 7.

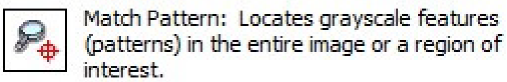

Figure 7. Recognize step

According [9], pattern recognition approaches the feature extraction technique of "objects" present in a digital image. The objects, parameters of the recognition system input are described by separate previously you pixel clusters of the background and will be analyzed for statistically. Every object in a recognition sis theme is described by its chartics or attributes. These characteristics are represented in a N dimensional space, where N is the number of features. Each object, but the way, within this vector space features, called feature vector.
To obtain the protruding segments in both the learning and recognition, the group part is divided into segments of a fixed comparing. Then it makes a transformation of the representation of contours of the parts of space (x, y) of pixels in mm using the calibration of the system software. The images are compared with those of stored pieces (standard parts) under this representation, the system of stock photography (Figure 8).

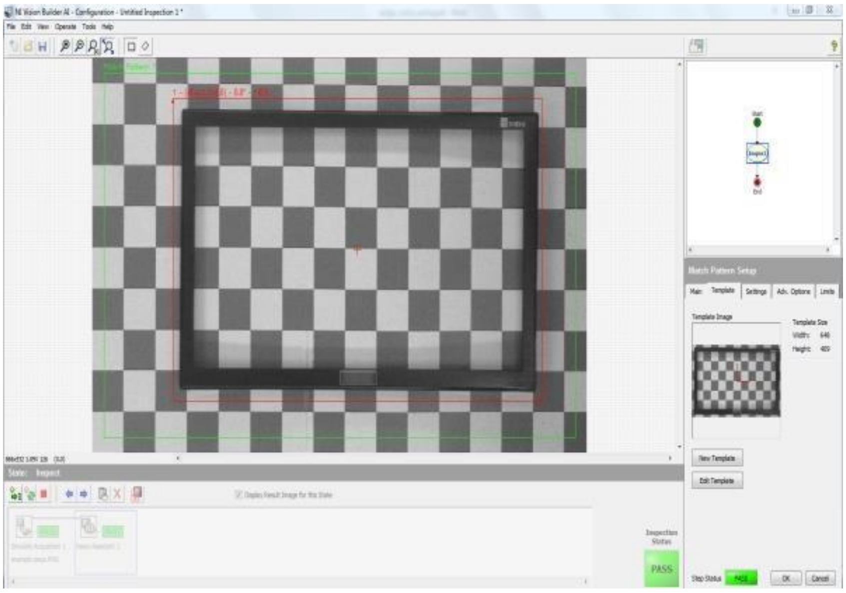

Figure 8. Image Recognize

In the representation via contours, the recognized will occur when there is a coincidence of the values of global attributes part observed with those of a given piece of system seat, standard piece as mentioned above, within the x-fair tolerance previously established by the general embracing specification and standard parts. Before the realization of mediction, Calibration is performed at the image, which pixels cross shape in real dimensions, which is used by the measurement function (Figure 9 and Figure 10).

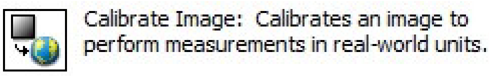

Figure 9. Calibration Step

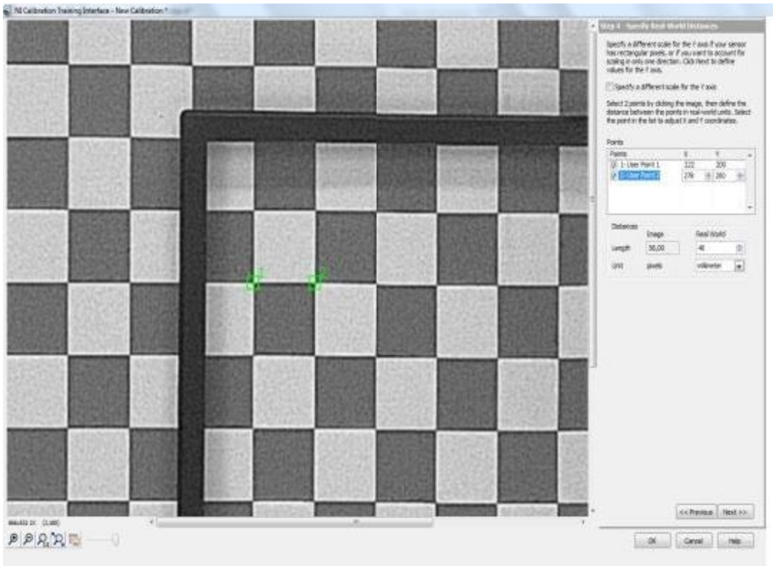

Figure 10. Image Calibration

The Caliper function (Figure 11) is the step that performs Inspection sizing, reiterating that everything is realized by comparison techniques in which is measured by the standard set by the software piece and inspection of tolerance for each material.

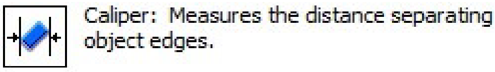

Figure 11. Automatic Caliper Step

The following will give some information about operation of the system:
In general, the vision system is typically constituted two cameras, colored 4k resolutions with two 5 mm lens to the correct conditioning of the image.
The following will be described the calculation of how it's gone taught the best lens to match the cameras (Figure 12).

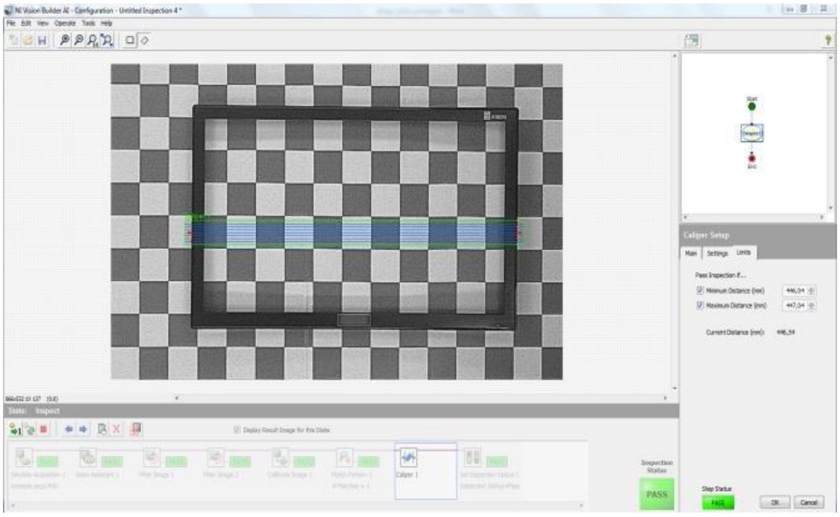

Figure 12. Calculation Lenses

3. RESULTS

The lighting has to be positioned correctly, so as not to highlight the parts, preventing the contrast while preserving only the wishes of attributes. The transmission interface/scan images (known as "framegrabber"), one can use a USB transmission interface. As for processing, is based on a process high capacity of a desktop i7, LABVIEW software to process the images and detect the relevant features through visual treatments.

The system should be operated via a graphic interface with the user. When the installation in an industrial environment, the ultimate goal of system should be detect possible failures in parts. For this, you have two cameras for image acquisition of parts can this be color or black/white. For moving parts, have a neutral color ha mat and chess design in order to obtain greater contrast with the parts and facilitate the processing of images with illumination to facilitate processing. Making the analysis of the histogram and starting the extraction of part features in order to decide, through the system manager, what better way to re-knowledge.

The system must control the correct positioning (orientation) of the pieces on the e frontier, in the production line output. However, varies placement are fully tolerated, if the camera can capture the part of the image as a whole. The belt will be controlled through of a Programmable Logic Control (PLC).

Made the acquisition of the images for learning all the parts of interest, the user will have to provide some parameters to be used both in the learning phase and in recognition. Such off-line procedures are fundamental to the operation of our system.

It is important to note that all parameters, is to be adapted to the requirements of the degree of similarity between the pieces and storage of payload data. In addition to the above parameters, each piece has associated with it an identification that is supplied by the user in the learning phase. This identification may be associated with the part name engraved on a file. Just as in

the learning phase, the models used in the system recognition phase are formed taking the parameters provided in the boot.
Therefore, the entire processing consists
use the same set of parameters. There will need to register the system there is any change in the parameters, for example, to include new pieces to your bank parts. The following have been the images of the results with an example of PASS and FAIL of the same model COVER REAR a 32 "TV (Figure 13 and Figure 14).

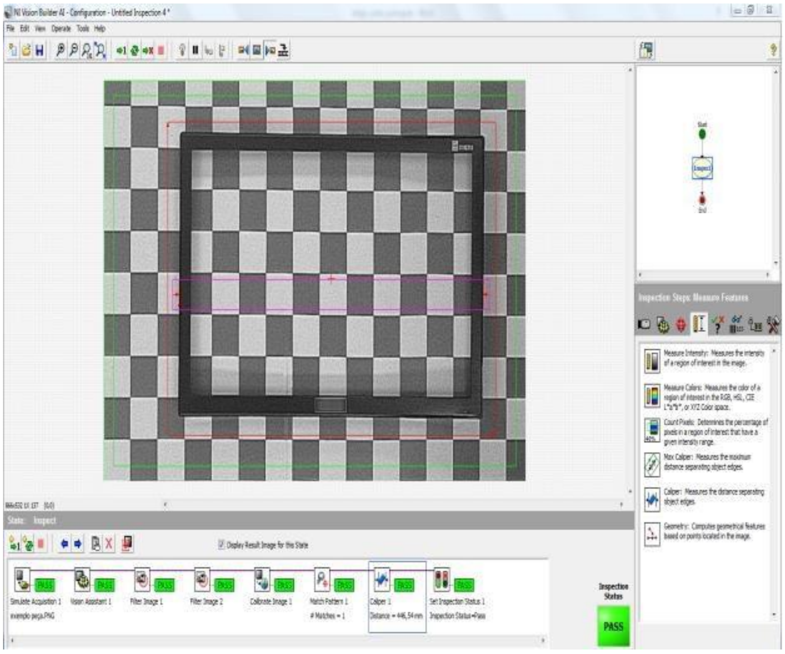

Figure 13. Resultado teste - PASS

3. CONCLUSÃO

In this paper, we describe the implementation of a two-dimensional binary computer vision system that incorporates multiple methods of scaling and inspection form, with a view to application in industrial environment. Our proposition to be to develop a system capable of recognize and locate a wide range of parts, using for this both their structural attributes, as its contours. The choice of technique will be given through the analysis of global attributes extract the image, and this method the big difference in our work.
The system was tested early in a bank of synthetic images, obtained via software, and later successfully employed in identifying and locating real parts from images captured by a camera of high resolution video accompanied by ultra low lenses distortion. It has worked to modernize and expand the flexibility of our system with large performance gains in an industrial environment.

We achieved great success, on the research and in development. The system was implemented and is working in the quality department of a large multinational company.

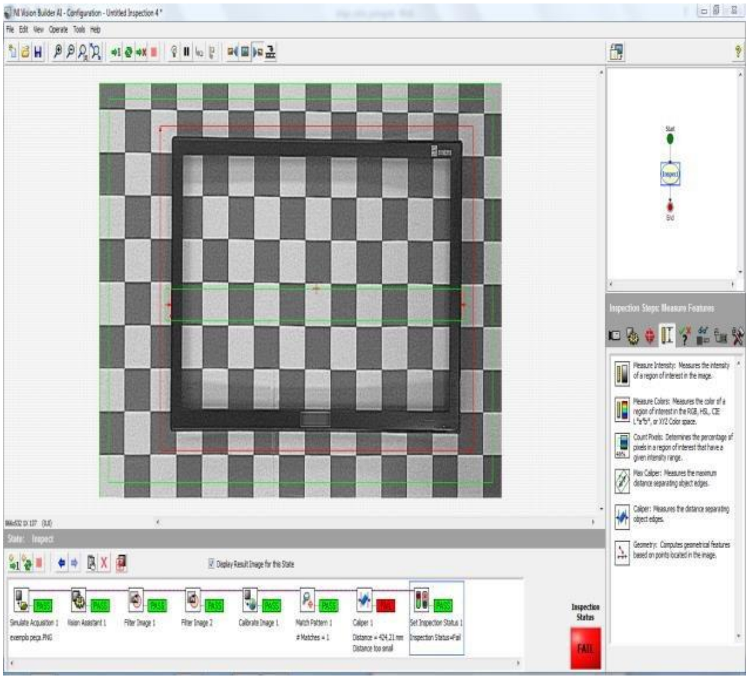

Figure 14. Resultado teste - FAIL

REFERENCES

[1] Abend, K., Harley, T. J., 1965. Classification of Binary Random Patterns, *IEEE Transactions on Information Theory*: 538-544.

[2] Asano, T., 1996. Digital Halftoning Algorithm Based on Random Space Filling Curve, *IEEE International Conference on Image Processing*, Vol 1, Lausanne, Sua, pp. 545-548.

[3] Almeida, L.B., 1994. The Fractional Fourier Transform and Time Frequency Representation, *IEEE Transactions on Signal Processing*: 3084-3091.

[4] Bunke, H., Sanfeliu, A., 1990. Syntactic and Structural Pattern Recognition: Theory and Applications.

[5] Evans, D. M. W., A Novel Algorithm for Computing the 1D Discrete Hartley Transform, *IEEE Signal Processing Letters*: 156-159.

[6] Faugeras, O., Luong, Q.T., 2001.The Geometry o Multiple Image: The Laws that Govern the Formation of Multiple Images of a Scene and some of Their Applications, MIT Press, Cambridge, MA, Estados Unidos.

[7] Nehme, D., Luis, E., 2000. Processa- mento Digital e suas aplicaes.

[8] Tanaka, E., 1995. Theoretical Aspects of Syntact Pattern Recognition, *Pattern Recognition*: 1053-1061.
[9] Reisfield, D.,Wolfson, H., Yeshurun, Y., 1995. Context Free Attentional Operators: *The Generalized Symmetry Transform, International Journey of Computer Vision* 14(2) 119-130.
[10] Zhang, D., Lu, G., 2002. A Comparative Study of Fourier Descriptors For Shape Representations and Retrieval, Proceedings Fifth Asian Conference on Computer Vision, Melborn, Austrlia,pp. 646-651.